

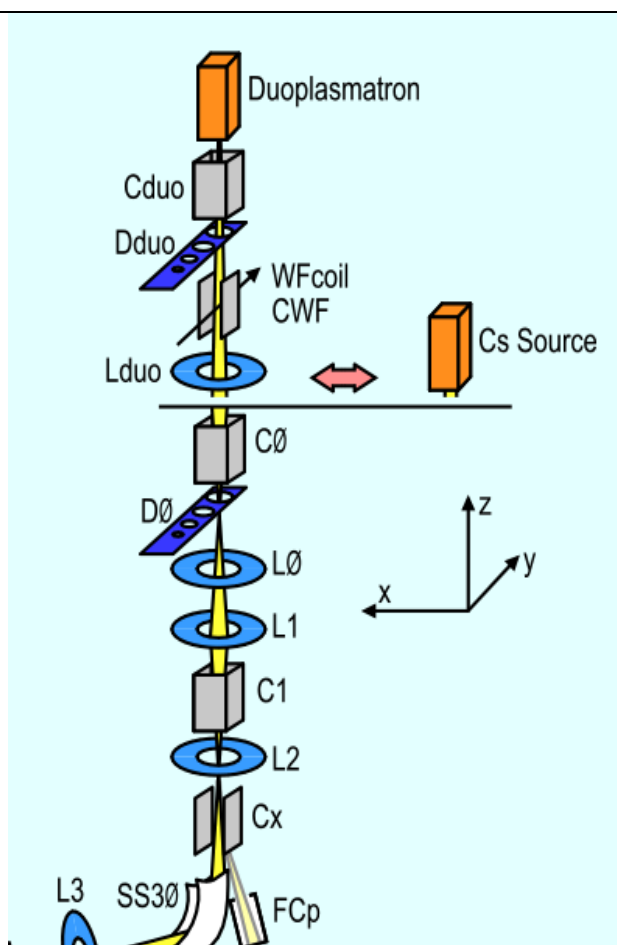


**The CAMECA NANOSIMS 50 L**  
**User's guide**



# The CAMECA NANOSIMS 50

## Primary ion optics user's guide





## Contents

1	INTRODUCTION	4
2	THE CS/DUO SWITCH	4
2.1	OVERVIEW	4
2.2	DESCRIPTION	5
2.3	USING THE CS SOURCE	6
2.3.1	Overview	6
2.3.2	Tuning and aging issue	8
2.3.3	Centering the Cs source	9
2.4	USING THE DUOPLASMATRON SOURCE	9
2.4.1	Physical principles	9
2.4.2	Practical settings	10
2.4.3	The Wien Filter	11
2.4.4	Tuning LDuo	14
3	INTERMEDIATE SECTION	15
3.1	OVERVIEW	15
3.2	DESCRIPTION	15
3.3	TUNING L0 AND L1	16
3.4	MONITORING THE PRIMARY CURRENT WITH FCP	19
4	CENTRAL COLUMN	20
4.1	OVERVIEW	20
4.2	DESCRIPTION	20
4.3	RASTERING THE PRIMARY ION BEAM	21
4.4	DYNAMIC TRANSFER	21
5	COAXIAL COLUMN	22
5.1	OVERVIEW	22
5.2	DESCRIPTION	23
5.3	MONITORING THE PROBE CURRENT WITH FCo	23
5.4	PROBE DIAMETER	24
5.5	PROBE SIZE VS E0P	25
5.6	INFLUENCE OF Z	26

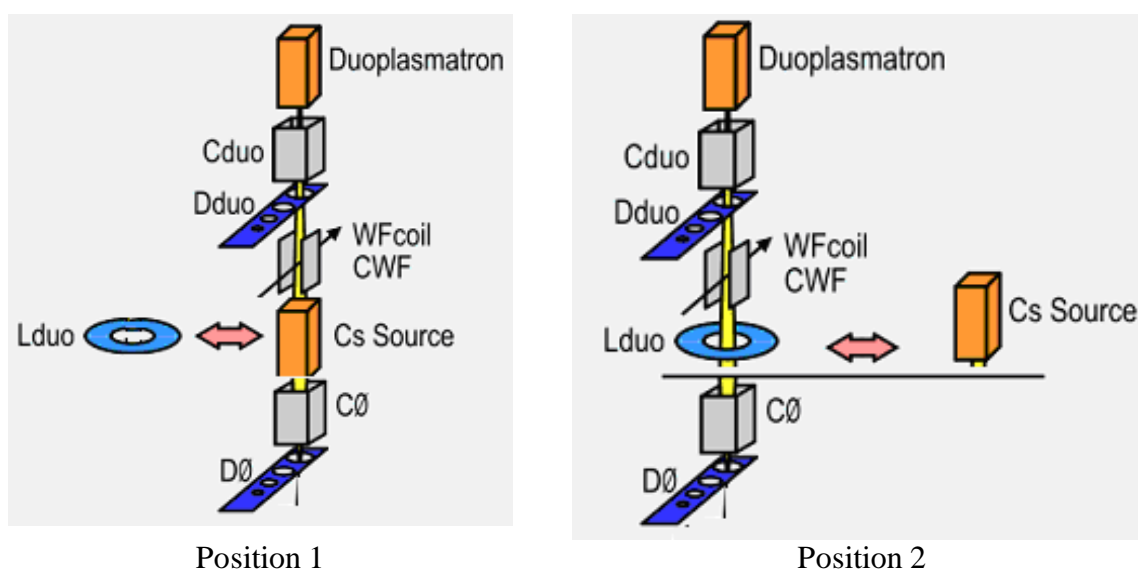
## 1 Introduction

The primary ion optic is composed of four different sections: the source chamber called also Cs/duo switch, the intermediate section, the central column and the coaxial column. The two first sections are exclusively used by the primary ion beam while the two last are common to secondary and primary ion beams.

$\text{Cs}^+$ ,  $\text{O}_2^+$ ,  $\text{O}^-$  and  $\text{O}_2^-$  can be used as primary ions depending of the source and of the polarity of the instrument.

## 2 The Cs/Duo switch

### 2.1 Overview



The Cs/Duo switch receives two ion sources: the Cameca Cs microbeam ion source and the Duoplasmatron gas source. In addition while using the duoplasmatron a Wien Filter is available.

This sources chamber is insulated from the primary ion column by a gate valve, and is equipped with one turbo pump. This allows the maintenance of the sources without venting the primary column.

The source interchange mechanism allows switching between ion sources without venting. A trolley supporting the Cesium source and the lens Lduo can be moved under vacuum between two different positions; position 1 the Cesium source is set on the axis of the primary column; position 2 the lens Lduo is set on the axis of the primary column.


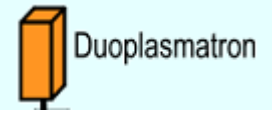



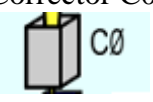

Total time for switching the source:

- From cesium to duoplasmatron: 45 minutes which is the time needed to cool down the Cs source before increasing the oxygen pressure.
- From duoplasmatron to Cesium: 10 minutes time needed to reach the base pressure in the source chamber.

[Contents ↑](#)

## 2.2 Description

List of elements :

Device	Label	Description and functionality
Cs Source 	Cs HV IONIZER RESERVOIR	Cs HV is the source High Voltage with respect to the ground. IONIZER is the electron current flowing between the ionizer filament and the ionizer. RESERVOIR is the electron current flowing between the reservoir filament and the reservoir.
Duo Source 	Duo HV ARC COIL	Duo HV is the source High Voltage with respect to the ground. ARC is the plasma arc current. COIL is the duoplasmatron coil current.
Corrector Cduo 	CDuo	A 4 plate deflector used to center the Duoplasmatron ion beam before entering the Wien filter.
Wien Filter 	CWF WFcoil	A Mass Filter consisting of 2 deflection plates (CWF) and a coil (WF Coil).
Lens Lduo 	LDuo	Lens used to focus the Duoplasmatron ion beam on D0 at the exit of the Wien filter.
Corrector C0 	C0	A 4 plate deflector used to center the primary ion beam at the exit of the Cs/duo switch.
Diaphragm D0 	D0	Aperture stop which limits the angular aperture of the Cs ion beam or acts as a mass selection diaphragm for the Wien filter. 4 different diameters are available.

[Contents ↑](#)

## 2.3 Using the Cs source

### 2.3.1 Overview

In the vapor state, cesium ionizes into positive ions  $\text{Cs}^+$  when it comes into contact with the surface of a tungsten plate at high temperature. If an electric field is applied to the surface of this tungsten plate  $\text{Cs}^+$  ions are extracted and can be used as primary ions. The CAMECA Microbeam Cesium Source has been designed on this principle (See the [figure1](#) below).

The cesium vapor is generated from a cesium chromate ( $\text{Cs}_2\text{CrO}_4$ ) or a cesium carbonate ( $\text{Cs}_2\text{CO}_3$ ) pellet contained in a reservoir raised to a temperature of  $400^\circ\text{C}$ . This temperature is required to release the cesium vapor.

The cesium vapor comes into contact with a tungsten plate enclosed in the ionizer head heated to  $1100^\circ\text{C}$ . The hot tungsten plate ionizes the vapor into  $\text{Cs}^+$ . The reservoir and ionizer are set to a voltage adjustable between 6 and 10 kV and heated independently by electric bombardment by means of two annular filaments (set at 0 Volt).

The extraction electrode, placed in front of the ionizer, at ground potential, generates an electric field to extract and accelerate the  $\text{Cs}^+$  ions. Figure 1 shows the layout of the various parts of the source.

Reference: G. Slodzian, B. Daigne, F. Girard, F. Boust, [F. Hillion](#) : A thermal ionization source for a  $\text{Cs}^+$  ion probe. Proceedings of the 8th SIMS Conference, Amsterdam sept. 91.

- |  |                        |
|--|------------------------|
| ① High voltage input                             | ⑥ Tungsten plate       |
| ② cesium chromate pellet ( not reactive to air ) | ⑧ Reservoir filament   |
| ③ Reservoir                                      | ⑦ Ionizer filament     |
| ④ Ionizer  | ⑨ Extraction electrode |

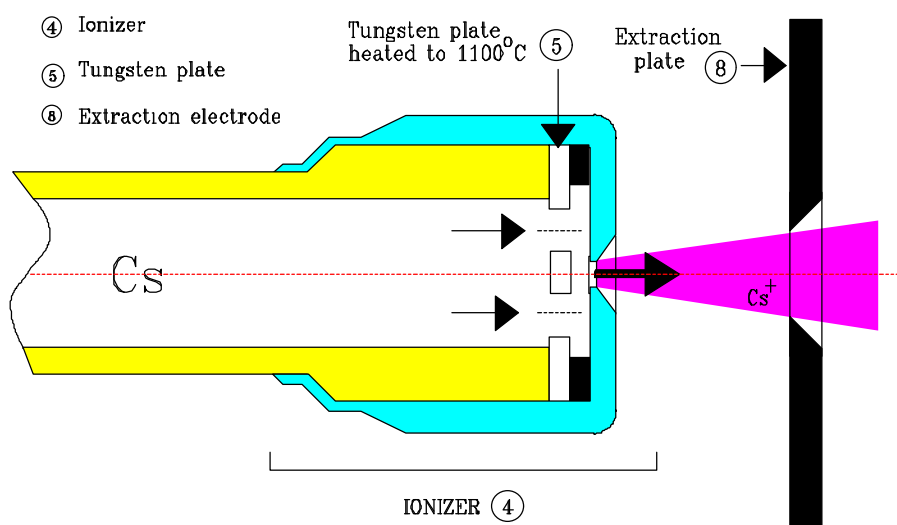
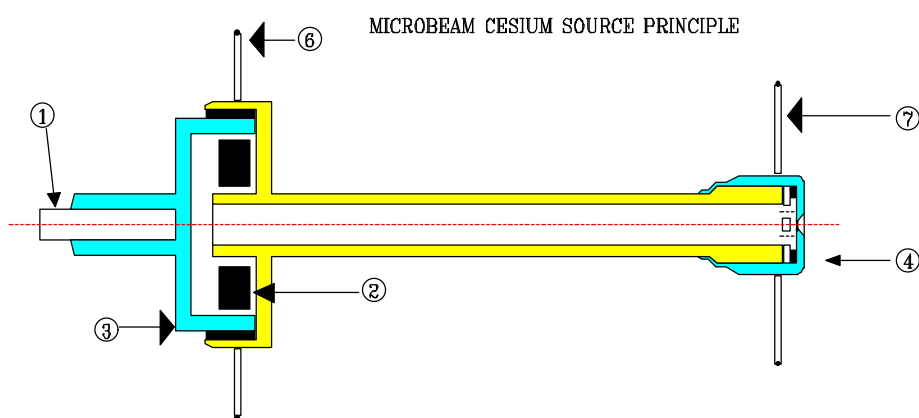


Figure 1

A constant emission of cesium ions is obtained by regulating the electron current flowing between the ionizer and its associated filament ( $I_{ION.}$ ) and between the reservoir and its associated filament ( $I_{res}$ ).

The total current delivered by the high voltage power supply ( $I_{TOTAL}$ ) is the sum of the ionizer and reservoir electron currents and a leak current mainly due to secondary electrons produced by low density plasma surrounding the source.

$$I_{TOTAL} = I_{RES.} + I_{ION.} + I_{Leakage}$$

*Note:  $I_{Leakage}$ , negligible during normal operating conditions, may be important during a runaway (first usage of a source); however, a security is designed to limit the over-heating of the source.*

### 2.3.2 Tuning and aging issue

2 types of Cs sources are available:

- The chromate source ( $Cs_2CrO_4$ )
- The carbonate source (conic  $Cs_2CO_3$ )

These two different types of Cs source correspond to different typical ionizer and reservoir currents.

Type	Ionizer at 8kV	Reservoir at 8kV
Chromate( $Cs_2Cr_2O_4$ )	1.6 mA	1.80 mA
Carbonate ( $Cs_2CO_3$ )	1.6 mA	0.35 mA

Table 1

The  $Cs^+$  current varies dramatically with the reservoir current, and slightly with the ionizer current.

The following data (Figure 2) have been recorded with a Cs carbonate source:

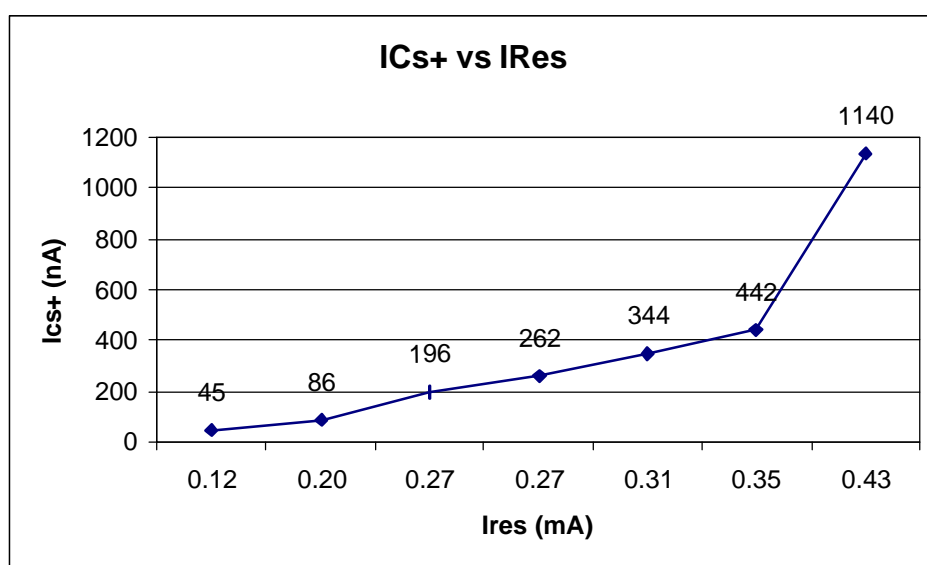


Figure 2

### Cs Source aging, reservoir current

Over long term, for a given spot size it is observed a trend to a current density decrease. This decrease must be compensated by increasing the reservoir current. For example, for a  $\text{Cs}_2\text{CO}_3$  reservoir, at an acceleration voltage of 10 kV, and an ionizer current of 1.7 mA, typical reservoir heating values are:

- Just after degazing the source, the reservoir current must be set to 0.2 mA.
- In the following days, it must be risen up to 0.3 mA.
- In the following weeks it gets more stable around 0.35 mA and can reach 0.6 mA at its life end.

It may occur that this aging is not uniformly going on and that the reservoir current must be set to higher value for a while and has to be reduced further.

#### Remark:

It may be required to decrease the acceleration voltage in the case of very low impact energy. When modifying the source acceleration voltage, in a first approach, both the reservoir and the ionizer currents must be modified so that both heating powers ( $I_{res} * Accel$ ) and ( $I_{ion} * Accel$ ) remain constant.

### 2.3.3 Centering the Cs source

Each time you switch from Duoplasmatron to the cesium source you must re-center it by acting on the rotating knob:

- ☐ Select the FCp mode (the primary ion beam is then directed towards the Faraday cup set at the end of the primary ion column) in the "Tuning" window or on the Keyboard.
- ☐ Set all correctors (C0x, C0y, C1x, C1y) to "0" Volts.
- ☐ Maximize the current with the knob. Check with C0x and C0y that the FCp current is really maximized.

For a more precise setting of the source and C0 plates, FCo can be used.

## 2.4 Using the Duoplasmatron source

### 2.4.1 Physical principles

A gas is introduced at low pressure to the interior of the hollow cathode through an adjustable leak. Plasma is produced by an arc maintained between the hollow cathode and anode which is kept at several hundred volts relative to the cathode. The discharge is maintained close to the axis by a conical intermediate electrode at a floating potential.

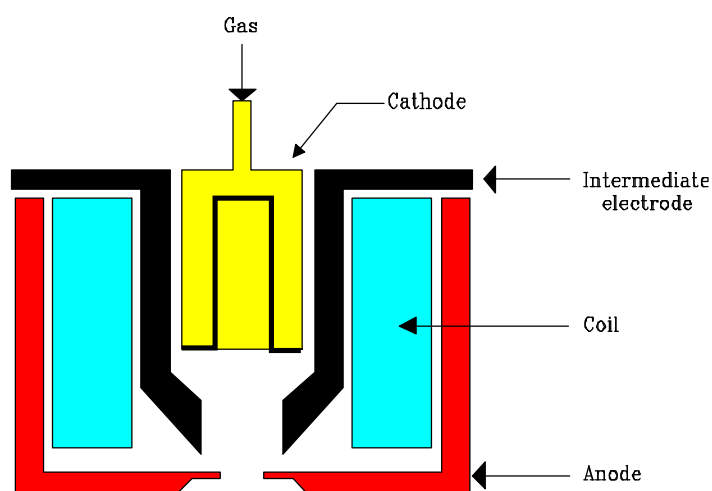
A magnetic field produced between the intermediate electrode and anode by a coil concentrates the plasma close to the axis. A part of the plasma passes through the opening in the intermediate electrode and expands in a second

chamber. Ions are extracted in this chamber through a hole (diameter is 400  $\mu\text{m}$ ) in the anode.

The duoplasmatron can produce positive or negative ions ( $\text{O}_2^+$ ,  $\text{O}^+$  and  $\text{O}_2^-$ ) according to the polarity of the extraction potential.

To obtain negative ions, the axis of discharge should be displaced relative to the axis of the extraction hole (roughly centered). This decentralization permits extraction of negative ions, which are concentrated in the periphery of the plasma and to avoid a strong electron flow which would be produced if the plasma remained centered. In practice, this is done by moving the intermediate electrode relative to the anode by approximately 0.8mm. Practically, turn the button up to the mechanical limit (clockwise or reverse) and turn back by roughly  $270^\circ$ .

The gas species generally used are Argon and Oxygen. Argon produces  $\text{Ar}^+$ . Oxygen produces positive or negative ions. For positive ions, the beam is composed of  $\text{O}_2^+$  and  $\text{O}^+$ . The abundance ratio  $\text{O}_2^+/\text{O}^+$  is approximately 10. For negative ions, the beam is composed of  $\text{O}^-$  and  $\text{O}_2^-$ . In this case, the abundance ratio is reversed, i.e.,  $\text{O}_2^-/\text{O}^- = 1/4$ .



#### 2.4.2 Practical settings

On the N50 the duoplasmatron is only used to produce  $\text{O}^-$  beam. The central electrode must be shifted on the side in order to maximize the extracted current. Table 2 gives typical values for the Oxygen pressure, the arc and the coil current.

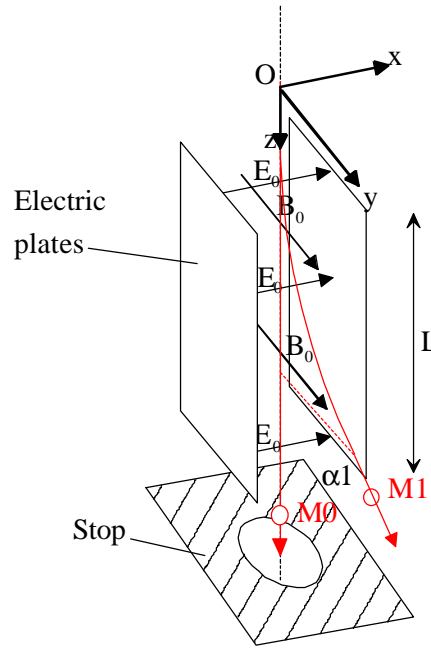
	Oxygen pressure	Arc current	Coil current
$\text{O}^-$	$10^{-5}$ Torr	80 mA	1.6 A (3000 digits)

Table 2

[Contents](#) ↑

### 2.4.3 The Wien Filter

*Physical principle*



A *Wien Filter* is basically formed by superimposing an homogeneous electrostatic field and a magnetic field. In the above figure, the magnetic field  $\vec{B}$  is parallel to Oy axis while the electric field  $\vec{E}$  is parallel to Ox axis so that a charged particle moving along Oz axis is submitted to two forces parallel to the Ox axis.

The charged particle is not deflected if the electrostatic force and the Lorentz force balance along the z axis.

$$\frac{e V_0}{M_0} = 4.9 \cdot 10^{-3} \left( \frac{E_0}{B_0} \right)^2 \quad [\text{eV/amu}]$$

Where  $E_0$  and  $B_0$  are respectively expressed in V/cm and gauss.  $M_0$ ,  $eV_0$  and  $e$  are respectively the mass, the energy and the electric charge of the particle.  $M_0$  is expressed in amu.

As  $eV_0/M_0$  is proportional to the particle velocity, it can be said that the Wien filter is a velocity filter. As it can be assumed that the particle energy  $eV_0$  is constant, a Wien filter is in fact a mass filter. The main advantage of the Wien filter is to be straight-line.

For achieving a mass filter, a stop must be included in the system, downward the combined electric and magnetic fields, so that the selected  $M_0$  trajectories can pass through the stop while the deflected mass trajectories are stopped.

When using a Wien filter in an ion optical system where the charged ions are accelerated at  $V_0$ , the ratio  $E_0/B_0$  is determined by the mass  $M_0$  which must be kept on axis, while both  $E_0$  and  $B_0$  intensities are determined by the closest mass  $M_1$  minimum deflection  $\alpha_1$  required to be rejected by the stop.

[Contents ↑](#)

$$a_1 = \frac{B_0(\text{gauss}) L(\text{cm}) e^{1/2}}{204 V_0^{1/2}} \left( \frac{1}{M_1^{1/2}} - \frac{1}{M_0^{1/2}} \right)$$

$L$  is the combined field length.

The electric field  $\vec{E}$  is controlled by the voltage  $V$  applied onto the electric plates, and the magnetic field  $\vec{B}$  is controlled by a current  $I$  supplying the coils of a magnetic circuit.

The N50 Wien filter consists of a pair of 76 mm height plates, biased by a voltage supply ranging within  $\pm 250$  Volts and a magnetic circuit. This circuit both inside and outside the vacuum chamber is excited by a coil supplied by a 7A source. Both the plate voltage and the coil current are controlled from the tuning user interface.

The Wien filter is used as a mass filter to eliminate spurious elements which can be generated in the Duoplasmatron. These species must be eliminated if they are considered as contaminants for the analyzed sample.

When using the duoplasmatron with oxygen in the positive polarity the major specie extracted from the source is the polyatomic ion  $^{16}\text{O}_2^+$ , but for instance  $\text{NO}^+$  and  $^{16}\text{O}^+$  also exist, with an abundance of 1 or 2 decades below  $^{16}\text{O}_2^+$ . It is necessary to eliminate  $\text{NO}^+$  and  $^{16}\text{O}^+$  if a fine spot is required since all species spots are not focused exactly at the same location because of earth or spurious magnetic fields.

In the negative polarity there are three major peaks as shown on figure 3:  $^{16}\text{O}^-$ ,  $^{16}\text{O}_2^-$ ,  $^{16}\text{O}_3^-$ .

[Contents](#) ↑

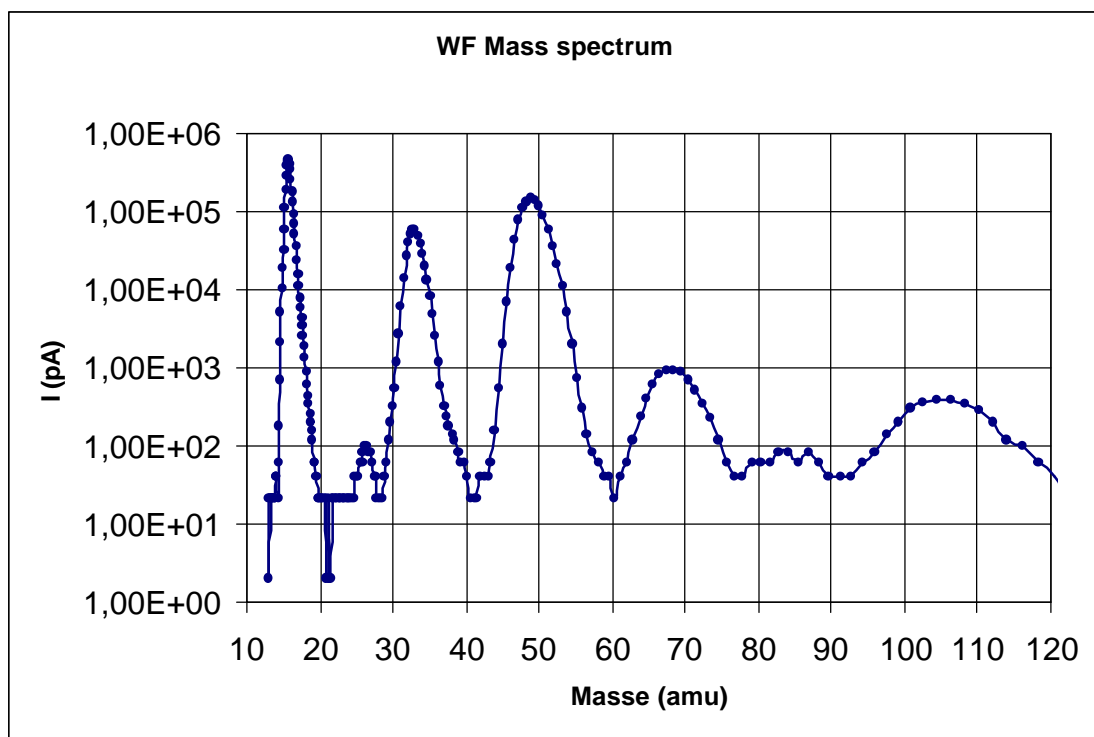


Figure 3: Wien filter mass spectrum

Figure 4 displays the experimental relationship between CWF and WF coil for  $^{16}\text{O}^-$  ions. It can be checked that the plate voltage is proportional to the magnetic field. When increasing both the magnetic field and the plate voltage, it can be useful to re-adjust D0.

Practical settings for the Wien filter when the column is used at 8kV:

- Wien coil: 2A
- CWF plates: 311 digits (30 volts)

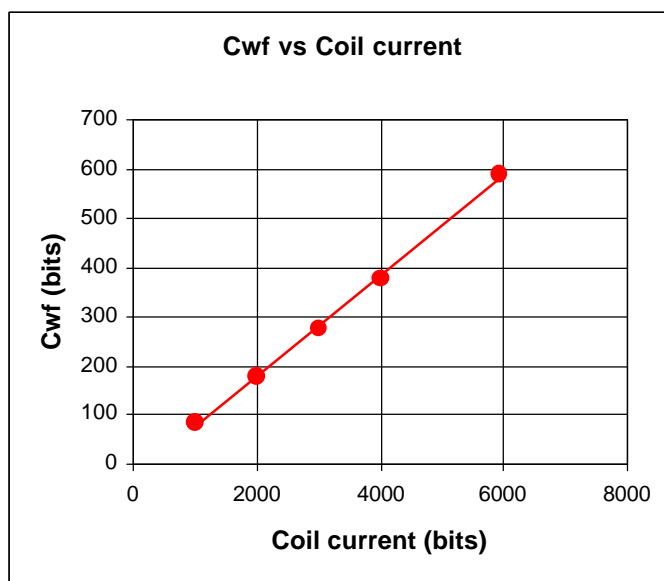


Figure 4: Experimental relationship between Cwf and the coil current

#### 2.4.4 Tuning LDuo

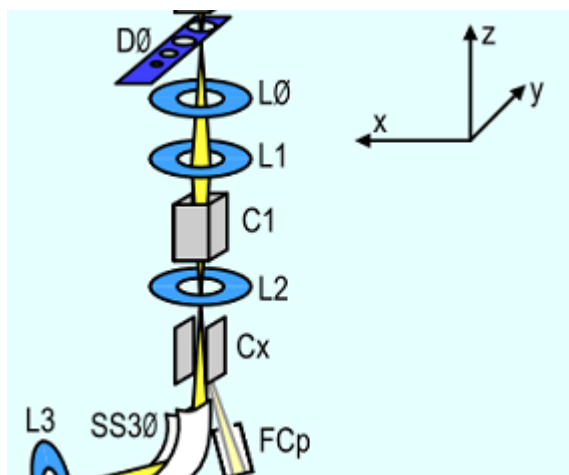
Each time you clean the duoplasmatron source you must re-center LDuo by acting on the rotating knob:

- ❑ Select the FCp mode - the primary ion beam is then directed towards the Faraday cup located at the end of the primary ion column - in the "Tuning" window or on the Keyboard.
- ❑ Set all correctors (Cduox, Cduoy, C0x, C0y, C1x, C1y) to "0" Volts.
- ❑ Tune LDuo voltage to the standard value (1610 digits at 8kV).
- ❑ Maximize the current with the knob, with Cduo and finally with C0.
- ❑ Select D0-2 (2<sup>nd</sup> position of diaphragm D0) and maximize the current by acting on LDuo. LDuo value must be 1610 +/- 25 digits at 8 kV.
- ❑ Set the Wien filter to 2A and maximize again the beam current in FCp by changing CWF without changing C0 or Cduo. D0y can be slightly adjusted if necessary.

For a more precise setting of the Wien filter, FCo can be used.







### 3 Intermediate section

#### 3.1 Overview



This section of the N50 is either used to increase the primary ion beam current or to demagnify the cross-over of the source. In addition a Faraday cup allows to measure the beam current entering in the central column.

#### 3.2 Description

Device	Label	Description and functionality
 Lens L0	L0	Lens used to vary the demagnification of the source image.
 Lens L1	L1	Lens used to vary the demagnification of the source image.
 Corrector C1	C1x C1y	A 4 plates deflector used to center the primary ion beam.
 Lens L2	L2	Lens used to vary the demagnification of the source image. Practically not used
 Corrector Cx	Cx	A 2 plates deflector used to direct the primary ion beam in FCp.
Secondary electrons Suppressor	SE FC	Tube at –30 volts used to prevent secondary electrons to escape from the primary Faraday Cup FCp
 Faraday Cup	FCp	Faraday Cup used to measure the primary ion beam current at the exit of the intermediate section.

### 3.3 Tuning L0 and L1

L1 can be used to modify the demagnification of the source image. L1 produces a real reduced image which will be seen by the following part of the primary column as a real object. This reduced image is located in between L1 and SS30.

For the Cs source at 8kV Figure 5 shows the variation of the Gaussian probe size versus L1. This theoretical graph has been computed with a 40 microns source size at the exit of the Cs source.

While reducing the probe size, the probe current will decrease. Figure 6 shows the theoretical and experimental variations of the probe current versus L1 for the same D1 diameter.

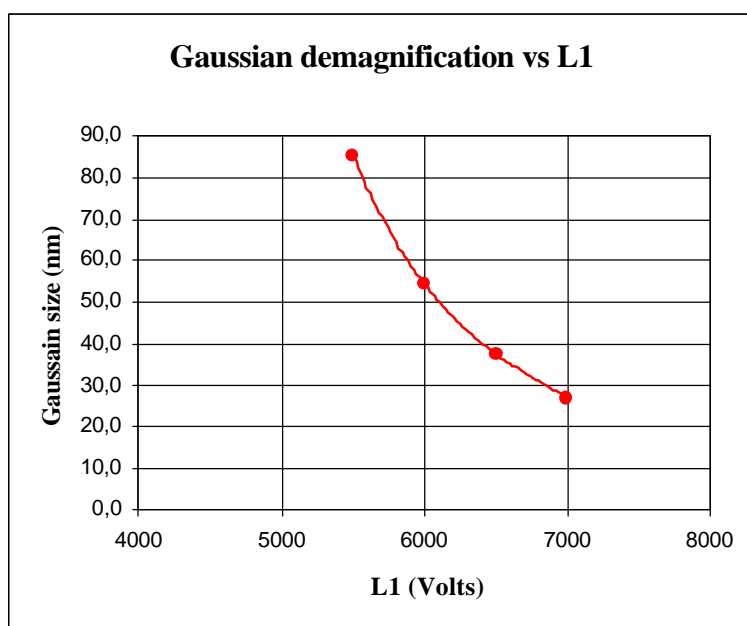


Figure 5

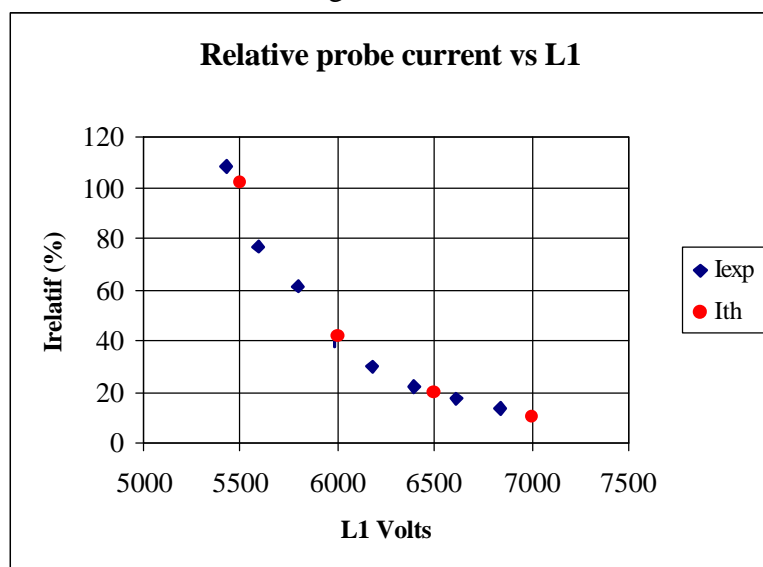


Figure 6

L0 or L0 and L1 are also currently used to increase the probe current. Of course while increasing the probe current, the probe size increases.

Probe current limitations are no more only due to D1 but also to the small differential pumping tube located between the source chamber and the central column. Figure 7 shows the variation of the probe current vs L0. L1 is kept at 0 volt and the source specie is Cs+.

A comparison has been made between theoretical and experimental values showing the effect of the pumping tube which limits the current at high L0 values.

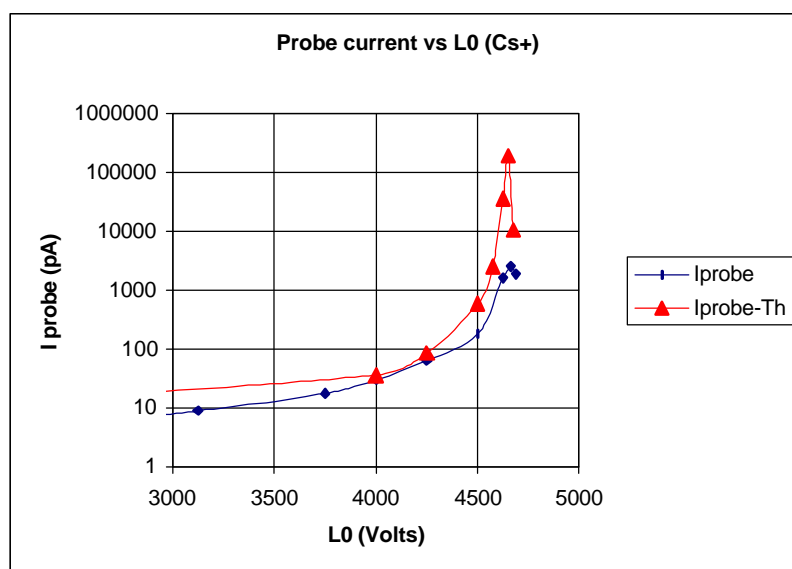


Figure 7

One can find different couple of values giving a maximum for the probe current as shown on Figure 8 and 9 while using L0 and L1 for Cs+.

29 nA of Cs+ has been measured for the following settings: FCp = 50 nA, D1-1 = 750 microns, L0 = 4250 V, L1 = 3100 V.

In these extreme conditions the probe size is huge and aberrations dominate the probe shape, leading to very long tails.

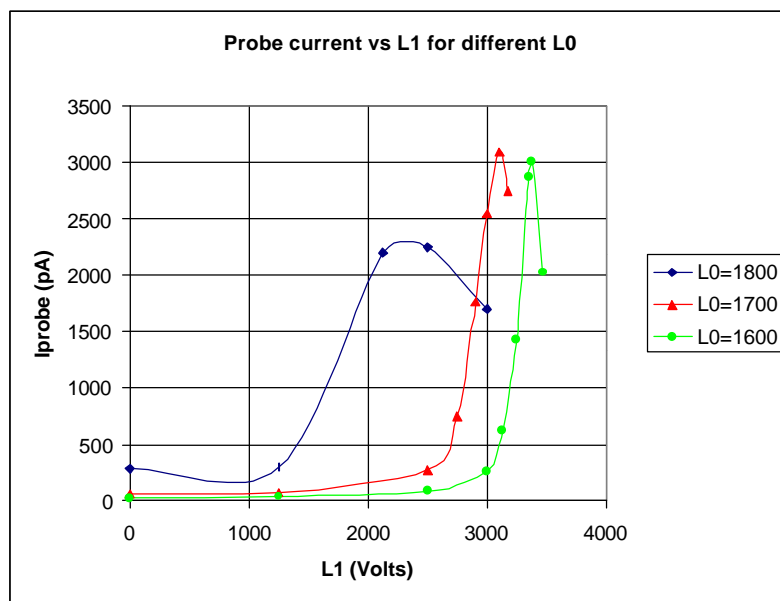


Figure 8

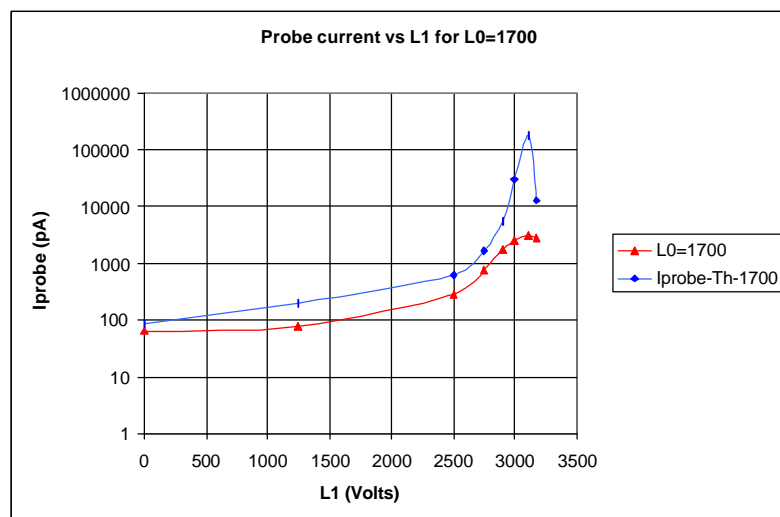


Figure 9

Experimental Conditions	Simulation made without beam stops
FCp = 33.45nA D1-1 (300μm)	Maximum beam current : 29 nA FCp = 50 nA D1-1 (750μm)

While using the Duoplasmatron, the optical column description is relatively similar. As the primary ion beam is focused in D0 after the Wien filter, D0 acts like a source for the primary ion column.

L0 is mainly used to focus the beam in the differential pumping tube located between the source chamber and the central column. As D0 is very close to L0, L0 must be set at a higher voltage.

Figure 10 shows the variation of the probe current vs L1, L0 kept at 2250 bits for 0-. Typical C1X and C1Y variations are also shown. Experimental conditions were the followings:

- FCp = 530 nA with D0-1 (200 microns),
- Wien Filter : Icoil = 2.0 A, CWF = 29.9 V,
- Lduo = 1608 bits.

[Contents ↑](#)

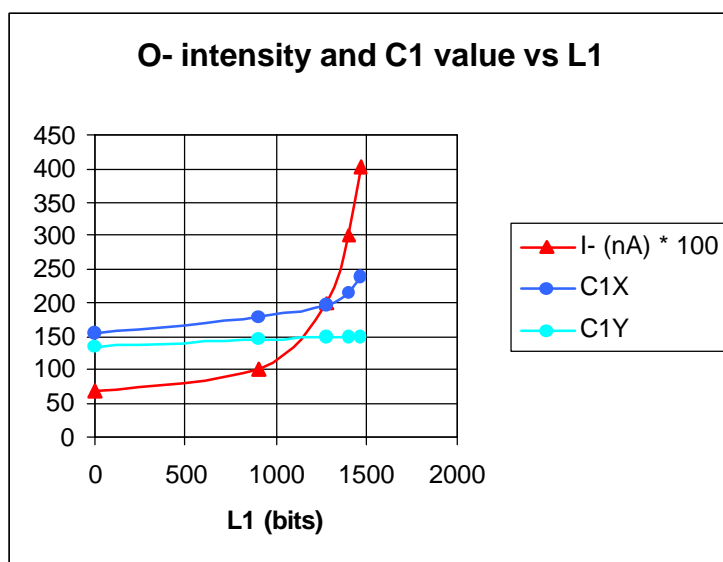


Figure 10

### 3.4 Monitoring the primary current with FCp

Choose FCp mode in the Tuning window or press FCp on the keyboard. L1 and Cx will be set at preset values. The primary ion beam is focused by L1 at the entrance of the FCp and centered in FCp by Cx.

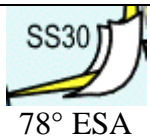

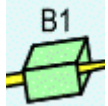




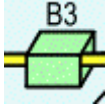
The beam current will be displayed in the “FC part” of the Tuning Window.

## 4 Central column

### 4.1 Overview

This section of the primary column is used to send the primary ion beam on the axis of the coaxial column and to raster the beam on the sample surface. An octopole is available to correct the astigmatism.

### 4.2 Description

Device	Label	Description and functionality
 78° ESA	SS30	30 mm radius spherical electrostatic sector used to rotate the primary ion beam by 78°.
 Lens L3	L3	Lens used to couple SS30, P1 and P4 in order to provide an achromatic deviation of the primary ion beam.
 Scanning plates B1	B1	A 4 plates deflector used to scan the primary ion beam on the sample surface.
 Scanning plates B2	B2x B2y	A 4 plates deflector used to scan the primary ion beam on the sample surface.
 Stigmator	Oct-90 Oct-45	Octopole used as a stigmator which acts like two quadrupole at 45°.
 Plates P4	P4h P4b	Deviating plates used to rotate the primary ion beam by 6°.
 Plates P1	P1h P1b	Deviating plates used to rotate the primary ion beam by 6° and to rotate the secondary ion beam by -6°.
 Scanning plates B3	B3	A 4 plates deflector used to scan the primary ion beam on the sample surface and which also act as a dynamic transfer system for the secondary ion beam.

### 4.3 Rastering the primary ion beam

The primary ion beam is scanned over the sample surface by the action of a set of three pairs of parallel plates B1, B2 and B3. The plates B3 are powered in synchronism with the two others scanning plates, so as to cancel the motion of the secondary ion beam (dynamic transfer) at the entrance slit.

Maximum practical field of view is 200\*200 square microns, with a number of pixels ranging from 64x64 to 1024x1024. Increasing the field of view above 50 microns leads to defocusing effects on the primary ion probe.

As the sample surface image is located near D1, D1 acts also as a field aperture diaphragm and thus limits the maximum field of view.

Practical rules: Field of view =  $0.6 * \text{diameter of D1}$

Tuning of B1, B2 and B3 is mainly linked to the dynamic transfer.

B3 and B1 are set at their theoretical values respectively: 4096 and 3700 bits. B2 is the free parameter and can be tuned independently in X and Y. Theoretical values for B2:  $B2X = 3170$ ,  $B2Y = 3480$ .

Electronic board uses two different types of amplifiers in the final amplification stage: up to 20 volts (2000 bits) ultra low noise amplifiers, above 20 volts low noise amplifiers. The practical field of view must be measured for both amplifiers:

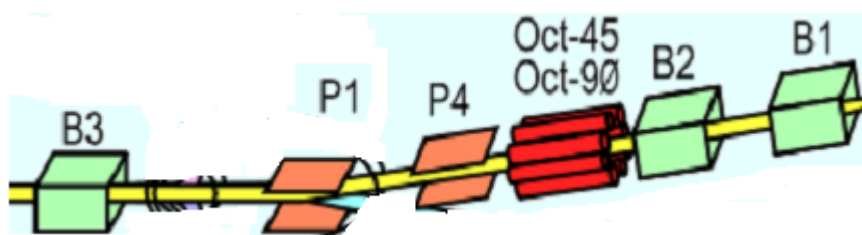
- ☐ Introduce the Silicon grooved sample and measure the real field of view around 40 microns SField\_m.
- ☐ Enter in the Setup/Keyboard/Raster section the new value for the field of view SField\_m in microns and SField\_b for the field in bits (Dac).
- ☐ Increase the field of view to 80 microns and measure the real field of view LField\_m and LField\_b
- ☐ Enter in the Setup/Keyboard/Raster section the new value for Field correction factor:

$$(\text{LField\_m} / \text{SField\_m}) * (\text{SField\_b} / \text{LField\_b})$$

Standard values are respectively 50 microns à 1900 bits and 10.

### 4.4 Dynamic Transfer

The plates B3 are powered in synchronism with the two others scanning plates B1 and B2, so as to cancel the motion of the secondary ion beam (dynamic transfer) at the entrance slit.



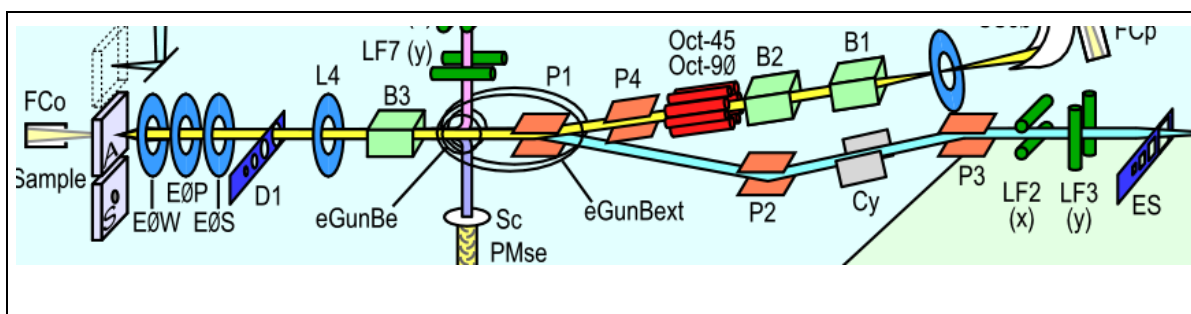
#### Procedure :

- ❑ Implant a large area 70 microns without D1,
- ❑ Reduce the scanning field to 10 microns and set up D1-2 and ES5,
- ❑ Tune E0S and the slit position to maximize the secondary ion beam current,
- ❑ Increase the scanning field to 60 microns and tune B2X and B2Y independently to get a homogeneous image.
- ❑ Introduce these new values in the setup
- ❑ Check again the raster relationship and the large field coefficient. Standard values are respectively 50 microns à 1900 bits and 10.

Theoretical standard values for B2:  $B2X = 3170$ ,  $B2Y = 3480$

## 5 Coaxial column

### 5.1 Overview









The same optical system is used to focus the primary ion beam and to collect secondary ions. The objective column is the common path for primary ions, secondary ions, primary and secondary electrons.

Compared to other SIMS instruments where the primary ion beam is introduced obliquely, this arrangement has the great advantage of considerably shortening the distance between the sample and the probe forming lens. Thus, focal length and aberrations of the objective lens are minimized, which leads to a smaller probe diameter for a given ion current.

A second advantage of this experimental setup is that secondary ions experience a strong electric field as they leave the sample leading to a higher useful yield, and to a dramatic reduction of the broadening of the secondary ion beam at the exit of the probe forming system, due to the initial angular and energy distribution. In addition, the normal incidence as opposed to oblique incidence of the primary ions minimizes shadowing effects on rough samples.

The diaphragm D1 controls angular aperture of the primary ion beam and acts as a field diaphragm for secondary ions.

## 5.2 Description

Device	Label	Description and functionality
 Lens L4	L4	Fourth electrode of the immersion lens, acts mainly on the secondary ion beam.
 Diaphragm D1	D1	Aperture stop which limits the angular aperture of the primary ion beam and limits the field of view.
 Electrode E0S	E0S	Third electrode of the immersion lens E0 which acts mainly on the secondary ion beam.
 Lens E0P	E0P	Second electrode of the immersion lens E0 which focus the primary ion beam on the sample.
 Electrode E0W	E0W	First electrode of the immersion lens E0 which acts mainly on the secondary ion beam.
 Faraday Cup	FCo	Faraday Cup used to measure the probe current.

## 5.3 Monitoring the probe current with FCo

Click on FCo button in the Holder window, FCo mode will be automatically selected in the Tuning window. The sample stage will move to a preset position where the primary ion beam can travel through it and reach the Faraday cup located on the main flange. The immersion lens E0 will be set at preset values to focus the primary ion beam in FCo.

The beam current will be displayed in the “FC part” of the Tuning Window.

To come back to the analysis position, click on the “SIMS” button in the holder window.

Remark: For a given D1 diameter FCo beam current is proportional to FCp beam current. For D1 = 300 microns FCo = 10<sup>-4</sup> FCp.

The probe current is also proportional to the power 2 of the D1

[Contents ↑](#)

## 5.4 Probe diameter

Probe size can be theoretically determined by means of the following relationship:

$$(\text{Probe size})^2 = (\text{Gaussian size})^2 + \Sigma (\text{aberrations})^2$$

Main aberrations for this kind of optical system are:

- Aperture aberration :  $\propto \alpha^3$
- Chromatic aberration :  $C_c \propto \Delta E/E$

Alpha being the half aperture at the sample and E and  $\Delta E$  are respectively the nominal energy and the energy spread of the primary ion beam. Cs and Cc are respectively aperture and chromatic aberration coefficients.

Cs and Cc are linked to the optical properties of the immersion lens. Electrodes shapes have been designed to minimize these two coefficients; practical values for the N50 are Cs = 66 mm and Cc = 16 mm.

For a given probe size (d) one can theoretically determine an optimum value for D1 (or  $\alpha$ ) which maximizes the probe current. In a first approximation by neglecting chromatic aberrations one can determine this optimum:

$$\alpha_{\text{opt}} = (d/C_s)^{1/3}$$

And

$$I_{\text{opt}} = (3\pi^2/16) B (1/C_s)^{2/3} d^{8/3}$$

A complete simulation with chromatic aberrations gives for a probe size of 100 nm, D1 = 240 microns and  $I_{\text{opt}} = 2\text{-}3$  pA.

Above simulations have been made with the following hypothesis at 8keV with Cs+ primary ions and the followings hypothesis: Source size 40 microns,  $\Delta E = 1$  eV (at least 15 eV for the duoplasmatron source), Cs = 66 mm, Cc = 16 mm.

As D1 is not continuously adjustable one has to do a compromise for each probe size, table 4 is a summary of practical D1 vs probe size for Cs+.

Probe size	D1	L1
100 – 120 nm	D1-2 or D1-3	0
70 – 100 nm	D1-3 or D1-4	6000 < L1 < 7000
< 70 nm	D1-4 or D1-5	> 7000

Table 4: Practical rules for small probe diameters with Cs+

D1 #	1	2	3	4	5
D1 diameter (microns)	750	300	250	200	150

Table 5: D1 Standard aperture diameter

While using O- beam the rules are more complex as in addition to D1, D0 has to be chosen. Table 6 is a summary of practical D1 and D0 vs probe size for O-.

Probe size	D0	D1	L1
> 2 microns	D0-1	D1-1	0
600 – 1000 nm	D0-1	D1-2 or D1-3	0
400 – 600 nm	D0-2	D1-3 or D1-4	0
300 – 400 nm	D0-3	D1-3 or D1-4	0
< 200 nm	D0-4	D1-4 or D1-5	0
< 200 nm	D0-4	D1-4 or D1-5	6000 < L1 < 7000

Table 5: Practical rules for small probe diameters with O-

[Contents ↑](#)

## 5.5 Probe size vs E0P

In much analysis the primary ion beam cannot be used focused as the beam will drill a very deep and narrow hole. Decreasing E0P will increase the probe size as shown on Figure 11.

Experimental conditions were as following: Cs+ at 8 kV, D1 = 150 microns.

In this measurement Delta E0P was in fact negative. Practical value is 52V per micron for D1 = 150 microns.

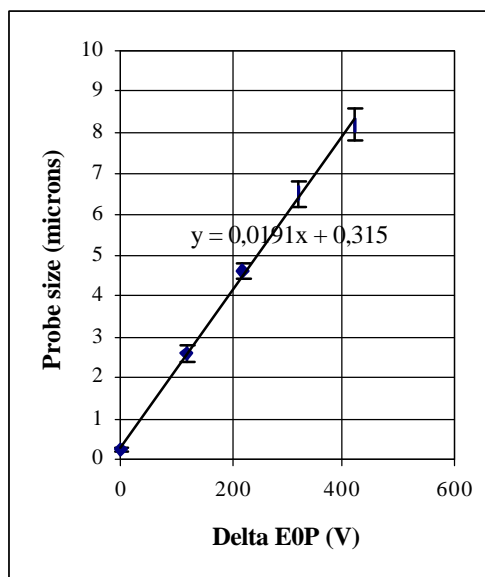


Figure 11

## 5.6 Influence of Z

The N50 has been designed to work with a distance between the immersion lens E0 and the sample set to 400 microns. Any change of this value will affect the focusing value of E0P and thus the focal length.

Practical rules for E0P: 60 Volts = 100 microns in Z

Question: will any change of Z affect the lateral resolution?

Figure 12 and 13 show the typical relationship between aberration coefficients Cs and Cc and the focal length.

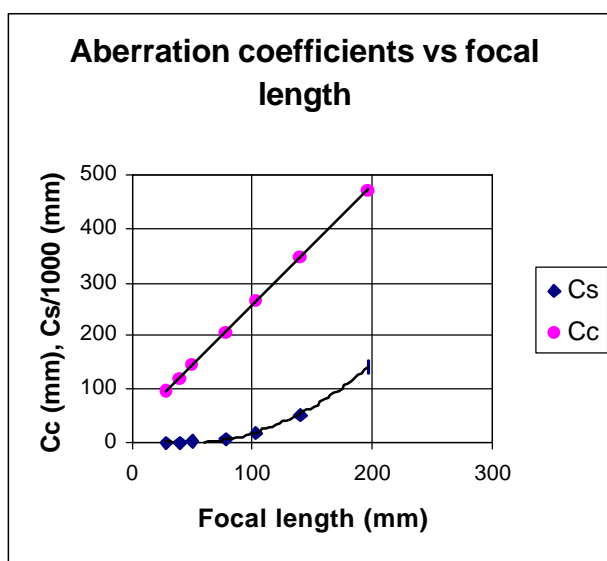


Figure 12

[Contents ↑](#)

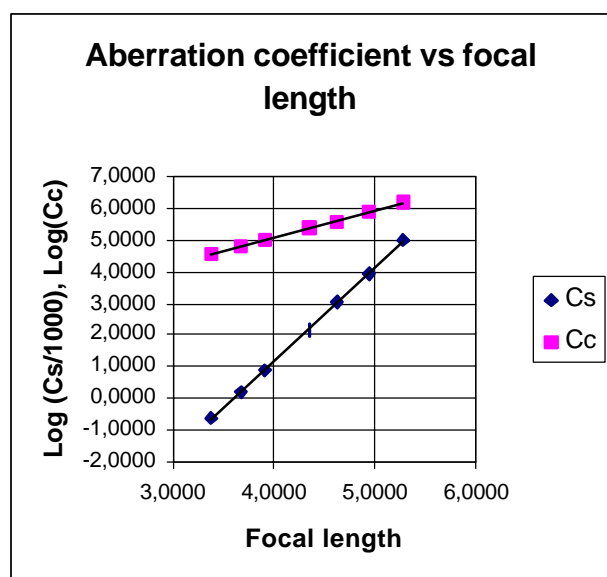


Figure 13

As shown on above Figure 13, Cc is proportional to  $f^{0.83}$  and Cs is proportional to  $f^{2.93}$ , f is the E0 focal length (roughly 6 mm). Changing Z is equivalent to changing the

focal length of E0 leading to  $dz/z = df/f$ . In addition relative variation of alpha will be also equal to relative variation of f:  $da/a = -df/f$ .

Let's assume that aberrations are expressed by:

$$Ab = \frac{1}{2} Cs \alpha^3$$

Thus:

$$dAb/Ab = dCs/Cs + 3 d\alpha/\alpha$$

$$dAb/Ab = 2.93 df/f - 3 df/f$$

$$dAb/Ab = -0.07 df/f$$

As  $f = 6\text{mm}$  and  $\Delta z = 100\text{ microns}$ :  $df/f = 0.015$  leading to  $dAb/Ab = 0.001$ . This result shows obviously that even a  $z$  variation of 100 microns will have no real effect on the aberration.

As the Gaussian reduction factor is directly proportional to the focal length, it will also be negligible.

In conclusion any  $z$  variation will not have any effect on the lateral resolution.

[Contents](#) ↑



# **The CAMECA NANOSIMS 50 L**

## **Secondary ion optics user's guide**

## Contents

1	THE SECONDARY ION COLUMN	3
2	THE COAXIAL COLUMN	3
2.1	OVERVIEW	3
2.2	DESCRIPTION	3
2.3	TUNING E0S	4
3	MATCHING OPTICS	8
3.1	OVERVIEW	8
3.2	DESCRIPTION	8
3.3	CENTERING LF2	10
3.4	CENTERING LF3	11
4	MASS SPECTROMETER	12
4.1	OVERVIEW	12
4.2	DESCRIPTION	13
4.3	MASS FRACTIONATION AT THE ENTRANCE SLIT	14
4.4	MASS SPECTROMETER TUNING	17
4.5	ANGULAR FOCUSING	17
4.6	MASS RESOLVING POWER	18
4.7	CHROMATIC COMPENSATION.	20
4.8	SECOND ORDER APERTURE ABERRATION	23
4.9	HEXAPOLE TUNING	25
4.10	TUNING LF5 AND C3X	27
5	MULTICOLLECTION SYSTEM	28
5.1	OVERVIEW	28
5.2	DESCRIPTION	28
5.3	THE USE OF ELECTRON MULTIPLIERS (EMs) FOR CAMECA SIMS INSTRUMENTS	30
5.3.1	OverView	30
5.3.2	EM output and discriminator threshold	30
5.3.3	EM aging	32
5.3.4	The ion to electron conversion issue	35
5.3.5	QSA Effects on Isotopic ratio measurements	37

## 1 The Secondary Ion Column

The secondary ion optic is composed of four different sections: the coaxial column, the matching optics, the mass spectrometer and the multicollection system.

The three last sections are exclusively used by the secondary ion beam while the first one is common to secondary, electron and primary ion beams.

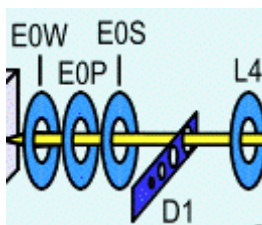
## 2 The Coaxial column

### 2.1 Overview

The same optical system is used to focus the primary ion beam and to collect secondary ions. The objective column is the common path for primary ions, secondary ions, primary and secondary electrons.


Compared to other SIMS instruments where the primary ion beam is introduced obliquely, this arrangement has the great advantage of considerably shortening the distance between the sample and the probe forming lens. Thus, secondary ions experience a strong electric field as they leave the sample leading to a higher useful yield, and to a dramatically reduction of the broadening of the secondary ion beam at the exit of the probe forming system, due to the initial angular and energy distribution. In addition, the normal incidence as opposed to oblique incidence of the primary ions minimizes shadowing effects on rough samples.





The diaphragm D1 controls angular aperture of the primary ion beam and acts as a field diaphragm for secondary ions.



### 2.2 Description

List of elements:

Device	Label	Description and functionality
 Electrode E0W	E0W	<b>FIRST ELECTRODE OF THE IMMERSION LENS E0 WHICH ACTS MAINLY ON THE SECONDARY ION BEAM.</b>

 Electrode E0S	E0S	Third electrode of the immersion lens E0 which acts mainly on the secondary ion beam.
 Lens E0P	E0P	Second electrode of the immersion lens E0 which focus the primary ion beam on the sample.
 Diaphragm D1	D1	Aperture stop which limits the angular aperture of the primary ion beam and limits the field of view.
 Lens L4	L4	Fourth electrode which acts mainly on the secondary ion beam.

## 2.3 Tuning E0S

Assuming that the primary ion beam focusing has already been made the first tuning to achieve in the secondary ion column is E0S. This electrode which mainly acts on secondary ion beam is in charge of focusing the secondary ion beam in the entrance slit (figure 1).

The optimum EOS changes with the ions species and with the distance Z between the sample and E0. One bit of EOS is roughly equivalent to 1.5 micron.

In addition to EOS, L4, LF2 and LF3 which are also acting on the secondary ion beam focusing but these last three lenses are at preset fixed potentials (table 1).

### E0S tuning procedure :

- ☐ Implant a small area (10 microns) without D1,
- ☐ Set the scanning mode ON in Tuning with a counting time per frame equal to 0,54s.
- ☐ Set up D1-2 and ES3 without any aperture slit or energy slit.
- ☐ Select one detector in the multicollection.
- ☐ Tune alternatively E0S and the beam position to maximize the secondary ion beam current by changing Cy and P2/P3 (\*).
- ☐ Modify Z value to get an EOS value in between 2700 and 2800.
- ☐ Check again EOS and the entrance slit position.

(\*) In order to keep the secondary ion beam motionless in front of the mass spectrometer, it is required to not change the entrance slit position. Thus the mass spectrometer tuning has not to be changed while the sample is moving or being exchanged.

Lens	E0S	L4	LF2	LF3
Voltage (bits)	2800 +/- 100	2760	1250	1810

Table 1: typical values for E0S, L4, LF2 and LF3

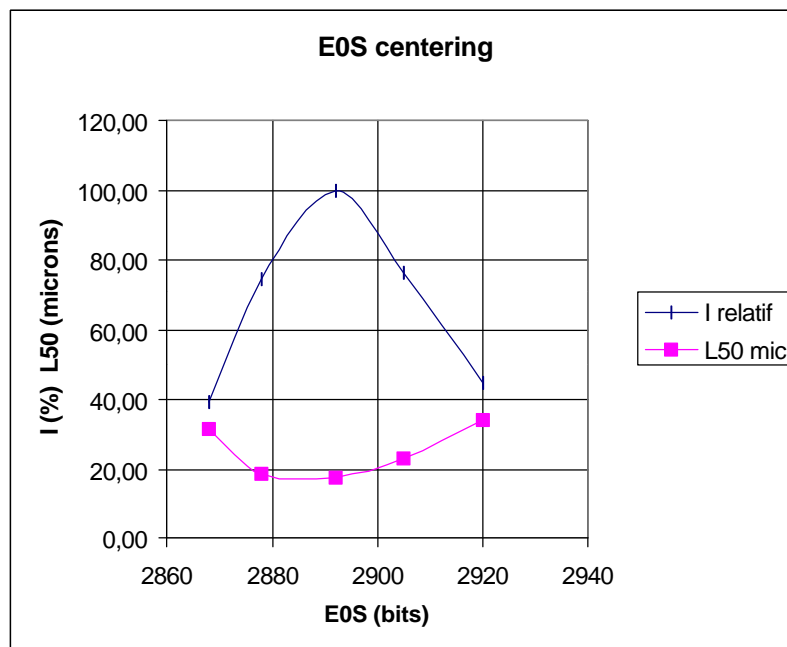


Figure 1: E0S centering

Following this focusing procedure it could be useful to check the dynamic transfer tuning especially if the mass spectrometer has to be used at high mass resolving power and if E0S has been largely modified.

The dynamic transfer is in charge of keeping the secondary ion beam motionless while the primary ion beam is scanned over the sample surface. Figure 1 shows the beam position at the entrance slit and the angle value at the cross-over position (roughly B3 center) while the beam is scanned over 30x30 microns without any dynamic transfer.

As the entrance width is ranging from 10 to 30 microns it is obvious that without dynamic transfer the transmission is dramatically reduced and that for field of view larger than a few microns there is quite no beam going through the entrance slit.

#### Dynamic transfer procedure :

- ☐ Implant a large area 70 microns without D1,
- ☐ Reduce the scanning field to 10 microns and set up D1-2 and ES5,
- ☐ Tune E0S and the slit position to maximize the secondary ion beam current,
- ☐ Increase the scanning field to 60 microns and tune B2X and B2Y independently to get a homogeneous image.
- ☐ Introduce these new values in the setup
- ☐ Check again the raster relationship and the large field coefficient. Standard values are respectively 50 microns à 1900 bits and 10.

Theoretical values for B2: B2X = 3170, B2Y = 3480 but large variations of these values are observed.

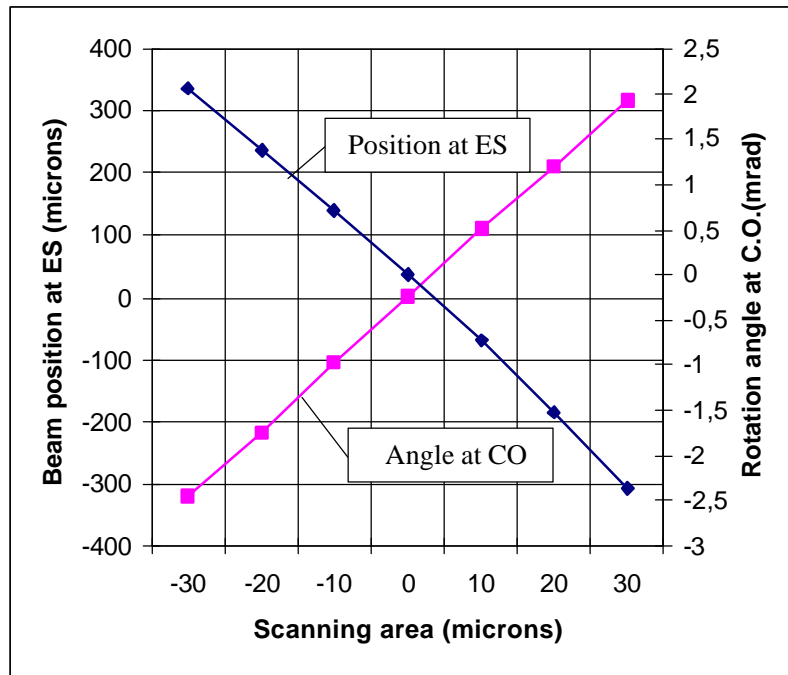


Figure 2: Theoretical variation of cross-over position.  
 These simulations have been made with the followings conditions:

- $B3 = 0$  Volts
- Sec. Ions emitted at different position on the sample

Remark: Changing EOS leads to a variation of the secondary ion beam cross-over position at the exit of the coaxial column. In addition to this position variation there is also a variation of the exit angle (figure 2). As a consequence for each EOS value it corresponds a particular setting of the dynamic transfer (especially B3) (Figure 3).

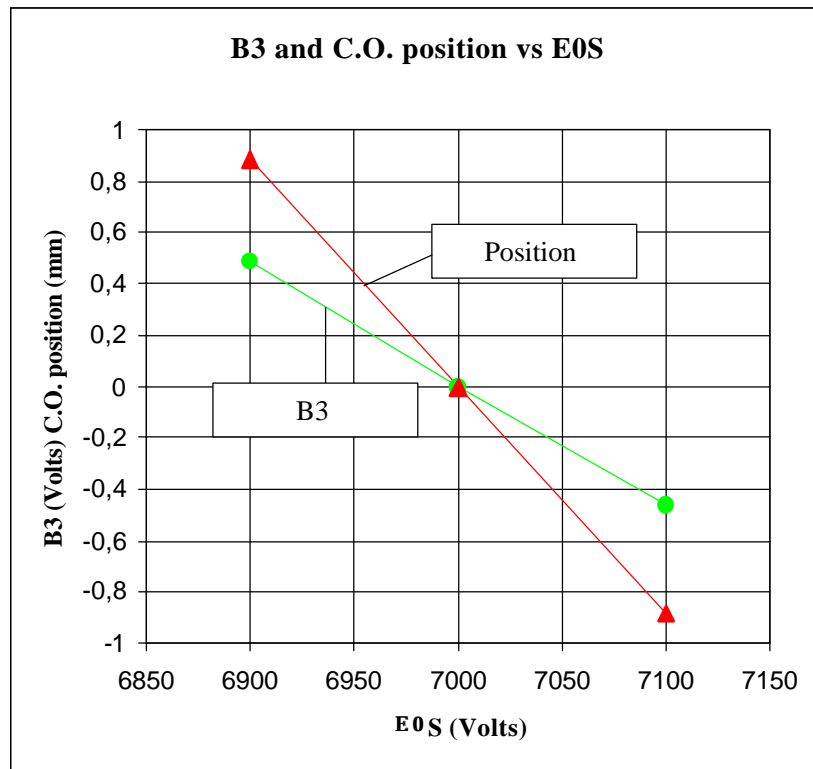


Figure 3: Theoretical variations of B3 vs E0S

These simulations have been made with the followings conditions:

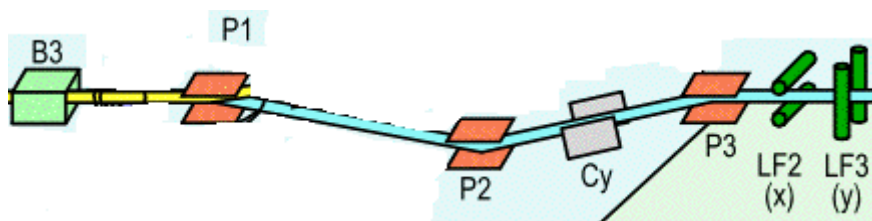
- B3 = 10 Volts
- Sec. Ions emitted at 30 microns
- Standard value for E0S: 7000 Volts (\*)

(\*) Depending of each particular instrument the standard E0S value can vary a lot.

[Content](#)

### 3 Matching optics

#### 3.1 Overview






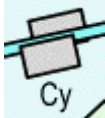



At the exit of the coaxial column the secondary ion beam travels through a set of parallel plates P1 which is in fact an electrostatic separator for primary and secondary ions of opposite signs. This symmetric design keeps the secondary and primary ion beams energy equal. This energy can be tuned from a few keVs to 10 keV.

Because of its high degree of dispersion in aperture and energy, the secondary ion beam must travel as straight as possible before it enters in the mass spectrometer. Otherwise its trace diagram (angular – space graph) will show very intricate folds leading to a dramatic reduction of the cutting efficiency of the slits in the mass spectrometer leading to a reduction of the transmission for a given mass resolving power. Thus in order to minimize these effects, small deviations have been chosen:  $6^\circ$  in P1 and P3 and  $12^\circ$  in P2. In addition P1, P2 and P3 have been set in order to ensure an achromatic deviation of the secondary ions.

After these three parallel plates the beam enters in the matching section of the mass spectrometer. A set of two slit lenses (unidirectional focusing lens) are necessary to adapt the secondary ion beam in terms of angular aperture and spatial dimensions in the radial and in the transverse plane. As the mass spectrometer is corrected for second order aperture aberration in the radial plane, the angular aperture in this plane can be relatively large; this possibility has been used as the beam is focus on the entrance slit in the horizontal plane. In the vertical plane, aperture is kept as low as possible and the beam is not focus in the entrance slit.

#### 3.2 Description

Device	Label	Description and functionality
 Scanning plates B3	B3	A set of 4 plates used to scan the primary ion beam on the sample surface and which also act as a dynamic transfer system for the secondary ion beam.
 Plates P1	P1h P1b	Deviating plate used to rotate the primary ion beam by $6^\circ$ and to rotate the secondary ion beam by $-6^\circ$ .
 Plates P2	P2h P2b	Deviating plate used to rotate the secondary ion beam by $12^\circ$ .

 Cy Corrector Cy	Cy	A 2 plates deflector used to center the secondary ion beam in the horizontal plane
 P3 Plates P3	P3h P3b	Deviating plate used to rotate the secondary ion beam by 6°.
 LF2 (x) Lens LF2	LF2	Slit lens used to control the height of the secondary ion beam in the vertical plane.
 LF3 (y) Lens LF3	LF3	Slit lens used to focus the secondary ion beam in the entrance slit (horizontal plane).

P1, P2 and P3 allow a centering of the secondary ion beam in LF2 and in the entrance slit (ES) in the vertical plane.

Cy allows a centering of the secondary ion beam in LF3 and ES in the horizontal plane.

In order to maintain the mass spectrometer settings unchanged it is recommended to re-center the secondary ion beam in ES with CY and P2/P3 (\*).

(\*) Caution: While using the Sec. Ion Beam centering software which determines the optimum values for Cy, P2 and P3, the relative ratio P2/P3 has to be properly set. This ratio allows maintaining the secondary ion beam parallel to the horizontal axis while changing P2 and P3. This ratio is very sensitive to the setting of LF2 (figure3). As LF2 is generally set to 1250 bits, the relative ratio P3/P2 must be set at 0.36. This coefficient must be introduced in the Setup (Tuning section).

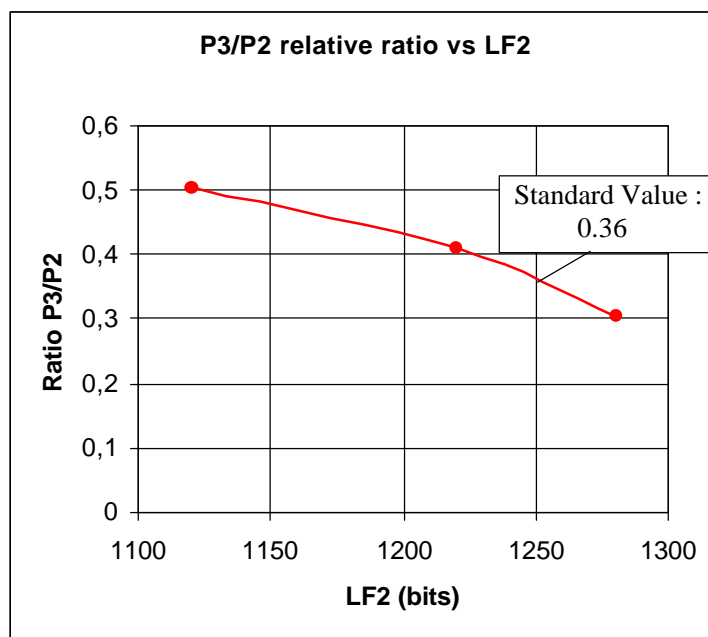


Figure 4: Relative variation of P3/P2 vs LF2

### 3.3 Centering LF2

In order to minimize aberrations along the secondary ion beam path it is necessary to center the beam in LF2 in the vertical plane. Indeed as LF2 is a slit lens acting only in the vertical plane, a reasonable misalignment in the horizontal plane will have no effect on the secondary ion beam quality.

The centering has to be done with the TIC detector and must be done without LF3.

Procedure:

- ☐ Remove the entrance and aperture slits.
- ☐ Set C2x, C2y, LF2 and LF3 to zero.
- ☐ Center the secondary ion beam in the TIC by means of Cy and C2x.
- ☐ Set LF2 to 1250 bits.
- ☐ Center the secondary ion beam by means of C2x. Normally C2y has not to be changed.
- ☐ Note C2x.
- ☐ Change P2 and P3 values
- ☐ Set LF2 to zero.
- ☐ Center the beam by means of C2x and note C2x.
- ☐ Back to 4 as long as the difference between C2x values at LF2=0 and at LF2=1250 bits are different by more than 15 bits.

Figure 5 shows a typical centering of LF2. As shown in this case P3 which was set at 880 bits and has not been changed during the procedure. Optimum P2 is roughly 1995 bits.

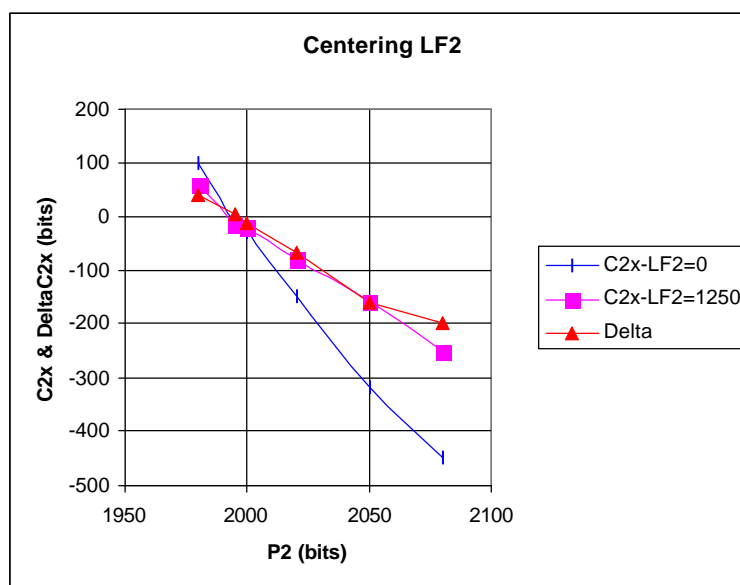


Figure 5: Centering LF2

### 3.4 Centering LF3

In order to minimize aberrations along the secondary ion beam path it is necessary to center the beam in LF3 in the horizontal plane. Indeed as LF2 is a slit lens acting only in the horizontal plane, a reasonable misalignment in the vertical plane will have no effect on the secondary ion beam quality.

The centering has to be done with the TIC detector and must be done with LF2 at its nominal value (1250 bits).

Procedure:

- ☐ Remove the entrance and aperture slits.
- ☐ Keep LF2, P2, P3 and C2x to the values found previously.
- ☐ Set C2y and LF3 to zero.
- ☐ Center the secondary ion beam in the TIC by means of Cy.
- ☐ Set LF3 to 1810 bits.
- ☐ Center the secondary ion beam by means of C2y.
- ☐ Note C2y.
- ☐ Change Cy value by 50 bits.
- ☐ Set LF3 to zero.
- ☐ Center the beam by means of C2y and note C2y.
- ☐ Back to 5 as long as the difference between C2y values at LF3=0 and at LF3=1810 bits are different by more than 30 bits.

Figure 6 shows a typical centering of LF3. Optimum Cy is 210 bits with C2y set at 250 bits.

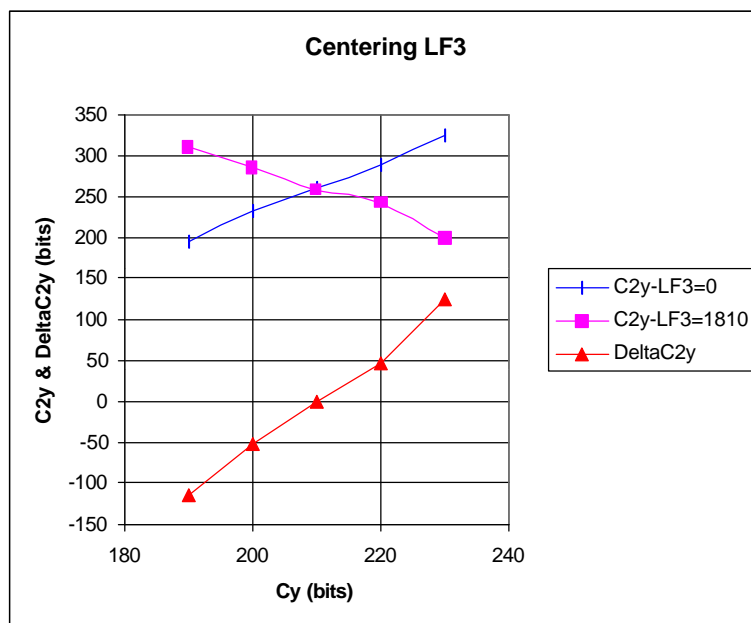
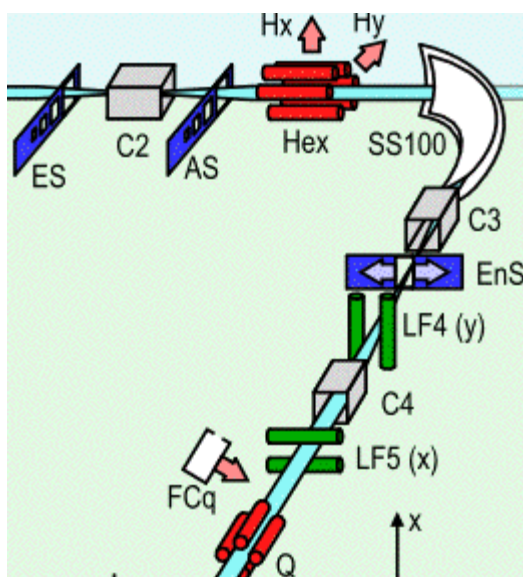


Figure 6: Centering LF3

[Content](#)

## 4 Mass spectrometer

### 4.1 Overview



The mass spectrometer is a double focusing system with a focal plane. In order to achieve angular and energy focusing along the whole focal plane, the magnetic prism and the electrostatic sector are coupled by a quadrupole lens (Q) and two slit lenses (LF4 and LF5).




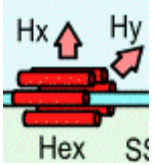
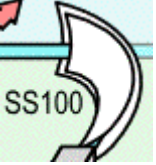




Three different slit assemblies limit the beam extensions:



- Entrance slit (ES) limits the spatial extension and the lateral energy of the secondary ion beam. It has a rectangular shape.
- Aperture slit (AS) limits the angular extension of the beam. It has a rectangular shape.
- Energy slit (EnS) limits the energy bandwidth of the beam.

Lens LF4 acts in parallel with Q on energy and angular focusing. Lens LF5 controls the height of the secondary ion beam in the magnet. The Hexapole (H) corrects second order aperture aberrations in the horizontal plane.

A proper choice of the matching section and of the three limiting slits lead to good compromise between mass resolving power and transmission.

## 4.2 Description

Device	Label	Description and functionality
 Entrance slit	ES Esx Esy	Entrance slit of the mass spectrometer – five different position corresponding to 5 different slit width and height.
 Corrector C2	C2x C2y	A 4 plates deflector used to center the secondary ion beam.
 Aperture slit	AS	Aperture slit of the mass spectrometer – five different position corresponding to 5 different slit width and height.
 Hexapole	H Hx Hy	Hexapole used to correct second order aperture aberration.
 90° ESA	SS100	100 mm radius spherical electrostatic sector used as an energy analyzer.
 Corrector C3	C3x C3y	A 4 plates deflector used to center the secondary ion beam.
 <b>ENERGY SLIT</b>	EnS pos EnS width	Continuously adjustable slit used to control the energy bandwidth of the secondary ion beam.
 Lens LF4	LF4	Slit lens used assure the chromatic focalization (horizontal plane).
 Corrector C4	C4x C4y	A 4 plates deflector used to center the secondary ion beam.

 LF5 (x) Lens LF5	LF5	Slit lens used to control the height of the secondary ion beam in the vertical plane.
 Q Quadrupole	Q	Quadrupole lens used to focalize the secondary ion beam on the magnet focal plane

### 4.3 Mass Fractionation at the entrance slit

Due to the presence of leaking Bfields along the secondary ion trajectories, the secondary ion beam at the entrance slit is mass fractionated. These fringing fields are mainly produced by the two ion pumps in charge of pumping the analysis and the central chamber. This effect leads to severe mass fractionation at the entrance slits in both planes: for example on a SiC sample  $^{12}\text{C}^-$  and  $^{28}\text{Si}^-$  ions are not located at the same position at the entrance slit plane (see Figure 7 and 8).

Two external coils have been added to cancel this effect.

Tuning procedure (simplified):

- ☐ Select a sample providing two different high intensity mass lines with large mass difference.
- ☐ Use SIBC software to scan these two mass lines in front of the entrance slit 3 and record the two center line positions. Cy and P2/P3 will be used to scan the secondary ion beam.
- ☐ Change the coils intensities to cancel the position difference in the horizontal and vertical planes as shown on figure 7 and 8.

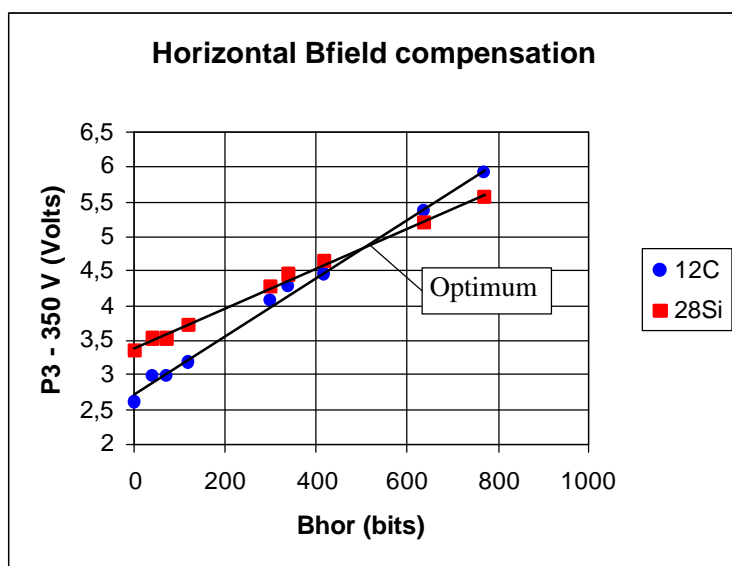


Figure 7: Vertical coil tuning

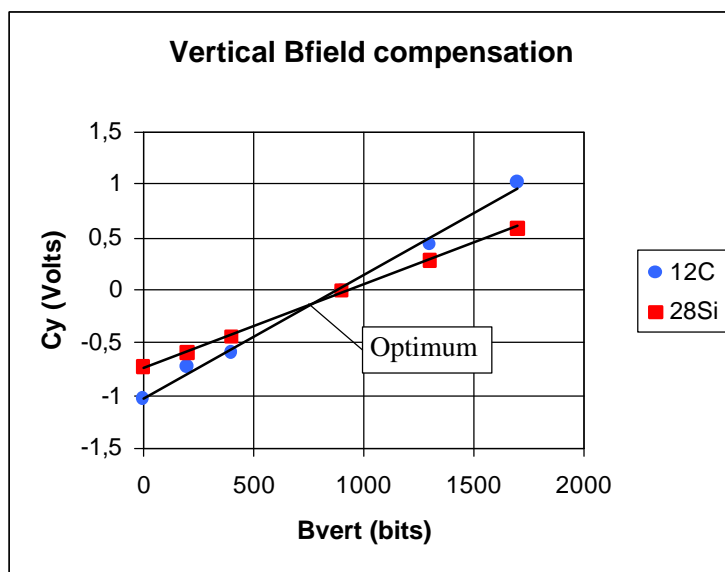


Figure 8: Horizontal coil tuning

If more precision is required as for high reproducibility simultaneous isotopic measurements – for example C and Si isotopic measurements – it is possible to use more mass lines to determine the optimum coils intensities.

Tuning procedure:

- ☐ Select a sample providing at least three different high intensity mass lines with large mass differences.
- ☐ Use SIBC software to scan these two mass lines in front of the entrance slit 3 and record the two center line positions.
- ☐ Change the coils intensities over a large range to reverse the relative position of the mass lines.
- ☐ Compute for each mass line the slope of the graph as shown on figure 9 and check that this slope is proportional to  $1/M^{1/2}$  (figure 10). If not try to redo the measurements in order to get a good fit for the slope.
- ☐ Determine the optimum by looking at the intersection of the different linear fit as shown in figure 9.

The following measurements have been made on a Si wafer. Three different secondary ion beams ( $^{16}\text{O}$ ,  $^{30}\text{Si}$  et  $^{28}\text{Si}_3$ ) have been scanned across the entrance slit (slit n°3 30 microns) in the horizontal plane. Corrector Cy has been used to scan these beams. Without vertical Bfield, the distance between 160 and 84Si3 is roughly 0,44 Volts which can be estimated to be 5 microns.

Figure 10 shows that the slope of the linear fit is proportional to  $1/\sqrt{M}$ , demonstrating that this effect is a pure magnetic field effect.

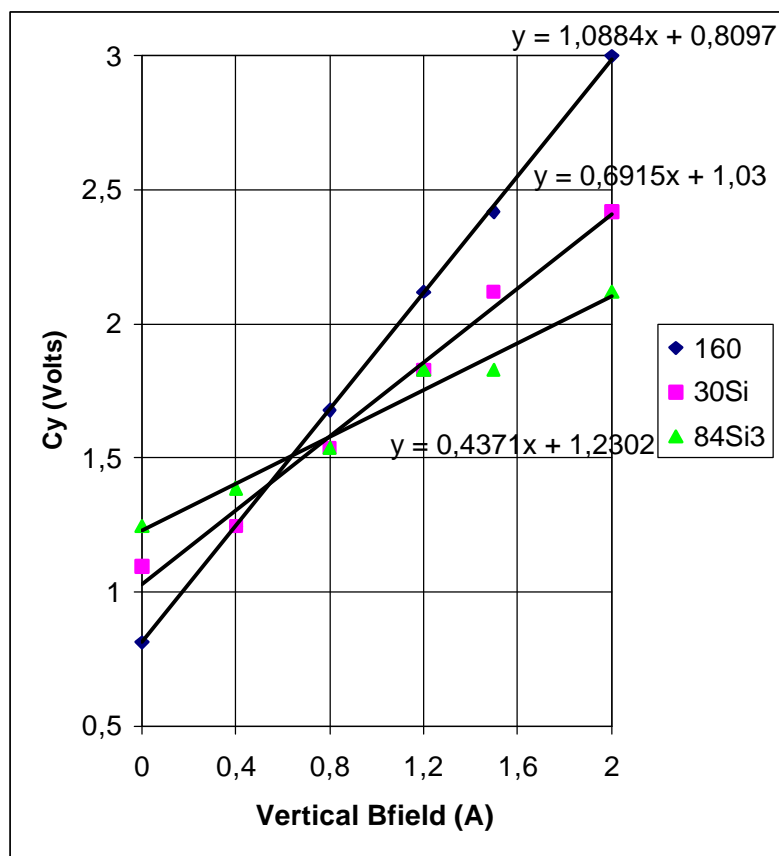


Figure 9: Horizontal coil tuning.

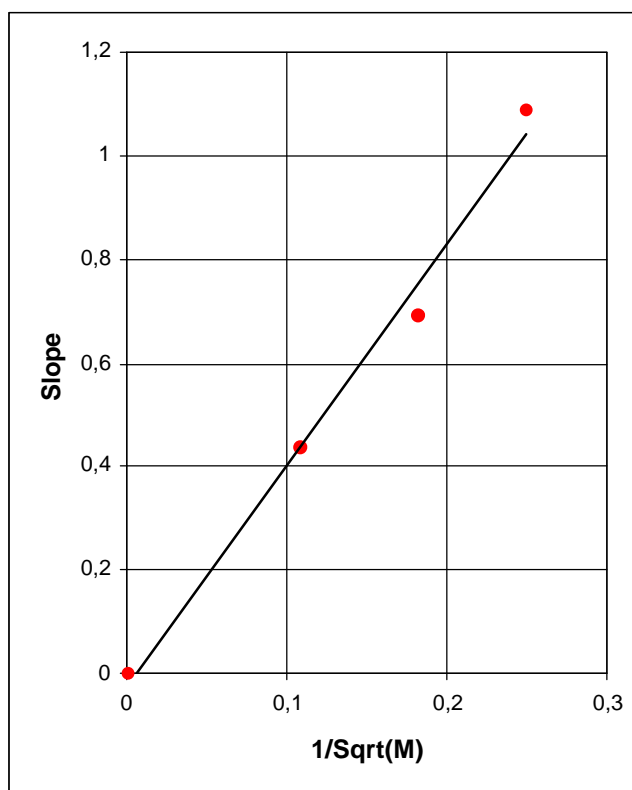


Figure 10: Slope vs  $1/M^{1/2}$

## 4.4 Mass spectrometer tuning

In order to reach high mass resolution without loss of transmission, the mass spectrometer has been designed with low aperture and chromatic aberration coefficients. Due to a particular design of the magnet, it is free of second order aperture aberrations in the radial plane; thus it can accept secondary ion beam with large angular aperture.

The mass resolving power  $M/\Delta M$  is dependant of numerous terms and this dependence is not only linear but also of higher order. The following formula describes the effect of the main ion beam parameters on the inverse of the mass resolving power.

$\Delta M/M = G WES + K_{\alpha} \alpha^2 + K_E \alpha \Delta E/E + (K_{\beta} \beta^2 + \text{higher order terms}.....)$		
<b>H, AS, ES</b>	<b>ENS, LF4, ES, AS</b>	<b>H, LF2, LF5</b>

- WES : Entrance slit width
- G : magnification of the spectrometer
- $K_{\alpha} \alpha^2$  : second order aperture aberration term,
- $K_E \alpha \Delta E/E$  : chromatic aberration term,

with  $\alpha$  being the half aperture angle in the radial (horizontal) plane,  $\beta$  the half aperture angle in the vertical plane,  $K_{\alpha}$ ,  $K_{\beta}$  and  $K_E$  second order coefficients for respectively radial aperture, vertical aperture and chromatic aberrations,  $\Delta E/E$  the relative energy spread of the secondary beam.

The bottom part of the table shows those optical elements having an effect on the aberration terms.

## 4.5 Angular focusing

As shown on figure 11, the electrostatic sector SS100 produces an image of the entrance slit located at the energy slit plan. The location and the size of this image are not tuneable. Then Q and LF4 produce a parallel beam at the entrance of the magnet leading to a focus point located on the focal plan. The location of this focus point depends directly of the mass and charge of the incoming ion beam.

Q and LF4 act both on angular focusing but due to the location of LF4 –as close as possible from EnS – Q is the essential lens to be tuned in order to reach the optimum focus.

### Tuning of Q:

- ☐ Set up ES3,
- ☐ Record HMR spectra for different values of Q.
- ☐ Select the optimum value for Q which corresponds to a maximum for the mass resolving power.
- ☐ Check Chromatic aberration (LF4 Tuning)
- ☐ Back to 2 as long as Q and LF4 setting are different from the previous steps.

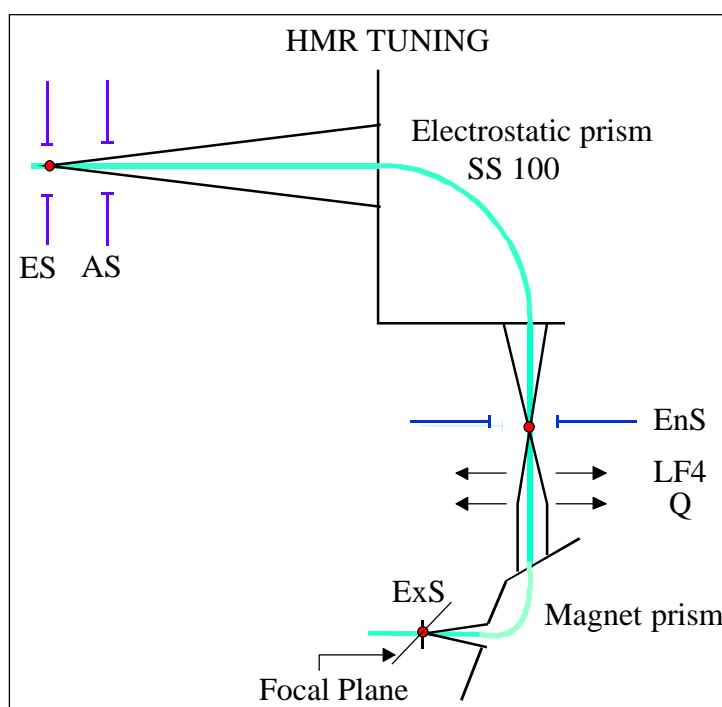


Figure 11: Angular focusing.

## 4.6 Mass Resolving Power

Different definitions are conceivable, each being suited to a special situation. The purpose of the MRP definition being referred to as the "Cameca definition", is to characterize the mass line width in relation to mass dispersion. Let us try to remove ambiguities in presenting a more general approach to MRP definitions.

The width labelled  $L_{10-90}$  is the width inside which one finds 80% of the line intensity and with 10% of intensity left on each side. If intensity is assumed to be uniformly distributed across the line and if aberration effects on the wings of the line are neglected (sharp line assumption), the total width of the line  $h_L$  would be,

$$h_L = L_{10-90} / 0,8 = 1,25 L_{10-90} \quad (1)$$

$L_{5-95}$  is also available as a result of HMR spectrum (Tuning) and is the width inside which one finds 90% of the line intensity

For the sake of simplicity, we consider situations where two adjacent mass lines are of equal intensity.

The dispersion in the plane of the exit slit is given by the following relation:

$$h_M \cong k R \frac{\Delta m}{m} \quad (2)$$

$h_M$  is the distance between the center of two mass lines differing by a mass difference  $\Delta m$ ,  $k$  is a numerical factor which depends upon the design of the spectrometer.  $R$  is the radius of the circular path in the uniform magnetic field and " $m$ " is the ion mass. In

the Nanosims set-up,  $k = 0.5$ . Thus we reach the general expression with atomic masses  $M$ ,

$$h_M \cong \frac{R}{2} \frac{\Delta M}{M} \quad (3)$$

Now let us take a selection slit width  $h_S$  and the sharp line assumption. To define a MRP we usually have to introduce additional conditions:

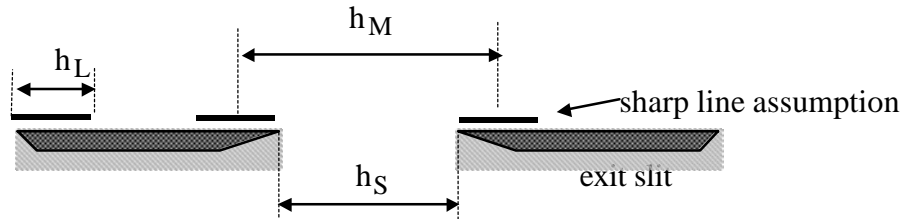
- Either the percentage of peak reduction,  $P\%$  of full intensity, due a narrow exit slit if  $h_S < h_L$  or the distance  $h_T$  over which the mass line may move inside the exit slit while keeping its full intensity if  $h_S > h_L$  (flat top peak).
- The other concerns the valley to peak ratio being accepted as a separation for two adjacent lines.

If one makes the choice of having a full intensity line and a point of zero intensity between two adjacent lines, MRP can be defined with the relation,

$$h_M \cong h_S + h_L \quad (4)$$

That is,

$$h_S + h_L = \frac{R}{2} \frac{\Delta M}{M} \rightarrow \frac{M}{\Delta M} = (MRP)_0 \cong \frac{R}{2(h_S + h_L)} \quad (5)$$



If one wishes to characterize the mass resolving limit capabilities, the conditions may be written as :

- $P$  arbitrarily fixed at 80% of the full intensity
- The valley to peak ratio arbitrarily fixed at 25%.

These conditions lead to:

$$h_s = L_{10-90} \text{ and } h_M = 2 L_{10-90} \quad (6)$$

and result in Cameca's definition:

$$MRP_{Cam} = M/\Delta M = R / 4 L_{10-90} \quad (7)$$

This value of MRP indicates the possible performance of the instrument consistent with the specified conditions regardless of the actual width of the exit slit but it should not be understood as a definition of MRP being suitable for any situation.

It is worthwhile noting that the width  $L_{10-90}$  is a parameter which takes its full meaning in relation with the mass dispersion  $h_M$  for a given mass difference  $\Delta m$  at each radius  $R$ . Instead of considering the variations of  $L_{10-90}$  and  $h_M$  with the radius  $R$  separately, it is convenient to use  $MRP_{Cam}$ .

From a practical point of view the procedure being followed is:

- ☐  $L_{10-90}$  is measured experimentally (or any other  $L(a\%-b\%)$  width....).
- ☐ for each specific problem the width of the exit slit has to be chosen according to some criteria: P% of the full intensity or the "length"  $h_T$  of the flat top.
- ☐ the valley to peak ratio between to adjacent lines.
- ☐ then the MRP is determined with the help of (3).

To provide users with information upon the intrinsic performances of the instrument, it is essential to determine the relations between the signal intensity and the mass line width at different radii R. But, considering the great variety of situations, it is left to users to determine which MRP definition they should use according to their specific problem (taking into account the intensity of interfering lines, the precision of the peak top flatness, ...) and which decision they have to make concerning the width of the exit slit.

Figure 12 shows typical data obtained on CN<sup>-</sup> ions. MRP has been computed according to the Cameca's definition. The relative transmission refers to the ratio Intensity with slits/intensity without any slits. The different points correspond to different choice of the available slits. There are no specific rules to determine which set of slits has to be used to reach a given mass resolving power. However one can set for the slits an order of efficiency as following:

ES, EnS, AS

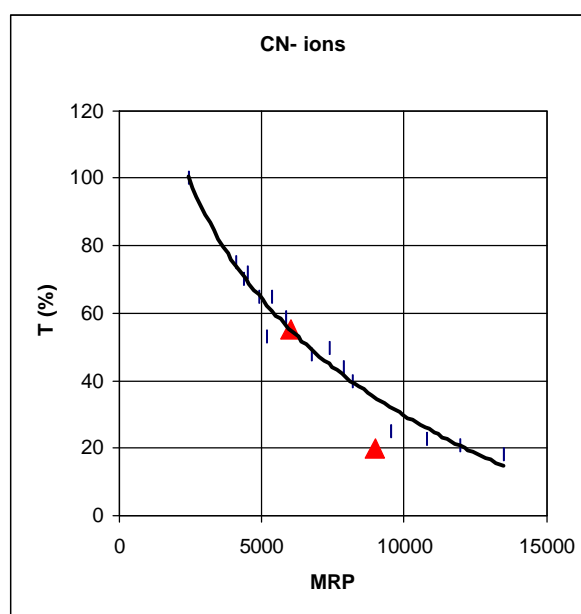


Figure 12: Transmission versus Mass resolving power

#### 4.7 Chromatic compensation.

As shown on figure 13, let suppose that two secondary ion beam with two different energies are emerging from the entrance slit on the axis. The electrostatic sector SS100 will disperse them according to their energy and the two emerging trajectories

will appear as coming from a single point named achromatic point  $Ac$ . This particular point is located at one radius from the SS100 exit face.

The magnet has also achromatic points. Let suppose that we send two trajectories focus on the magnet achromatic point  $Ac'$ , they will emerge with the same angle from the magnet.

Q and LF4 have been design to conjugate  $Ac$  and  $Ac'$  in order to compensate chromatic dispersion at the exit of the magnet.

Q and LF4 act both on angular focusing and on chromatic compensation. Q is the main lens for angular focus and chromatic compensation. Due to its location - as close as possible from EnS – LF4 acts mainly on chromatic compensation.

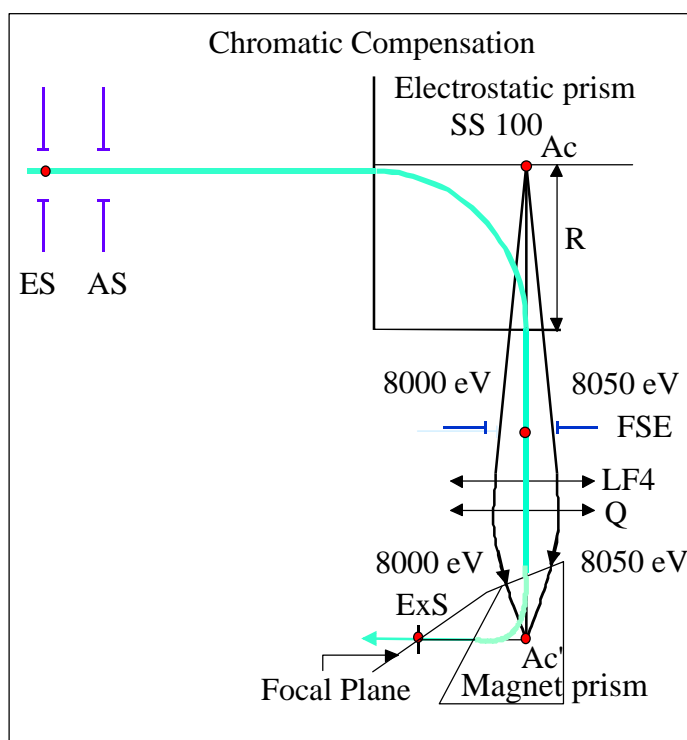


Figure 13: Energy focusing.

#### Tuning of LF4:

- ☐ Select ES3,
- ☐ Record 3 HMR spectra for each LF4, corresponding to 3 different values of E0W offset (figure 14)
- ☐ Select the optimum value for LF4 which corresponds to a motionless mass line (slope = 0 on figure15)

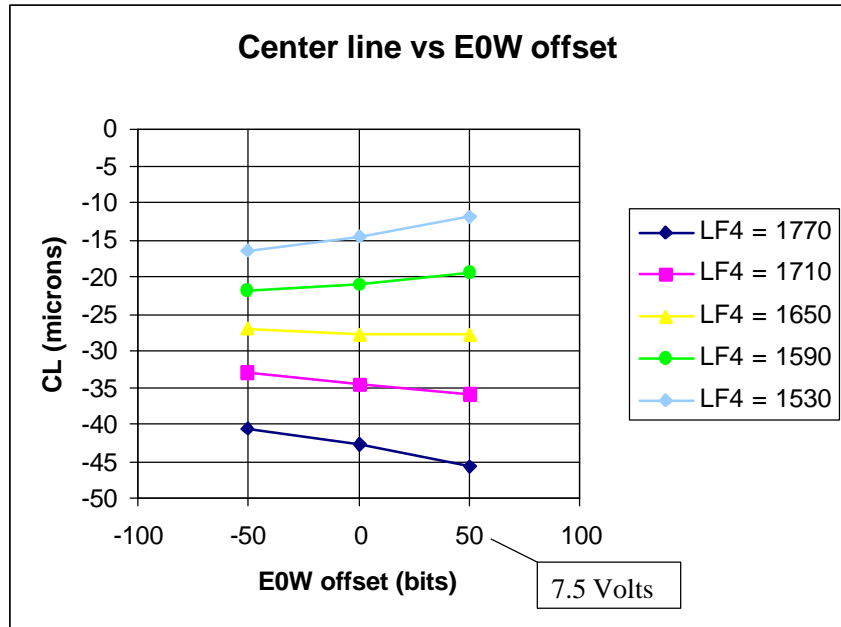


Figure 14: Beam position vs E0W offset.

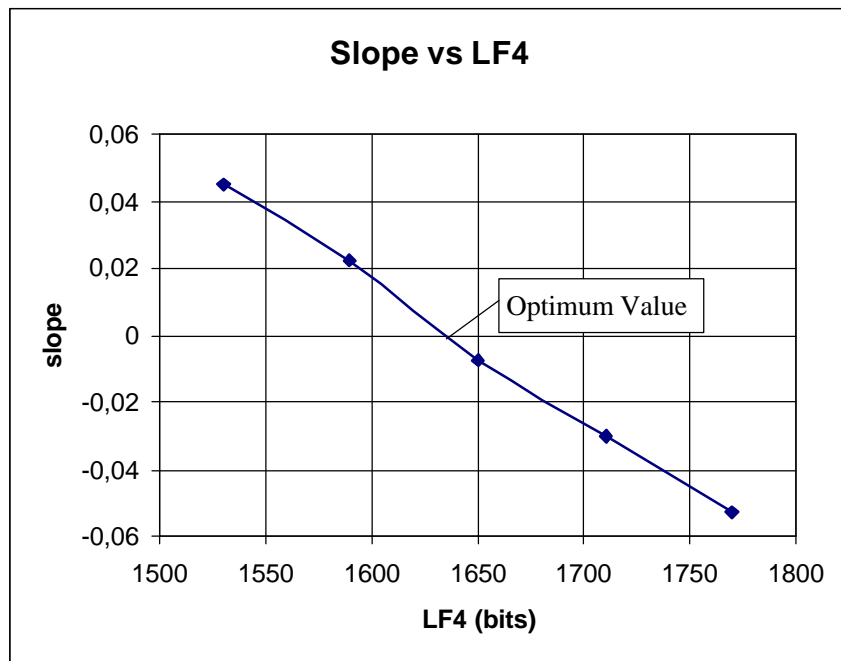


Figure 15: Slope vs LF4.

Remark : As Q acts on Chromatic compensation, LF4 cannot remain unchanged as Q varies. Thus, For each value of the Quadrupole Q one can determine an optimum value for LF4 (figure 16).

This empiric relationship can be introduced in the setup (Keyboard section)

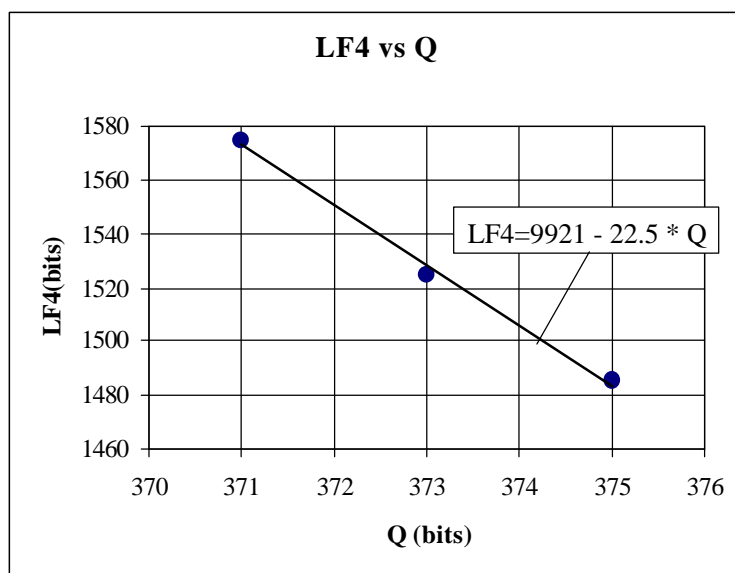


Figure 16: LF4 vs Q.

#### 4.8 Second order aperture aberration

These aberrations are mainly due to the electrostatic sector SS100. Let suppose we have a mono energetic secondary ion beam emerging from the entrance slit. This beam has a very small aperture in the horizontal plane in a mean direction doing an angle  $\alpha$  with respect to the axis.

This beam will be focus in the energy slit plan but not on the axis. The distance z from the axis is proportional to the power 2 of  $\alpha$  (figure 17)

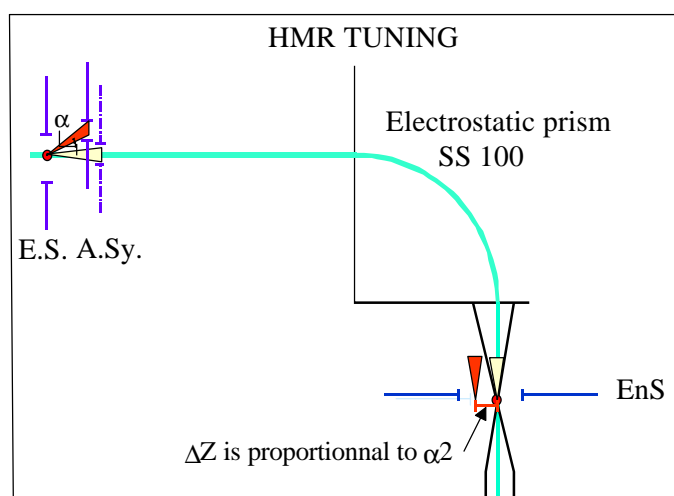


Figure 17:  $\alpha^2$  aberrations

Now, let suppose we have an other mono energetic secondary ion beam emerging from the entrance slit. This beam has a very small aperture in the vertical plane in a mean direction doing an angle  $\beta$  with respect to the axis. This beam will be focus in the horizontal plane at the energy slit but not on the axis. The distance  $z$  from the axis is proportional to the power 2 of  $\beta$  (figure 18)

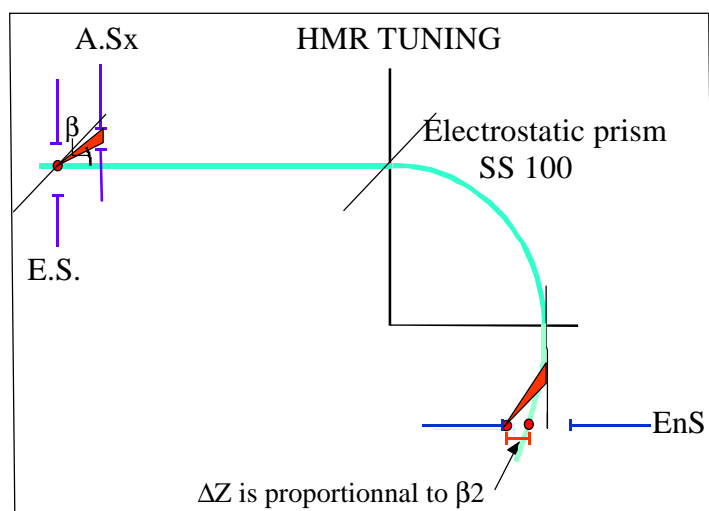


Figure 18:  $\beta^2$  aberrations

Figure 19 and 20 demonstrate the existence of these aberrations. These measurements have been done with ES5 and AS5 on a SiC sample. AS5 position has been changed either in the horizontal plane (As5y for  $\alpha^2$  aberrations) or in the vertical plane (AS5x for  $\beta^2$  aberrations).

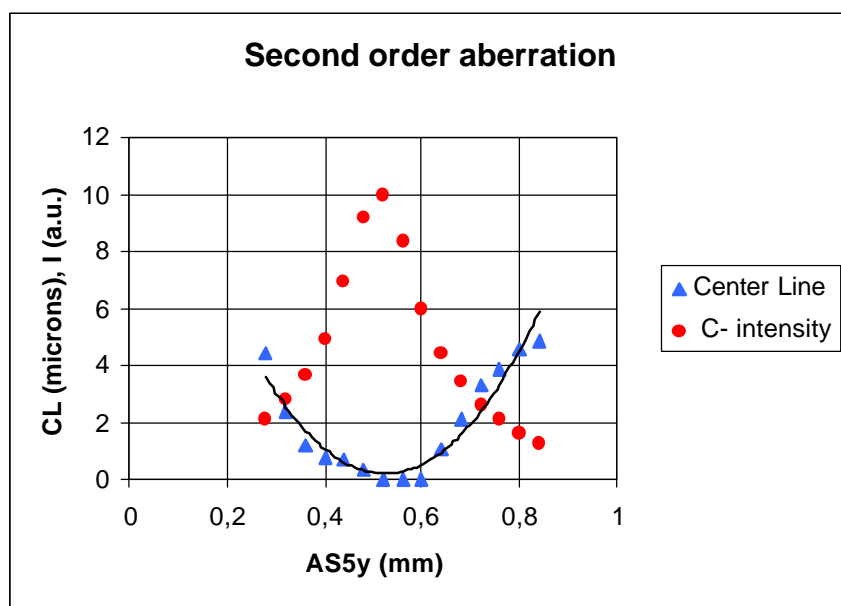


Figure 19: aberrations in the radial plane ( $\alpha^2$ )

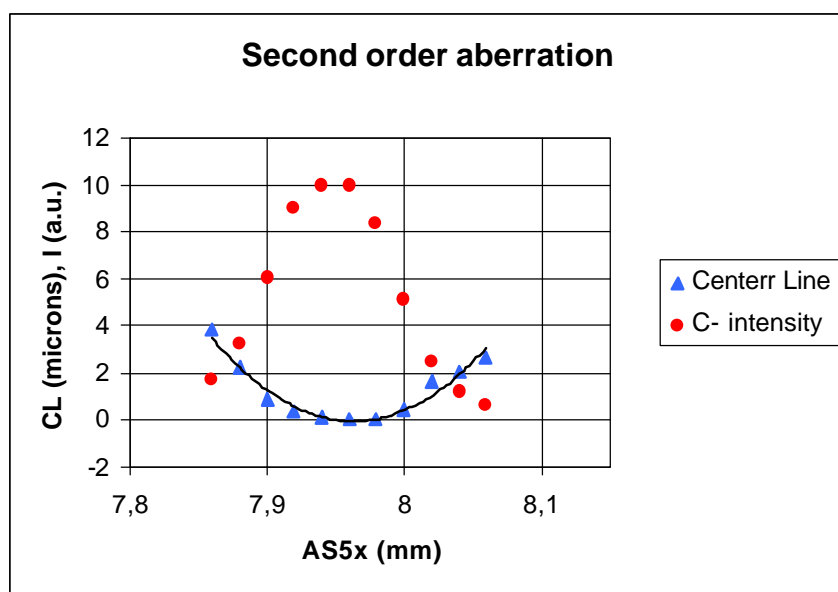


Figure 20: aberrations in the radial plane ( $\beta^2$ )

Remark: These two last measurements are extremely difficult as the secondary ion beam has to perfectly focus in the exit slit. If not, one will see a linear dependence instead of a parabolic one.

#### 4.9 Hexapole tuning

The mass spectrometer is corrected for second order aperture aberrations in the radial plane by the Hexapole H. In the vertical plane, the beam shape has been transformed from a circular one to a slit one, leading to a dramatic reduction of angular aperture and thus of aberration effects.

The hexapole has to be tuned both in position and in value. The followings figures (21, 22 and 23) show typical variations of the mass resolving power while the positions and values of H are changed.

Experimental conditions:

- ES3, without AS.
- EnS (intensity reduction of 20%)

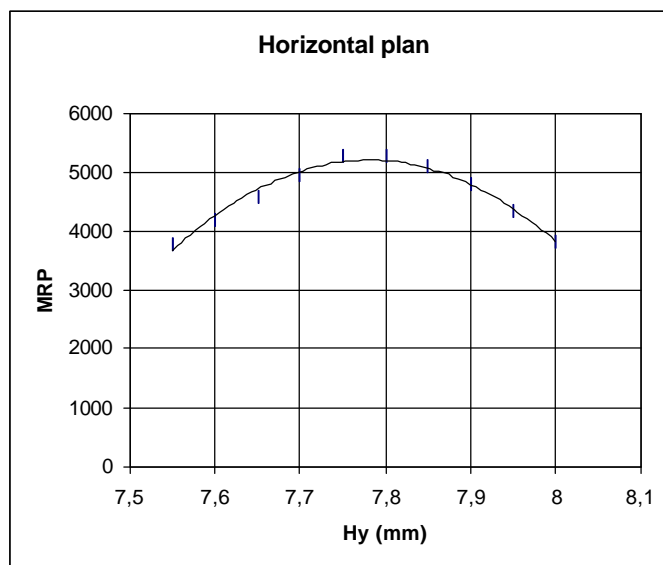


Figure 21: Mass Resolving Power vs H position in the horizontal plan.

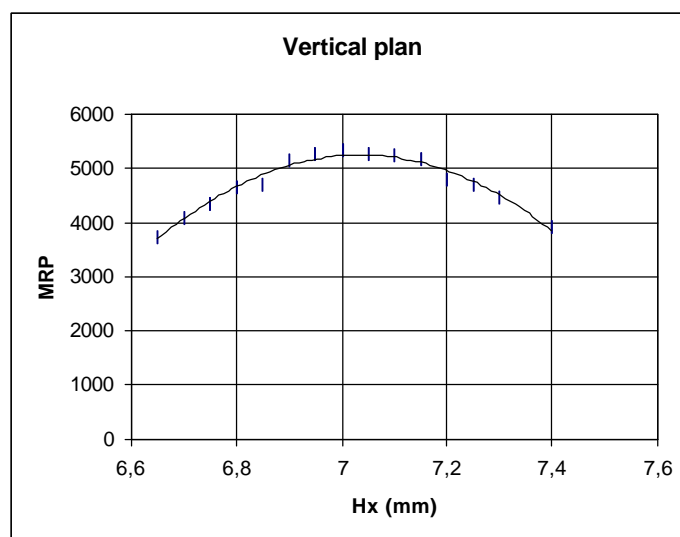


Figure 22: Mass Resolving Power vs H position in the vertical plan.

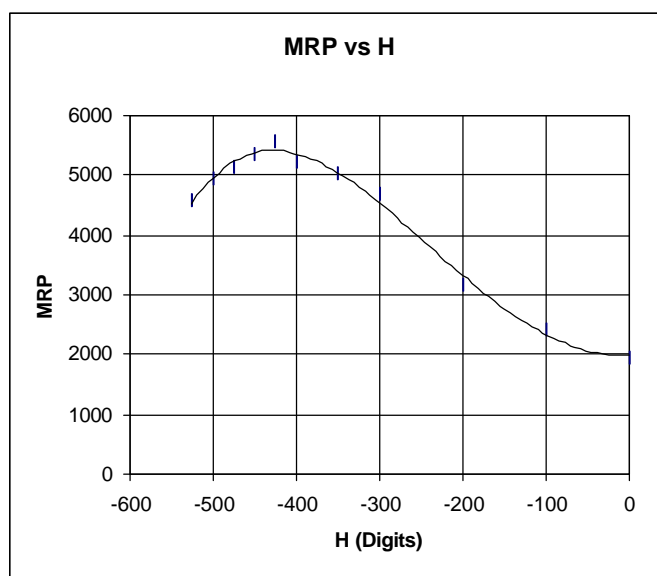


Figure 23: Mass Resolving Power vs Hexapole value.

#### 4.10 Tuning LF5 and C3x

LF5 must be set between 1800 and 1900 bits at 8 keV. This value can be slightly changed knowing that increasing LF5 will lead to a decrease of the mass resolving power, an increase of the transmission and a larger flat top peak on C4x scanning.

C3x is a deflector that must be used to center the secondary ions beam in LF5 as shown on figure 24b. C3x corresponding to figures 24a and 24b are not correct. For each C3x there is an optimum value for C4x.

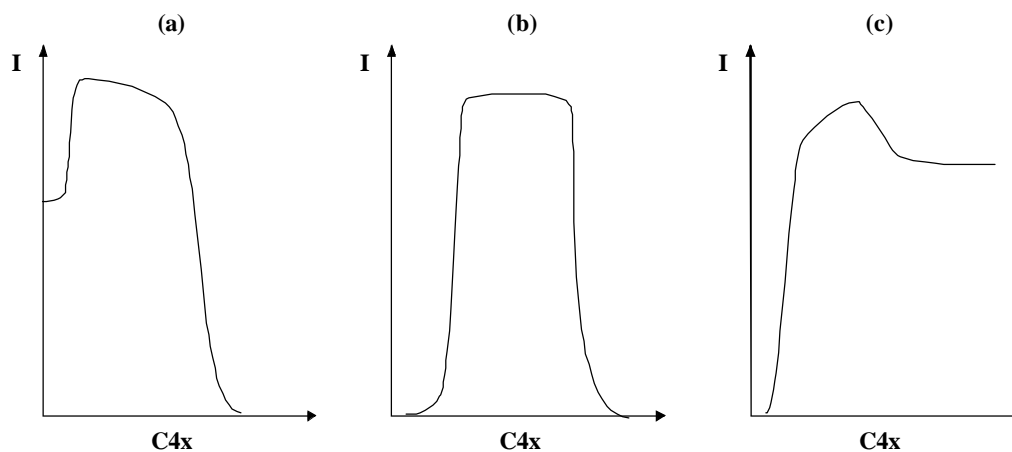
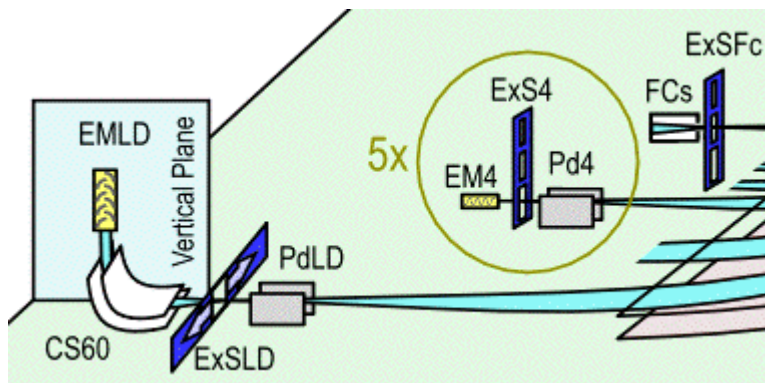


Figure 24: Tuning C3x

[Content](#)


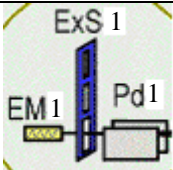
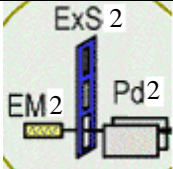
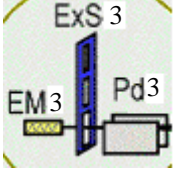
## 5 Multicollection system

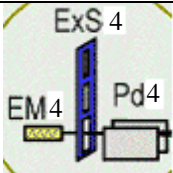
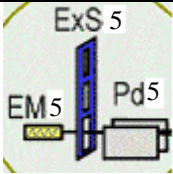
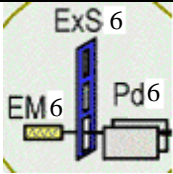
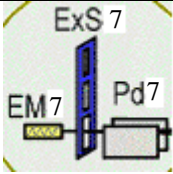
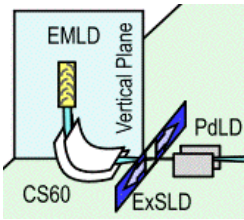
### 5.1 Overview



The multicollection system is essentially made of two parts: a mechanical system which allows the operator to move detectors under vacuum and 7 detectors. These detectors can be either Faraday Cup (FC) or Electron Multiplier (EM).

### 5.2 Description

Device	Label	Description and functionality
 Faraday Cup secondaire	FCs PdFC+ PdFC- SEFC ExSFC	<b>FARADAY CUP EQUIPPED WITH ONE SLIT ASSEMBLY (3 POSITIONS) AND ATTACHED TO TROLLEY 1.</b> (*) Only on the N50 std.
 Trolley 1	EM1, Thd1 Pd1+, Pd1- ExS1	Trolley 1 equipped with one miniature electron multiplier, one slit assembly (3 positions) moveable under vacuum.
 Trolley 2	EM2, Thd2 Pd2+, Pd2- ExS2	Trolley 2 equipped with one miniature electron multiplier, one slit assembly (3 positions) moveable under vacuum.
 Trolley 3	EM3, Thd3 Pd3+, Pd3- ExS3	Trolley 3 equipped with one miniature electron multiplier, one slit assembly (3 positions) moveable under vacuum.

 <p>Trolley 4</p>	<p>EM4, Thd4 Pd4+, Pd4- ExS4</p>	<p>Trolley 4 equipped with one miniature electron multiplier, one slit assembly (3 positions) moveable under vacuum.</p>
 <p>Trolley 5</p>	<p>EM5, Thd5 Pd5+, Pd5- ExS5</p>	<p>Detector 5 equipped with one miniature electron multiplier, one slit assembly (3 positions).</p>
 <p>Trolley 6</p>	<p>EM6, Thd6 Pd6+, Pd6- ExS6</p>	<p>Trolley 6 equipped with one miniature electron multiplier, one slit assembly (3 positions) moveable under vacuum.</p>
 <p>Trolley 7</p>	<p>EM7, Thd7 Pd7+, Pd7- ExS7</p>	<p>Detector 7 equipped with one miniature electron multiplier, one slit assembly (3 positions).</p>
 <p>Large detector</p>	<p>EMLD, ThdLD PdLD+, PdLD- ExSLD CS60ext CS60int</p>	<p>Large detector equipped with one large electron multiplier, one cylindrical electrostatic analyzer, a continuously adjustable slit moveable under vacuum.</p> <p>(*) Only on the N50 std.</p>

In front of each detector there is a pair of parallel plate which allows scanning the mass line in front of the exit slit. The deflection coefficient is roughly 10 microns per Volt. These plates are also used to focus the secondary ion beam in each exit slit by applying the same voltage to both plates. 50 Volts is roughly equivalent to one bit of the quadrupole lens used to conjugate the electrostatic sector SS100 to the magnet. One can choose independently under vacuum the exit slit size for each detector mounted on a trolley. There are three different widths, the height remaining the same (2400 microns).

Each trolley is driven by a step by step motor under computer control with a minimum step of 1.2 microns. The minimum distance between trolleys is 5.8 mm.

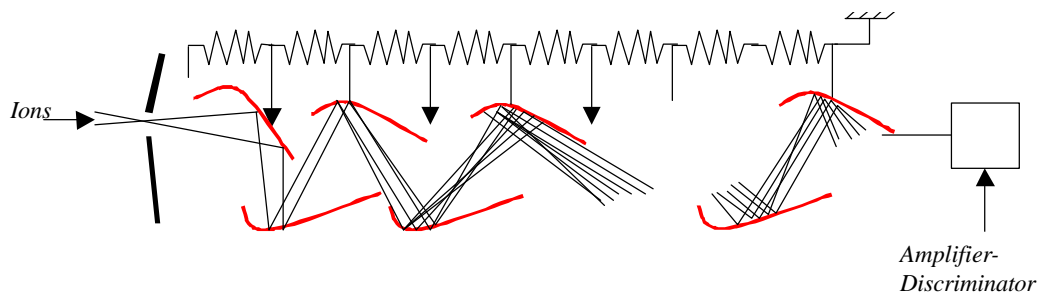
## 5.3 The use of Electron Multipliers (EMs) for Cameca SIMS Instruments

### 5.3.1 OverView

Cameca is currently manufacturing several models of SIMS instruments. Some of them (IMS6f, IMS-Wf and SC-Ultra) can detect secondary ions of a single mass at the same time and are therefore equipped with a single EM which can be as large as 20mm, typically, the AF150H, manufactured by ETP.

Other SIMS instruments (Nanosims50, IMS1270) can detect simultaneously ions of different masses and are therefore equipped with a multicollector comprising several movable EMs which must be as small as possible for making possible the simultaneous detection of high mass isotopes. Both the IMS1270 and the Nanosims50 multicollectors are equipped with R4146 EM, manufactured by Hamamatsu and customized especially for Cameca. The R4146 width is smaller than 7mm.

The Cameca SIMS instruments EMs are always working in a direct pulse counting mode whereas the secondary ions are counted one per one. A secondary ion striking the first dynode (conversion dynode) of the EM induces a secondary electron emission. Then, these electrons are accelerated through the successive dynode stages in order to amplify the secondary electron current. A *gain* (mean number of electron per secondary ions) of about  $10^8$  is obtained. For most of the secondary ions reaching the detector, a charge pulse is produced at the last dynode output. The charge amplitude is converted in voltage, and the pulse amplitude, in Volt is proportional to the EM gain.



It may occur that two or more ions impinge the EM first dynode within a time interval small enough to be detected as a single ion. This effect is known as EM dead time and can be corrected as far as the dead time is known precisely, that is the case since a the EM channel is electronically paralysed during a fixed time whenever a pulse is detected. The dead time effect is not dealt with in this document.

### 5.3.2 EM output and discriminator threshold

#### Definitions

The *ion/electron conversion efficiency* ( $N_p$ ) corresponds to the response of the first dynode. It is derived from the  $P(k)$  distribution law which gives the probability for one ion to produce  $k$  electrons. It is reasonable to assume that

$P(k)$  is a *Poisson* law where  $Np$  is the mean.  $Np$  depends on the incident ion features: mass, velocity and nature (single or molecular) species.

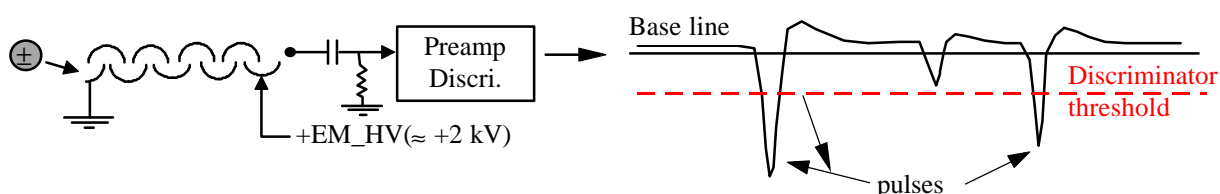
The **EM gain** is the ratio between the electron output current and the ion input current. It involves both the first dynode *ion/electron conversion efficiency* and the other dynodes amplification effect. This last amplification depends on the *EM HV* and also on the EM age.

The **PHA (or PHD) distribution** is the probability  $P(V)$  for an EM output pulse to have a voltage amplitude  $V$ . As the EM gain, it depends also on both the first dynode *ion/electron conversion efficiency* and the other dynode amplification effect.

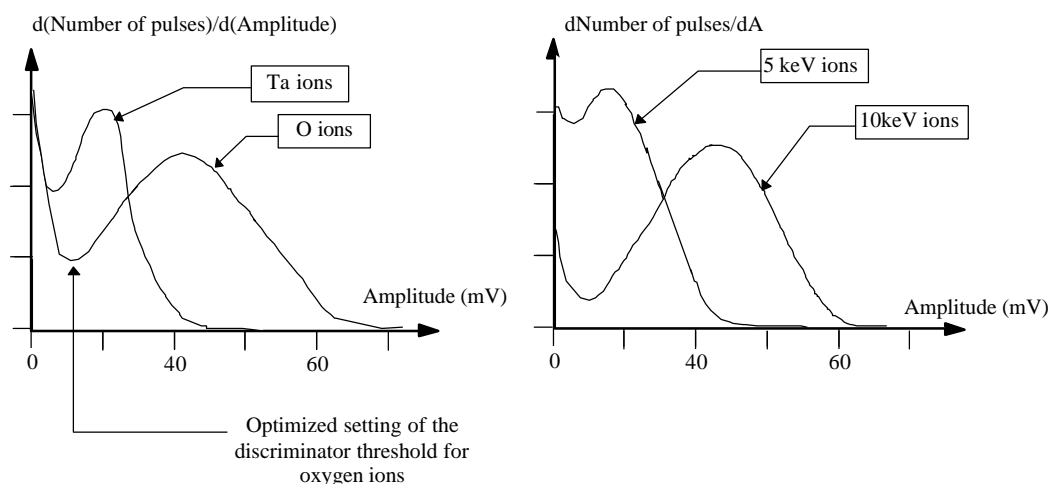
The **EM Yield** is the ratio between the number of output pulses counted after the EM discriminator (see below) and the number of incident ions.

### The EM detection channel

The first electrons produced by the first dynode when impinged by an ion are amplified by the successive stages the electron multiplier with a gain in the range of  $10^8$  (EM gain). As it is displayed on a PHA distribution curve, the pulses detected at the EM output do not have the same amplitude (see the figure below). A preamplifier converts the charge pulses into voltage pulses and amplifies them. Then, a discriminator selects the pulses larger than a given *threshold*.



### Typical PHA distribution curve



The large number of pulses with a small amplitude (first part of the pulse amplitude distribution) are due to the system noise. These pulses are therefore eliminated by using a discriminator with an adjustable threshold. The setting of the threshold is the result of an optimization which minimizes the *EM background* (typically < 5 counts/min) and to EM detection efficiency (number of counted pulses per secondary ion).

### 5.3.3 EM aging

When an EM is getting older the EM gain (*output electrons per ion*) decreases (figure 25), leading to a  $Y_{EM}$  decrease if the EM HV is kept constant. For recovering the original gain and yield, The EM HV must be increased.

Note that the life time of an electron multiplier depends on the gain and the total number of ions counted (total integrated charge). Frequent high intensity measurements shorten the EM life time.

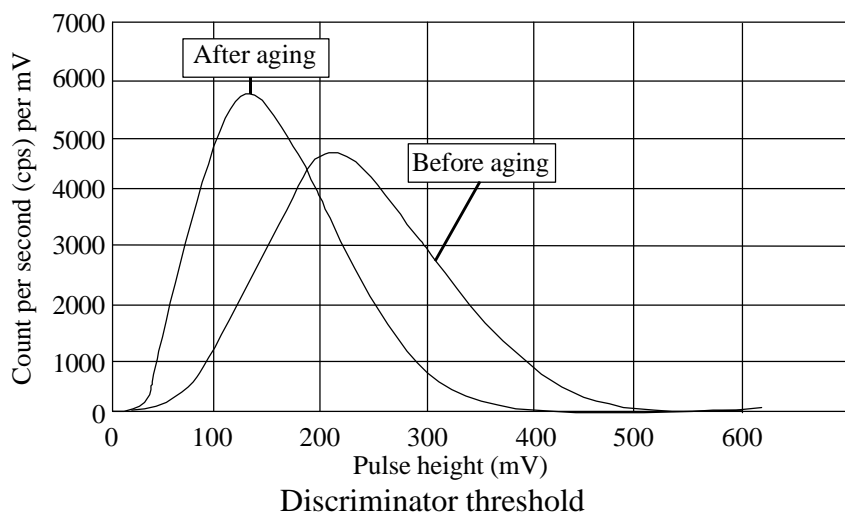


Figure 25

This evolution can be characterized by two parameters: the maximum of the PHD and the ratio D/G as described on Figure xx.

Figure 26 and 27 show the evolution of these two PHD parameters versus time for  $^{32}S^-$  ions. Secondary ion beam intensity was  $1.410^6$  cps over 3 hours.

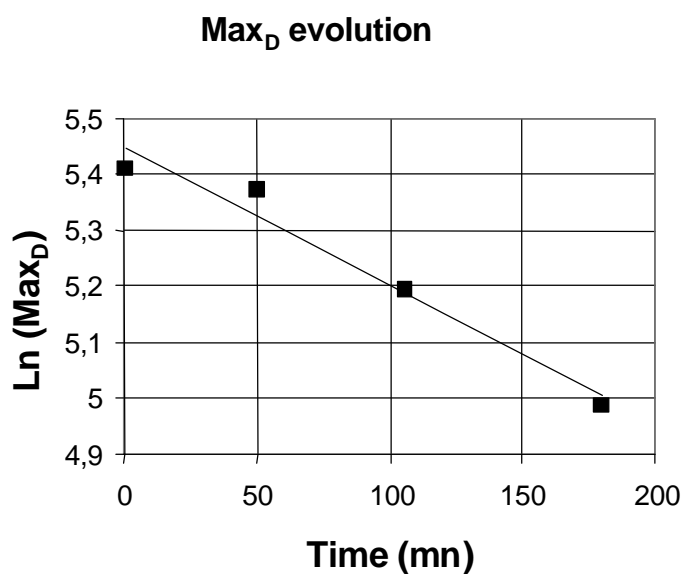


Figure 26

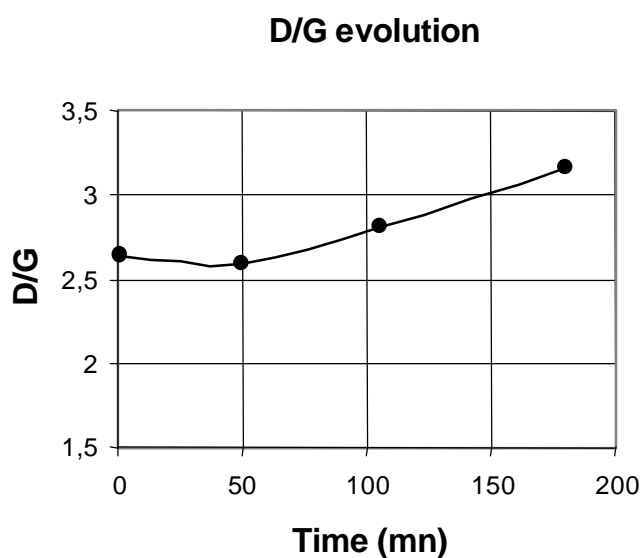


Figure 27

As shown on Figure 26, the evolution of Max<sub>D</sub> with time can be expressed as:

$$Max_D \propto \exp \left( -t/t_D \right)$$

With  $t$  being the exposure time and  $\tau_D$  the fitting parameter.

Figure 28 shows a comparison between two types of miniature electron multiplier. These two types of EM differ by the size of the dynode; the large one has dynode surface larger by a factor 3. These measurements obviously show that:

- $1/\tau_D$  is proportional to the ion beam intensity.
- The Aging effect has been reduced by a factor ranging from 5 to 22 thanks to the large EM version

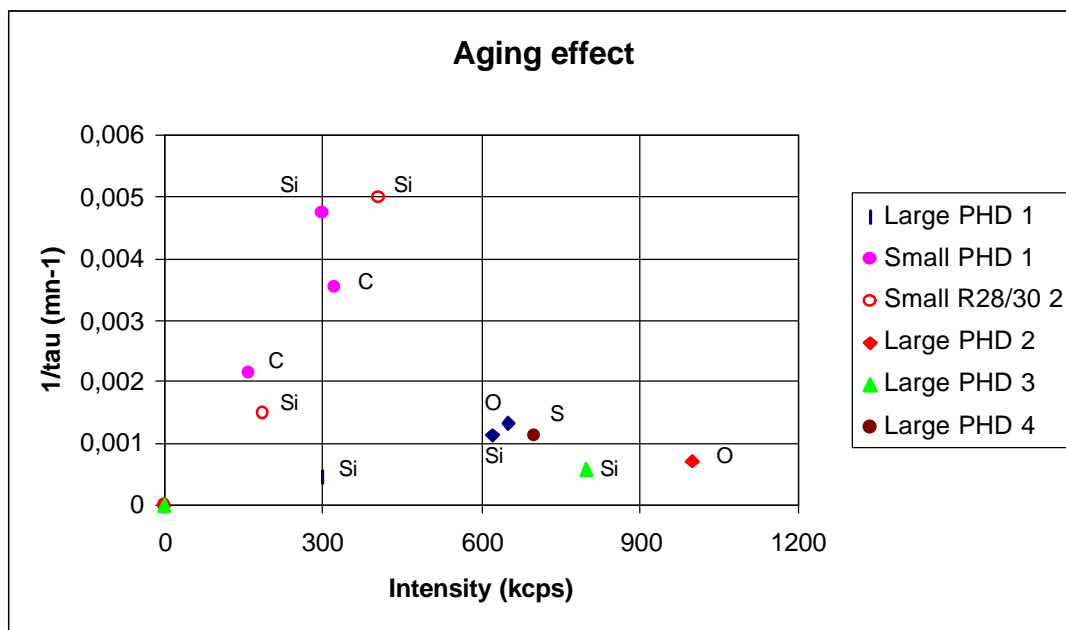


Figure 28:  $1/t$  Comparison between two EMs version

This aging effect will lead to a dramatic decrease of the detection efficiency with time and especially for high count rate. One way to estimate this effect is to measure an isotopic ratio with one abundant isotope and a very weak one. The two isotopes have to be recorded simultaneously with two different EMs. The EM detecting the abundant isotope exhibits a change of its detection efficiency due to aging effect while the others remain unchanged.

The relative variation of isotopic ratio  $R$  can be expressed as:

$$DR/R \propto \exp(-t/t_R)$$

An empirical relationship between  $\tau_D$  and  $\tau_R$  has been established as following:

$$\tau_R = 1/20 \tau_D$$

Table 1 summarizes the change in Silicon isotopic ratios before and after an EM has been aged. These experimental values are in good agreement with the above empirical formulae.

	Before aging	After aging
High voltage	1640 V	1670 V
MaxPHD	220 mV	175 mV

$^{29}\text{Si}/^{28}\text{Si}$	$5,070 \cdot 10^{-2}$	$5,025 \cdot 10^{-2}$
$^{30}\text{Si}/^{28}\text{Si}$	$3,376 \cdot 10^{-2}$	$3,339 \cdot 10^{-2}$
Change Of Max PHD		-20,5 %
Change of $^{29}\text{Si}/^{28}\text{Si}$		-0,88 %
Change of $^{30}\text{Si}/^{28}\text{Si}$		-1,09 %

#### 5.3.4 The ion to electron conversion issue

The ion to electron device is the EM first dynode. Aging does not occur at the first dynode, but at the last dynode, probably caused by contamination problems. However, it can be demonstrated that an improvement of the first dynode electron/ion rate should make the EM insensitive to the last dynode aging.

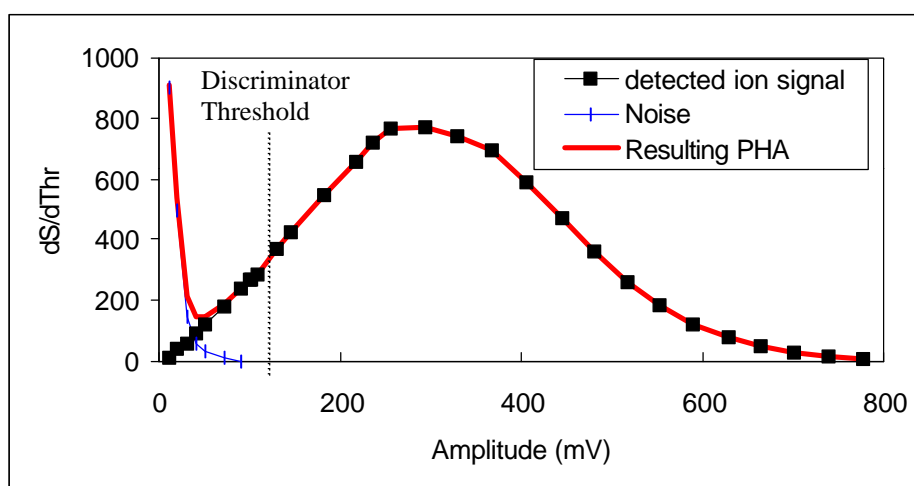


Figure 29: PHA

On figure 29 the red curve is the PHA distribution as it can be displayed with our instruments. It results from the sum of the amplified ion signal and a noise consisting of short pulses. Slodzian<sup>1</sup> has shown that from such a curve shape, just by assuming that the electron emission at each dynode was following a Poisson law, it can be deduced, for CuBe dynode EM, an ion/electron conversion efficiency of 9 and an electron/electron yield of some 2.5.

The issue is that for eliminating noise pulses, it is required to set the discriminator threshold at a level such as it cuts also several per cent of the useful signal, leading to a yield of some 93%, which is not constant if the EM gain varies because of aging. It should be highly desirable to have the hereunder PHA distribution curve (figure 30).

<sup>1</sup> *Precise in situ measurements of isotopic abundances with pulse counting of sputtered ions*, G.Slodzian et al., EPJ, Appl. phys. , 2001 , vol. 14 , no 3 , pp. 199 - 231

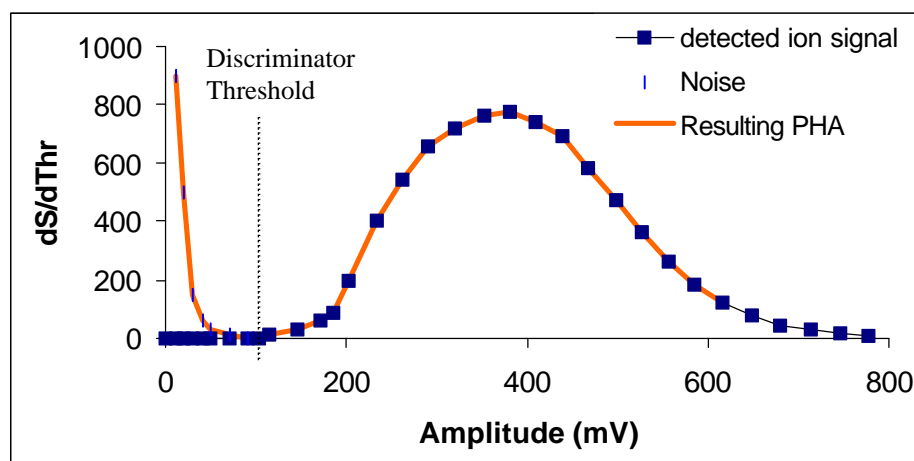
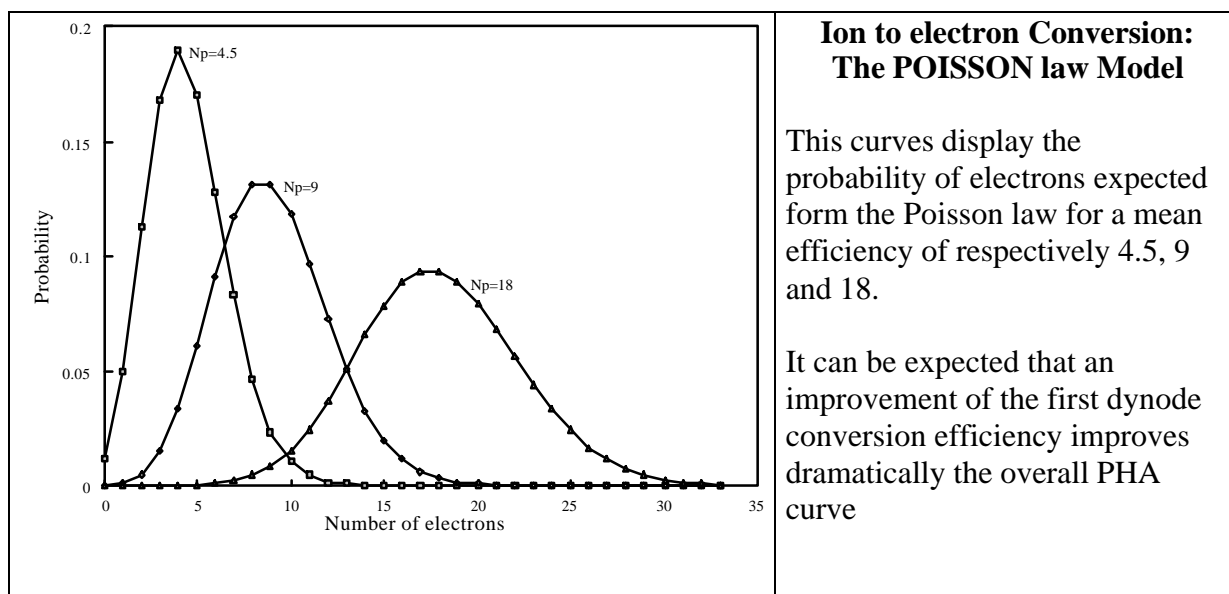


Figure 30 : High quality PHA

Such a PHA curve should be obtained providing the ion to electron conversion efficiency could be improved.



The PHA distribution curve is dominated by the first dynode conversion efficiency but depends also on the following dynodes (mainly the next 2 dynodes with a mean yield of 2.5 each). As the electronic discriminator cannot accept pulses larger than 1.5 Volts, let's assume that the pulse mean amplitude will be always tuned at some 300 mV and that the threshold level for eliminating all the noisy pulses is 100 mV. From the simulation of the first 3 dynodes, it is possible to draw the probability that an incident ion leads to a pulse smaller than 0.33 of the mean amplitude

1 <sup>st</sup> dynode ion to electron conversion efficiency (Np)	Mean number of electrons emitted by the 3 <sup>rd</sup> dynode (Np x 6.25)	Probability (number of electrons < 0.33 Mean)
4.5	28.125	12%
9	56.25	3.8%

### 5.3.5 QSA Effects on Isotopic ratio measurements

Secondary ions are often considered to be only a small fraction of the bunch of sputtered particles resulting from the impact of a single primary ion. However, the average number  $K$  of secondary ions ejected per primary ions may reach values as high as 20% for some elements. In such conditions, the probability to get more than one secondary ion per primary impact is not negligible and those ions may arrive at nearly the same time on the conversion dynode of the electron multiplier. QSA are registered as single pulses so that the registered number of counts is slightly lower than the actual number of incoming ions.

Assuming a Poisson statistics, the correction factor is given in a first order approximation by:

$$N_{cor} = N_{exp} (1 + K/2) \quad (1)$$

Where  $N_{cor}$  is the real number of ions reaching the first dynode and  $N_{exp}$  the number of pulses counted with a given threshold and  $K$  is the ratio secondary over primary.

In order to show the effect of QSA on isotopic ratio measurements, the ratio  $^{34}\text{S}/^{32}\text{S}$  (figure 31) has been measured for different  $K$ . As  $K$  for  $^{34}\text{S}$  is roughly 22 times lower than for  $^{32}\text{S}$ , the effect of QSA can be neglected. Thus the experimental Sulfur isotopic ratio  $R_{exp}$  must vary with  $K$  according to:

$$K_{cor} = K_{exp} / (1 - K_{exp}/2)$$

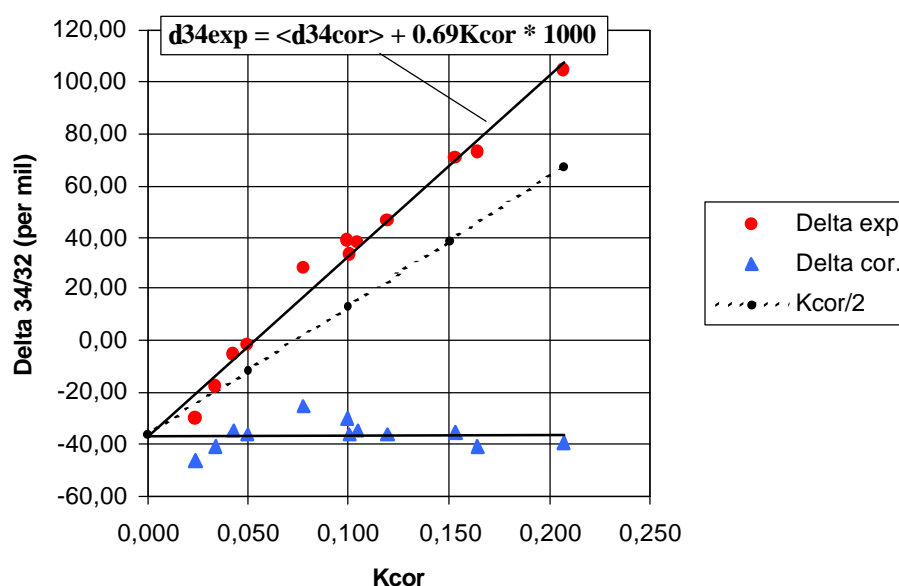


Figure 31: QSA on Pyrite (Primary ion Cs<sup>+</sup>, 1 pA)

If  $\langle \delta^{34}\text{cor} \rangle$  represents the corrected relative deviation of  $^{34}\text{S}/^{32}\text{S}$  ratio, the linear relation (Figure 31) writes down:

$$\delta^{34}\text{exp} = \langle \delta^{34}\text{cor} \rangle + 0.69 K_{\text{cor}} * 1000$$

This experimental coefficient, 0.69 instead of being 0.5, is obviously different from the value given by relation (2) obtained from Poisson statistics. It might be due to the inadequacy of Poisson statistics to describe the phenomenon or to other effects such as fractionations due to differences in ion selection generated by the change of K. Further investigation needs to be done with measurements coupling Faraday cup and EM and on different elements.

[Content](#)

The CAMECA logo is displayed in white capital letters on a grey rectangular background. Two small red triangles are positioned above the 'A' and 'C' characters. Below the logo, there is a red horizontal line and another grey rectangular area.

# **The CAMECA NANOSIMS 50 L**

## **Normal Electron Gun (NEG) user's guide**

## Contents

<b>1.</b>	<b>INTRODUCTION</b>	<b>3</b>
<b>2.</b>	<b>NORMAL INCIDENCE ELECTRON GUN</b>	<b>3</b>
2.1	ELECTRICAL CHARGING EFFECTS	3
2.2	NEG DESCRIPTION	6
2.3	ELECTRON BEAM COLUMN ALIGNMENT	7

## 1. Introduction

This *NEG user's guide* is a complement to the N50L ion optics user's guide

## 2. NORMAL INCIDENCE ELECTRON GUN

This section is divided into 3 parts. The first recalls the physical processes, which cause electrical charging effects during SIMS analysis. The second is a physical description of the normal incidence electron gun (NEG). The third includes procedures to perform the alignment of the electron beam column and describes the experimental procedures to perform analysis on insulating samples.

### 2.1 ELECTRICAL CHARGING EFFECTS

During SIMS analyses, positive, negative or neutral primary particles impinge the sample surface and either positive secondary ions or negative secondary ions, and secondary electrons, leave the sample surface.

As the yields secondary ions/primary ions and secondary electrons/primary ions are not equal to 1, it is clear that an excess of charge will occur over the sputtering area. If the sample has an intrinsic conductivity, the excess electrical charges can flow towards the conductive sample holder and the potential of the surface will be kept constant. On the other hand, if the sample is an insulator, the electrical charges accumulate on the sample surface and the potential surface is modified positively or negatively, depending on the sign of charges appearing over the sputtering area.

[Contents ↑](#)

## NEGATIVE MODE

In order to collect positive secondary ions, the sample is brought at a positive potential (e.g. +8 kV). In that case, only positive secondary ions can escape from the sample surface and leave behind negative charges (secondary electrons and negative ions being trapped on the sample surface by the strong extraction field). The number of charges  $Q_+$  appearing on the sputtered area per incoming primary particle is therefore given by the relationship:

$$Q_+ = q_p + q_s Y^+ \quad (1)$$

where:

$q_p$  is equal to 0 or neutral, +1 for positive and -1 for negative primary particle (only single charged primary ions are considered).

$q_s$  Is the sign of the charges left behind by the secondary ions.

$Y^+$  Is the yield for positive secondary ions/primary particles. This yield is always less than 1.

Equation 1 shows that for the use of positive primary ions, a positive charge is building up on an insulating material and for negative primary ions or neutral (FAB), it is a negative charge. In fact, to give a complete description of the phenomena occurring in negative mode, secondary electrons coming back from the front plate of the immersion lens should be also considered, but, in first approximation, they can be neglected.

## POSITIVE MODE

In order to collect negative secondary ions, the sample is brought at a negative potential (e.g. - 8 kV). In that case, negative secondary ions and secondary electrons can escape from the sample and leave behind positive charges where the positive secondary ions are trapped on the sample surface by the extraction field. In positive mode, equation 1 therefore becomes:

$$Q_- = q_p + q_s (Y^- + Y^e) \quad (2)$$

where:

$Y^-$  Is the yield for negative secondary ions/primary particles, which is always less than 1.

$Y^e$  Is the yield for secondary electrons/primary particles, which is always more than 1.

Equation 2 shows that in positive mode whatever the primary particles are, a positive charge is building up over the sputtered area. The following table summarizes the different cases which can occur for an insulator analysis:

[Contents ↑](#)

	Secondary Ions	Primary Ions	Charging Up
<b>1</b>	+	Neutral	< 0
<b>2</b>	+	—	< 0
<b>3</b>	+	+	< 0
<b>4</b>	—	Neutral	> 0
<b>5</b>	—	—	> 0
<b>6</b>	—	+	> 0

The above shows that depending on the experimental conditions (polarity of secondary ions), the sign of electrical charging can be either positive or negative. If no charge compensation is carried out, the potential of the sputtered area will exceed the nominal value of 8kV and, therefore, no secondary ions will be collected since the mass spectrometer is adjusted to analyze ions accelerated under 8 kV.

In order to keep the surface potential of the analyzed area constant when a positive charge occurs, a flood of electrons may be used for charge compensation. But, for negative charging effects, no charge compensation is possible by using an electron gun.

However, it must be noted that the use of neutral or negative primary particles for positive secondary ion analysis enables one to perform SIMS analysis of insulators, even if negative charge builds up. As a matter of fact, low density of neutral or negative primary beam allows one to reach a steady state with negative charging corresponding to a few tens of volts, which may be compensated by applying an offset on the sample holder.

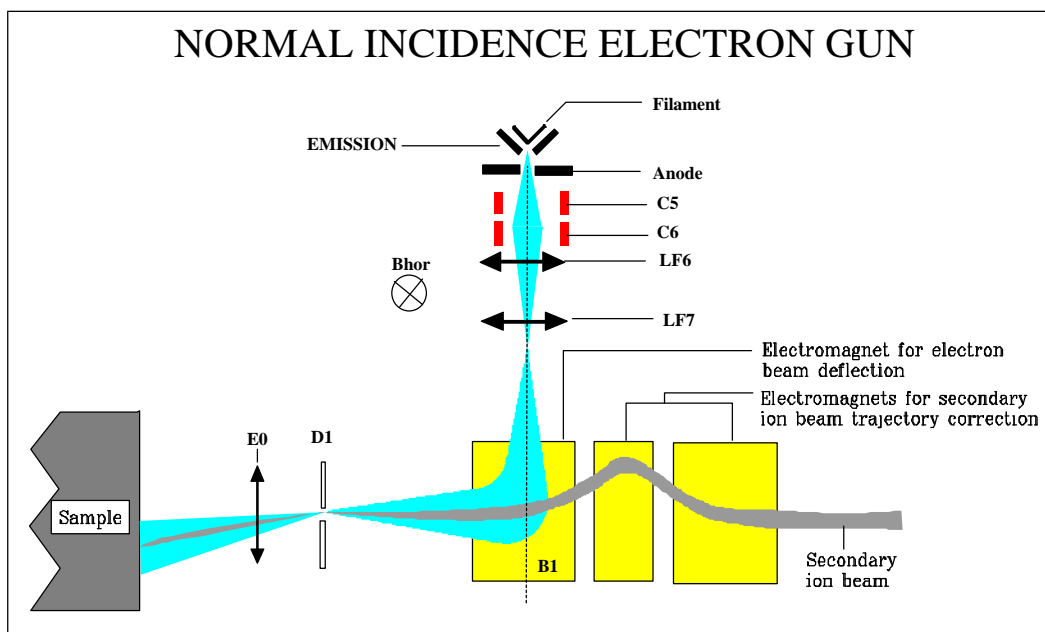
## IDENTIFICATION OF CHARGING EFFECTS

When an analysis is performed on an insulating material, it is important to know if the charge compensation works well. Of course, a high voltage sample breakdown is an obvious indication of incorrect charge compensation. However, sometimes there is no HV breakdown but charging effects are present.

One way to verify if there is charging effects is to check the energy slit position and to compare it with the standard position on a conductive sample.

Another criterion to identify charging effects is the shape of the secondary ion energy distribution. On a conductive sample when a narrow energy slit (a few eV), centered on the peak intensity of the energy distribution, is mechanically pulled towards the low energy ion side, the secondary ion intensity decreases to zero for a small shift (corresponding to 5-10eV). On an insulating material, when there are charging effects, the energy distribution is deformed, and even by pulling the energy slit over the complete range, no sharp decrease of the secondary ion intensity can be reached.

## 2.2 NEG DESCRIPTION

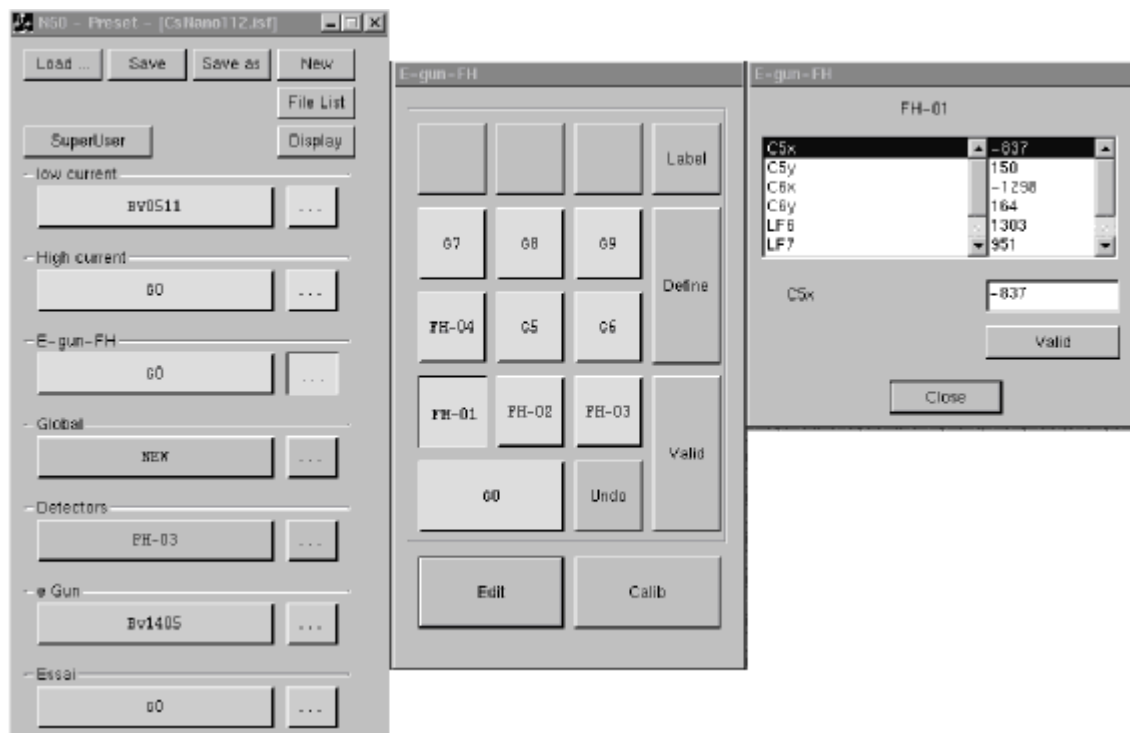


The figure below shows a schematic drawing of the normal incidence electron gun. The electron source is a tungsten filament which can be brought to a potential adjustable between 0 and -10kV and a Wehnelt. The optical column of the electron gun is composed of two slit lenses, two sets of deflector (in X and Y) and a magnetic sector (B1). This optical system is adjusted to form an image of the e-gun cross-over in the plane of D1.

Two other magnetic sectors are required to compensate the deviation of secondary ion beam undergone in the B1 sector. The shape and the size of these two sectors have been determined in order to compensate the deviation in B1 to the first order. A fine tuning of this compensation is available by using Bhör (vertical coils).

In positive mode, making use of the reversibility principle, it is clear that incoming  $e^-$  will follow the same trajectories than the secondary ions. And, if electrons go through the crossover plane on the secondary optical axis, they will arrive on the sample surface with a normal incidence and energy close to zero since the potentials of the filament and the sample are the same.

## 2.3 ELECTRON BEAM COLUMN ALIGNMENT



The alignment of the normal incidence electron gun is performed in order to get the highest electron beam current possible in FCo (located at the back of the sample stage) with the primary beam turned off.

The sample holder is brought at a negative voltage. In this case the sample surface acts as a mirror for primary electrons.

A complete procedure, described below, must be followed after maintenance of the e-gun (filament change) or when it seems that the performance for insulator analysis is not as good as it was before.

### Complete Procedure for the positive mode

- ☐ Start the instrument to analyze negative secondary ions.
- ☐ Select FCo in the Holder window and set D1-1.
- ☐ Start the electron gun source (refer to the [Source Software user's guide](#)).
- ☐ Set at zero LF6, LF7, C5, C6. Use the previous values for Egun-Be, Bhor, Bvert.

- ☐ Tune Egun-Be and C5 (X and Y) to maximize the E-gun current.
- ☐ Start to increase LF6 and maximize the E-gun current with Egun-Be, C5 and C6 (mainly in X, as LF6 acts only in X).
- ☐ Start to increase LF7 and maximize the E-gun current with Egun-Be, C5 and C6 (mainly in Y, as LF7 acts only in X).
- ☐ Repeat alternatively the two previous steps.
- ☐ After several optimizations, a maximum electron current of at least **500 nA** should have been obtained.

At this step of the NEG alignment, the electron beam should reach the sample surface with intensity high enough for charge compensation.

- ☐ Select the SIMS Mode and move the stage to the Al<sub>2</sub>O<sub>3</sub> test sample.
- ☐ Remove the gold layer on 80x80 microns and check 18O intensity in the multicollection. After going through a maximum 18O intensity will decrease by a few orders of magnitude due to charge effects. Reduce the scanning area to 50 microns to increase the charge effects (Remains of the gold layer can decrease the charge effects on the crater edges).
- ☐ Set the E-Gun Hv to -8005 Volts to be sure that electrons will reach the sample. Increase slowly E-Gun heat, you must see 18O intensity increasing and then decreasing. Select the heat value corresponding to the maximum.
- ☐ Then decrease slowly E-Gun HV and look at 18O intensity, it must go through a maximum. Select the HV value corresponding to the maximum.
- ☐ Repeat alternatively the two previous steps.

The NEG is now ready to perform insulator analysis in the positive mode. Save an *ISF* (refer to the [Preset Software user'guide](#)) so that at a later time this NEG status can be restored. Typical parameter values (in bits ) for **-8 kV** accelerating voltage are reprinted in the here under table:

e-gun heater	2500 bits
e-gun emission	0.14
e-gun HV	-8005 Volts
e-gun Be	3204 bits
LF6(x)	1300 bits
LF7(y)	1075 bits
Bvert	420 bits
Bhor	300 bits

### **Routine Procedure:**

The reproducibility of adjustments for the alignment of the NEG is very good and therefore, a fast start is possible.

- ☐ Start the instrument.
- ☐ Load an *ISF* corresponding to the last *NEG* tuning.
- ☐ Move the stage to the Al<sub>2</sub>O<sub>3</sub> test sample.
- ☐ Remove the gold layer on 80x80 microns and check 18O intensity in the multicollecion. After going through a maximum of 18O intensity will decrease by a few orders of magnitude due to charge effects. Reduce the scanning area to 50 microns to increase the charge effects (Remains of the gold layer can decrease the charge effects on the crater edges).
- ☐ Set the E-Gun Hv to -8005 Volts to be sure that electrons will reach the sample. Increase slowly E-Gun heat, you must see 18O intensity increasing and then decreasing. Select the heat value corresponding to the maximum.
- ☐ Then decrease slowly E-Gun HV and look at 18O intensity, it must go through a maximum. Select the HV value corresponding to the maximum.
- ☐ Repeat alternatively the two previous steps.
- ☐ NEG is now ready for charge compensation.

[Contents](#) ↑





# **The CAMECA NANOSIMS 50 L**

## **Tuning Software user's guide**



# Contents

<b>1.</b>	<b>INTRODUCTION .....</b>	<b>3</b>
1.1	ENTER/EXIT PROGRAM .....	3
1.2	THE MAIN WINDOW .....	4
<b>2.</b>	<b>THE TUNING MAIN WINDOW .....</b>	<b>5</b>
2.1	FC DETECTOR PANEL.....	5
2.2	EM DETECTOR PANEL.....	5
2.3	CONTROL PANEL .....	6
2.4	SLIT PANEL .....	6
2.5	SYNOPTIC PANEL .....	6
2.6	ACQUISITION SELECTION PANEL.....	6
2.7	SCANNING MODE DEFINITION.....	7
<b>3.</b>	<b>THE SUMUP WINDOW .....</b>	<b>7</b>
<b>4.</b>	<b>TUNTODEFA FILE DISPLAY .....</b>	<b>8</b>
<b>5.</b>	<b>MASS TABLE WINDOW .....</b>	<b>8</b>
<b>6.</b>	<b>RESET/SETUP WINDOW.....</b>	<b>9</b>
<b>7.</b>	<b>TROLLEY STEP SCAN ACQUISITION WINDOW .....</b>	<b>10</b>
<b>8.</b>	<b>HMR ACQUISITION WINDOW .....</b>	<b>11</b>
8.1	AUTOMATIC PEAK CENTERING .....	12
<b>9.</b>	<b>PHD ACQUISITION WINDOW .....</b>	<b>13</b>
<b>10.</b>	<b>REAL TIME IMAGING ACQUISITION WINDOW .....</b>	<b>14</b>
<b>11.</b>	<b>ENERGY ACQUISITION WINDOW.....</b>	<b>15</b>
11.1	AUTOMATIC ENERGY CENTERING .....	16
<b>12.</b>	<b>SECONDARY ION BEAM ACQUISITION WINDOW.....</b>	<b>17</b>
12.1	AUTOMATIC ENERGY CENTERING .....	18
<b>13.</b>	<b>BEAM STABILITY ACQUISITION WINDOW.....</b>	<b>19</b>
13.1	RESULTS WINDOW.....	20
<b>14.</b>	<b>WIEN FILTER ACQUISITION WINDOW.....</b>	<b>21</b>
<b>15.</b>	<b>BAR GRAPH ACQUISITION WINDOW .....</b>	<b>22</b>
<b>16.</b>	<b>E0S ACQUISITION WINDOW .....</b>	<b>23</b>
16.1	AUTOMATIC E0S CENTERING.....	24
<b>17.</b>	<b>TOOLS ACQUISITION WINDOW .....</b>	<b>25</b>

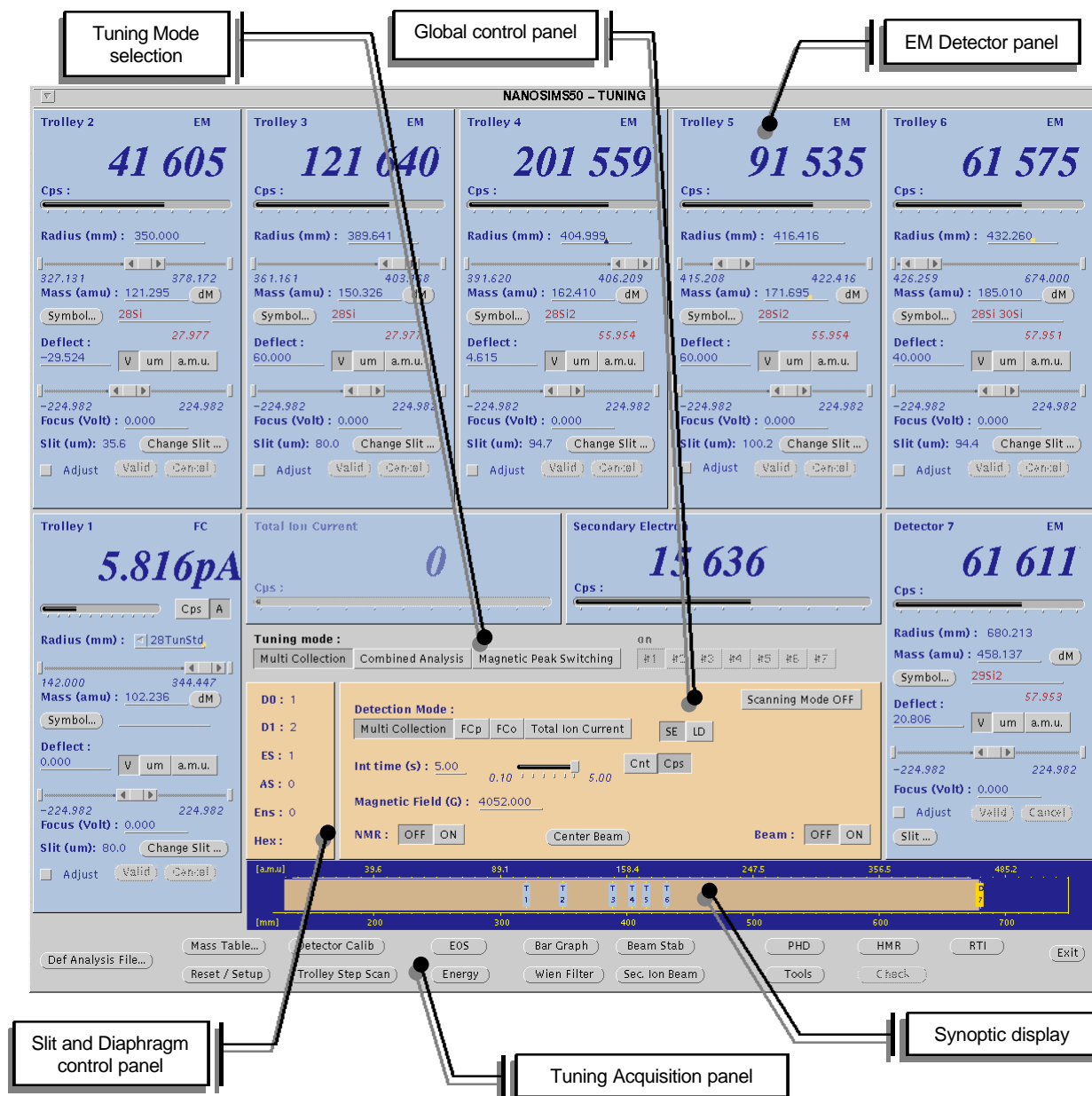
# 1. INTRODUCTION

This program is used to tune the instrument.

## 1.1 Enter/Exit Program

- In order to start tuning, windows must be opened by clicking the *Tuning* icon  in the main icon board. The icon must be red .
- In order to iconize the program click either the *Tuning* icon in the main icon board or the  $\nabla$  symbol in the header of the main dialog box.
- In order to quit the program, click the right mouse button in the *Tuning* window header and select *quit* in the pull down menu or the *Exit* button in the main dialog box. All dialog boxes are erased and the *Tuning* icon in the main icon board returns to the blue colour.

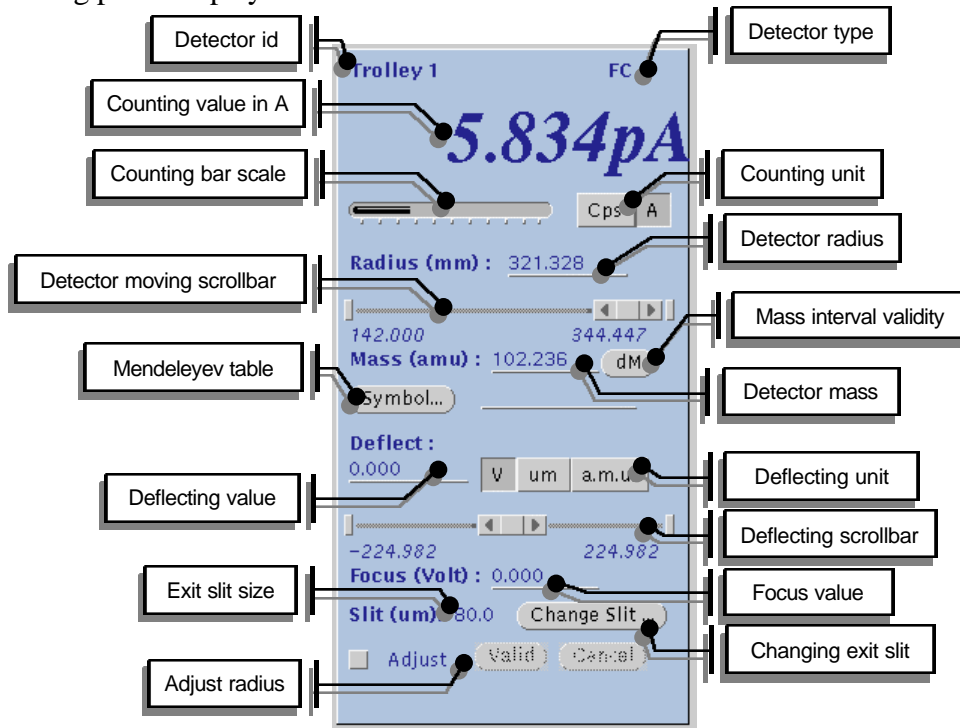
## 1.2 The main window



## 2. THE TUNING MAIN WINDOW

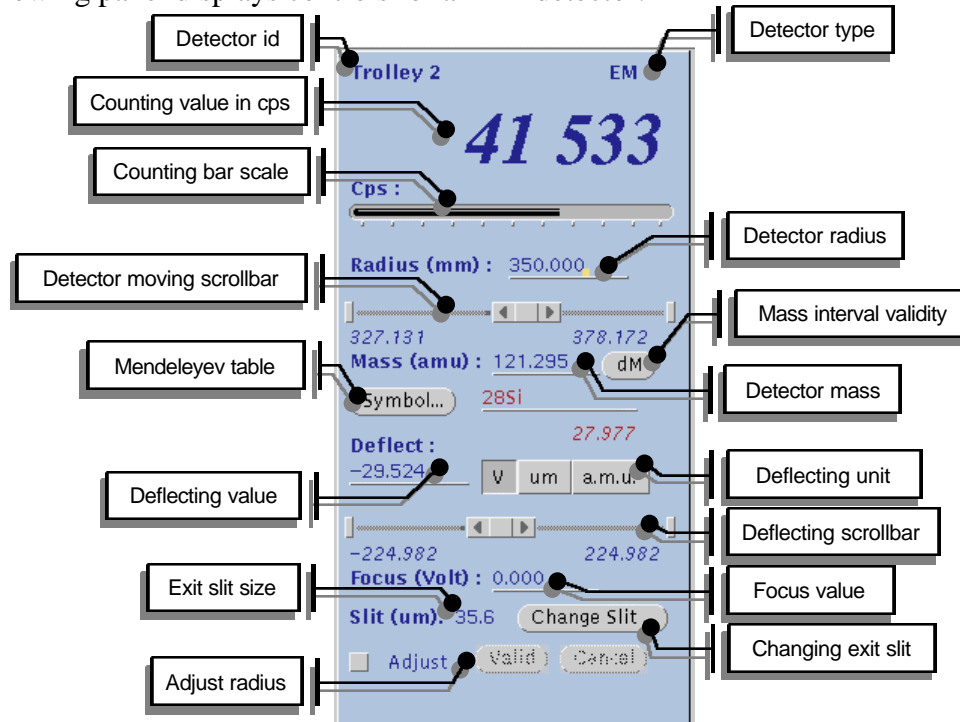
### 2.1 FC Detector panel

The following panel displays controls for a FC detector.



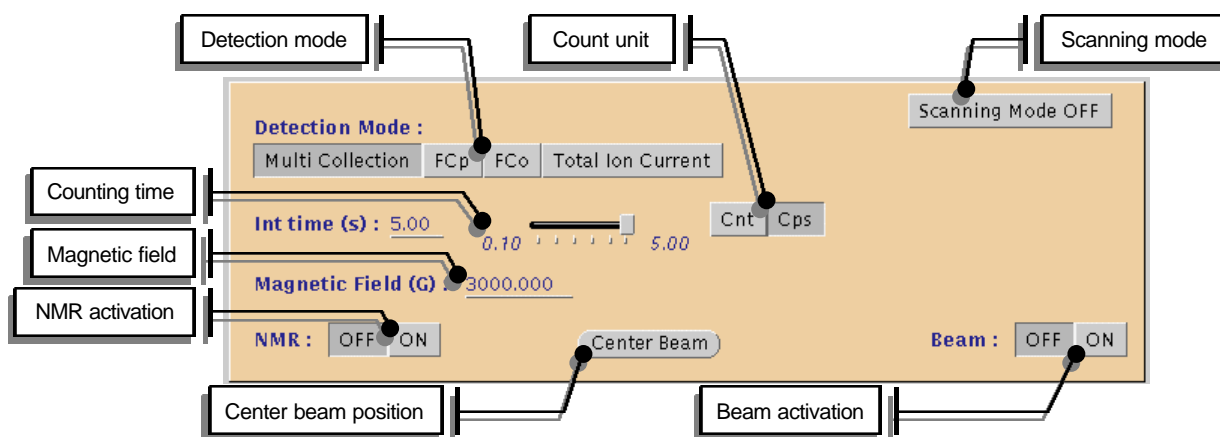
### 2.2 EM Detector panel

The following panel displays controls for an EM detector.



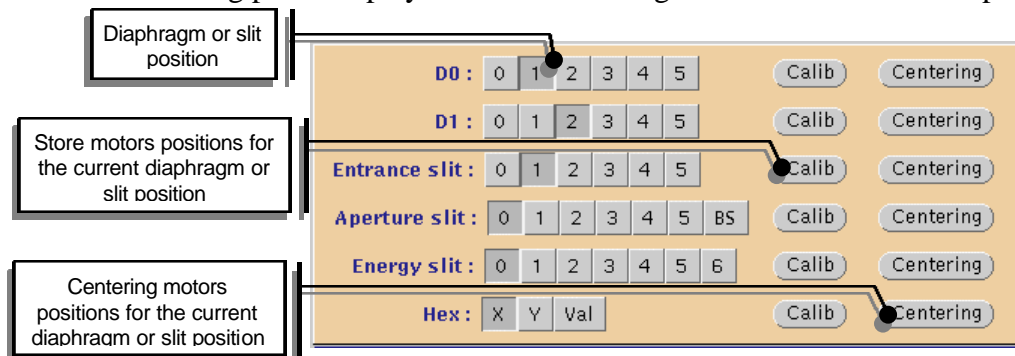
## 2.3 Control panel

The following panel displays global controls for the tuning.



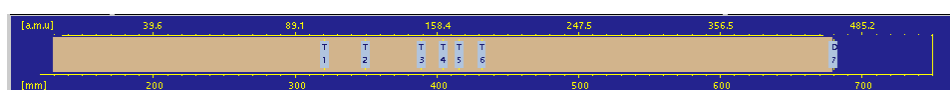
## 2.4 Slit panel

The following panel displays controls to manage motorized slits and diaphragms.



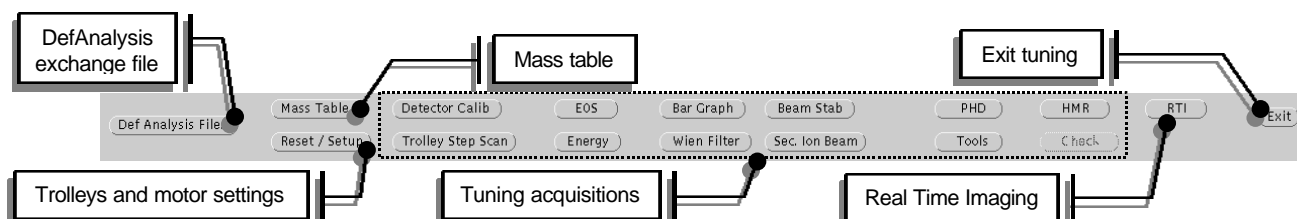
## 2.5 Synoptic panel

The following panel displays the detectors synoptic positions (mm and a.m.u.) according to the magnetic field value.



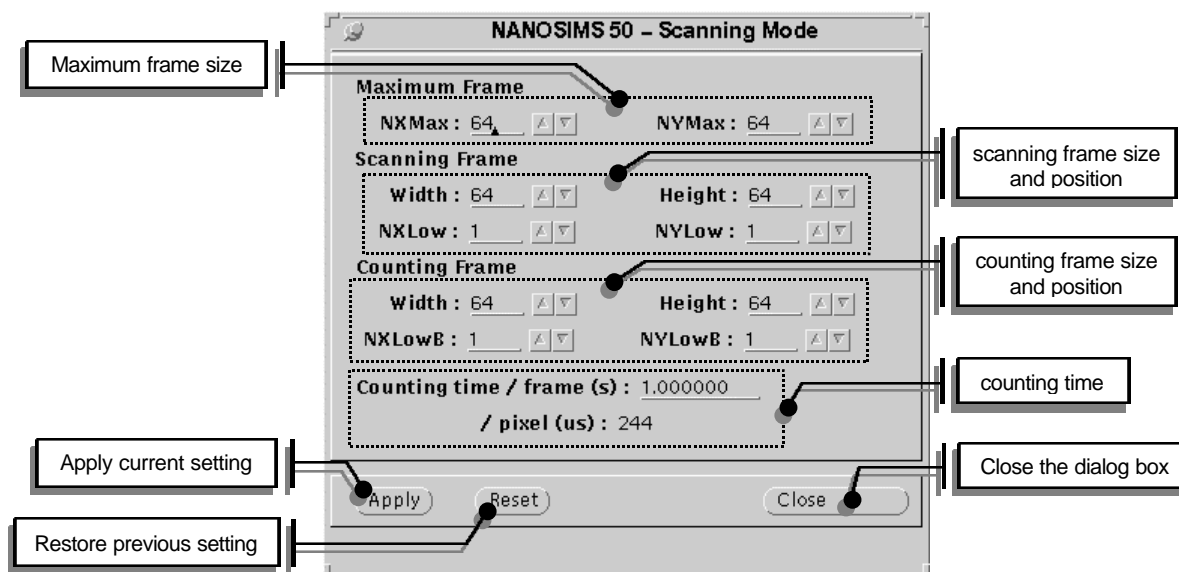
## 2.6 Acquisition selection panel

The following panel displays the available tuning acquisitions and settings.



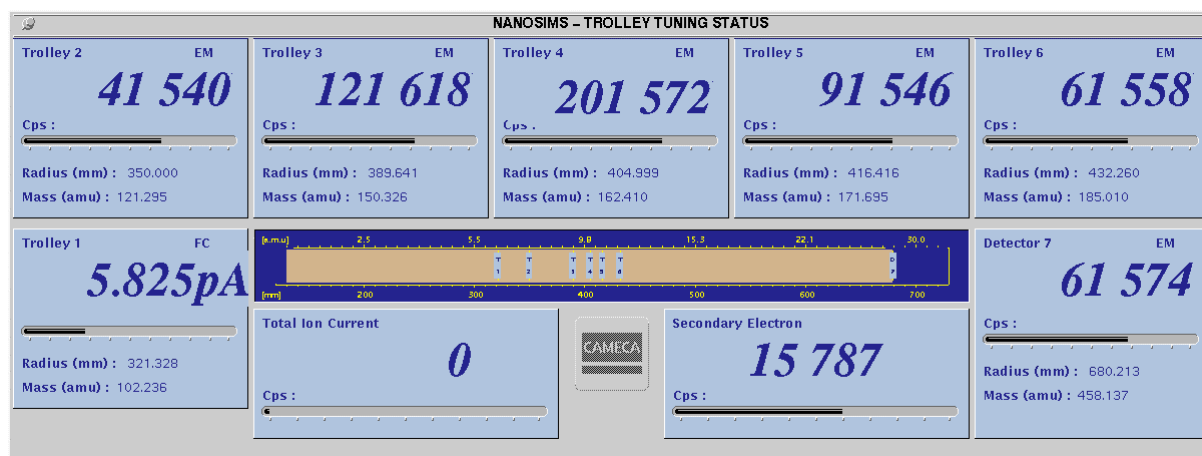
## 2.7 Scanning mode definition

The following panel displays the scanning mode counting settings.



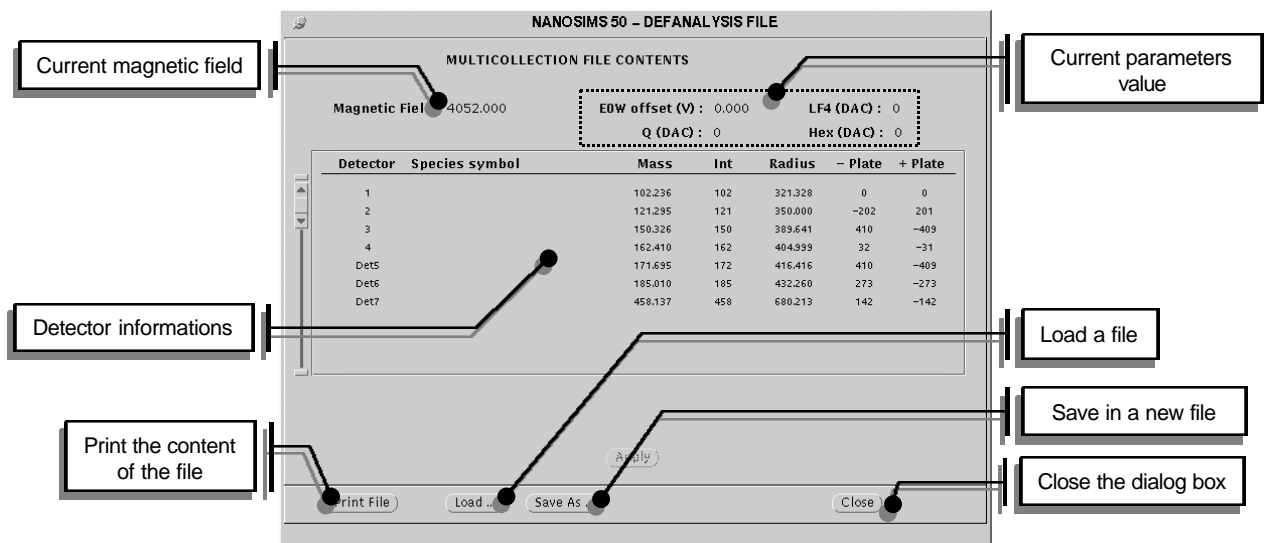
## 3. THE SUMUP WINDOW

This window is a reduced view of the main window.



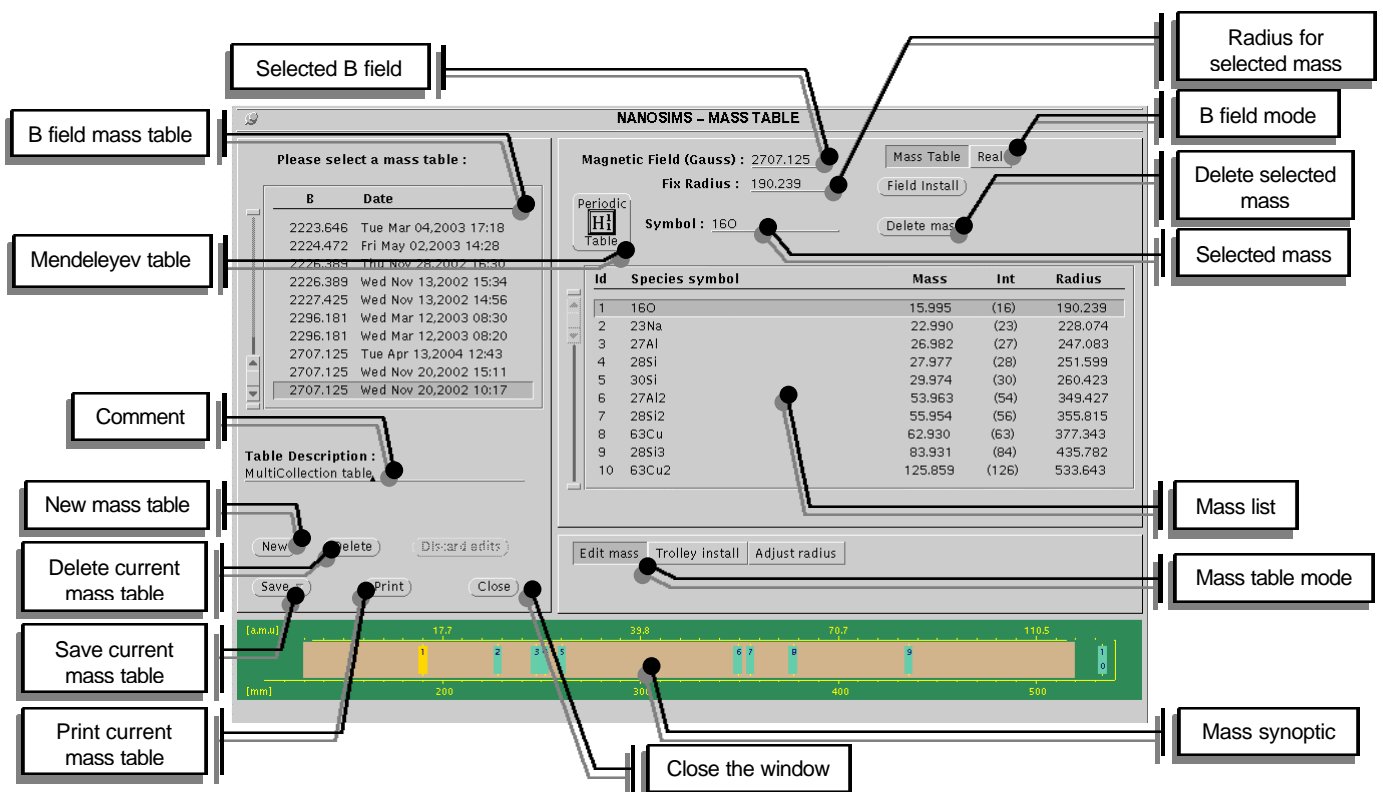
## 4. TUNTODEFA FILE DISPLAY

The following window displays the data saved to be used by def analysis software.



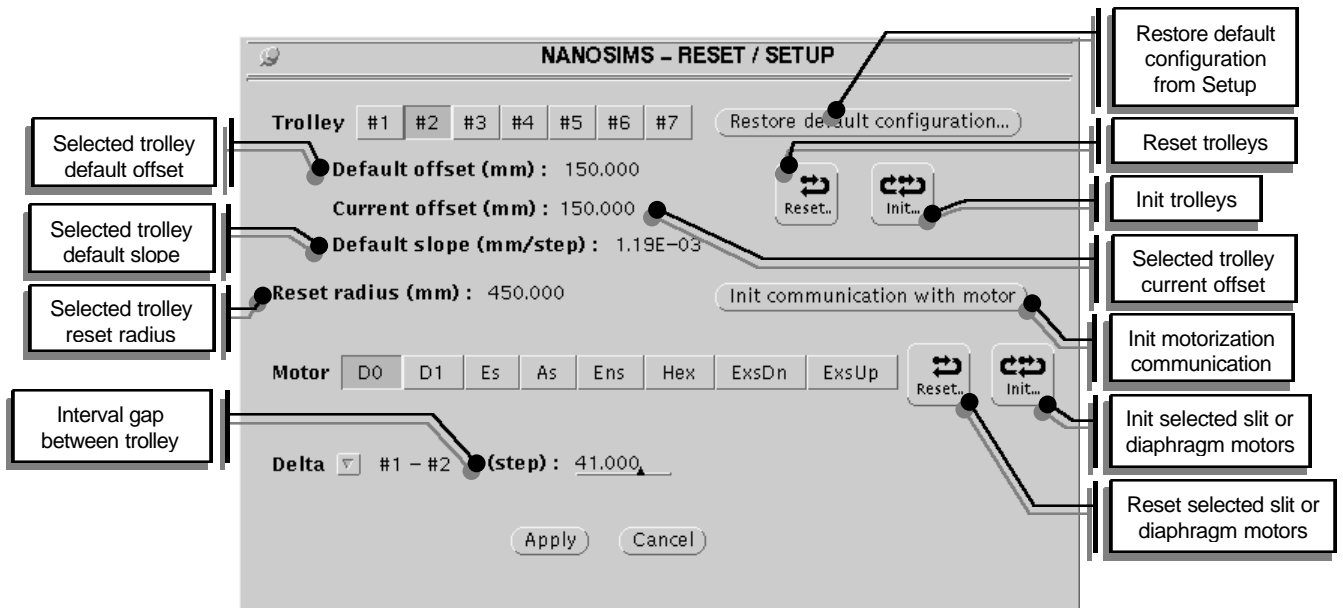
## 5. MASS TABLE WINDOW

The following window displays the data saved to be used by def analysis software.



## 6. RESET/SETUP WINDOW

The following window displays settings for trolleys and motorized slits and diaphragm.

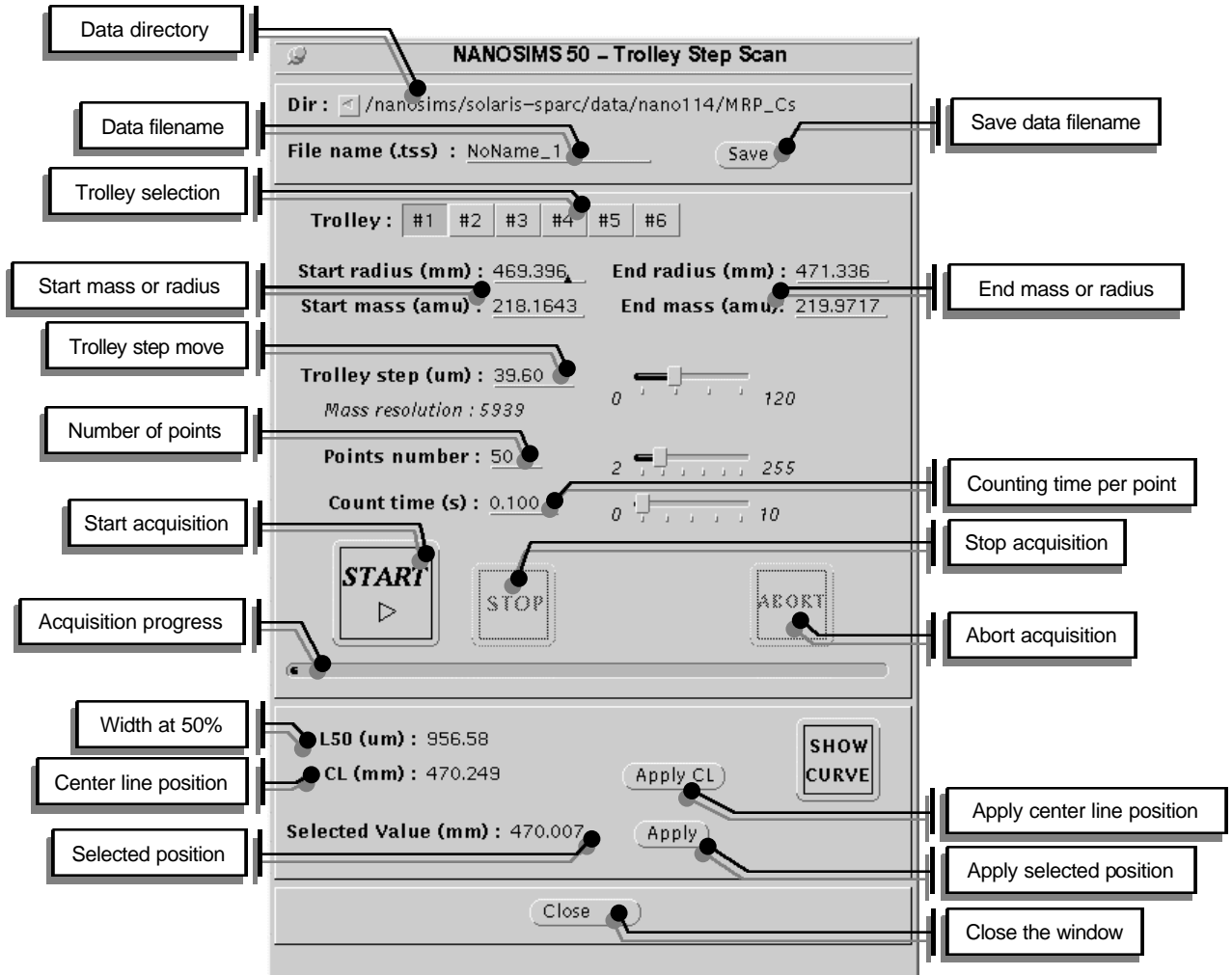


## 7. TROLLEY STEP SCAN ACQUISITION WINDOW

This Trolley Step Scan acquisition is used to measure the variations of the EM counts as a function of the trolley position.

Trolley position start value, step value, number of point and counting time are independently adjustable by user.

The following window displays settings for trolleys step scan acquisition.

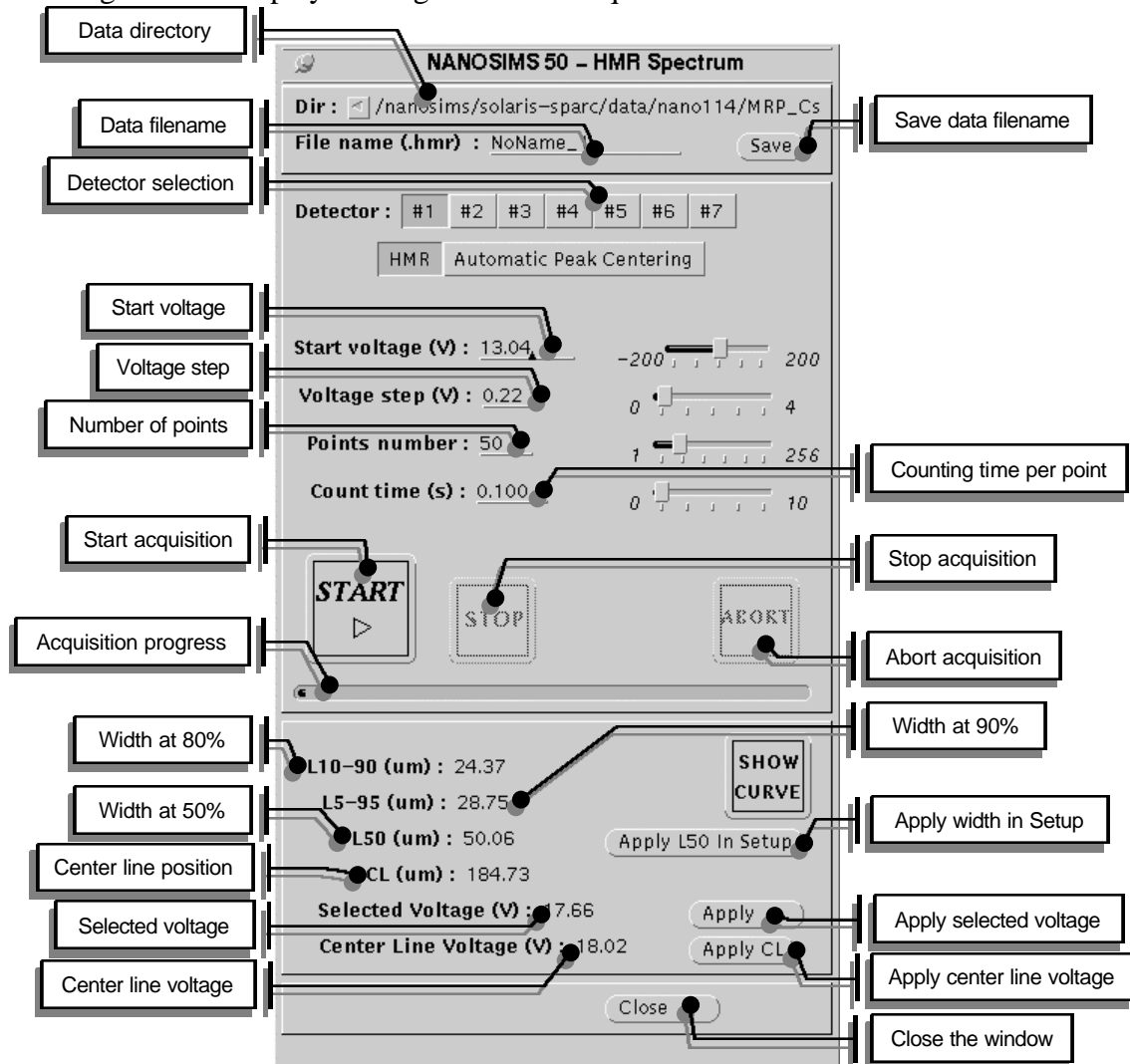


## 8. HMR ACQUISITION WINDOW

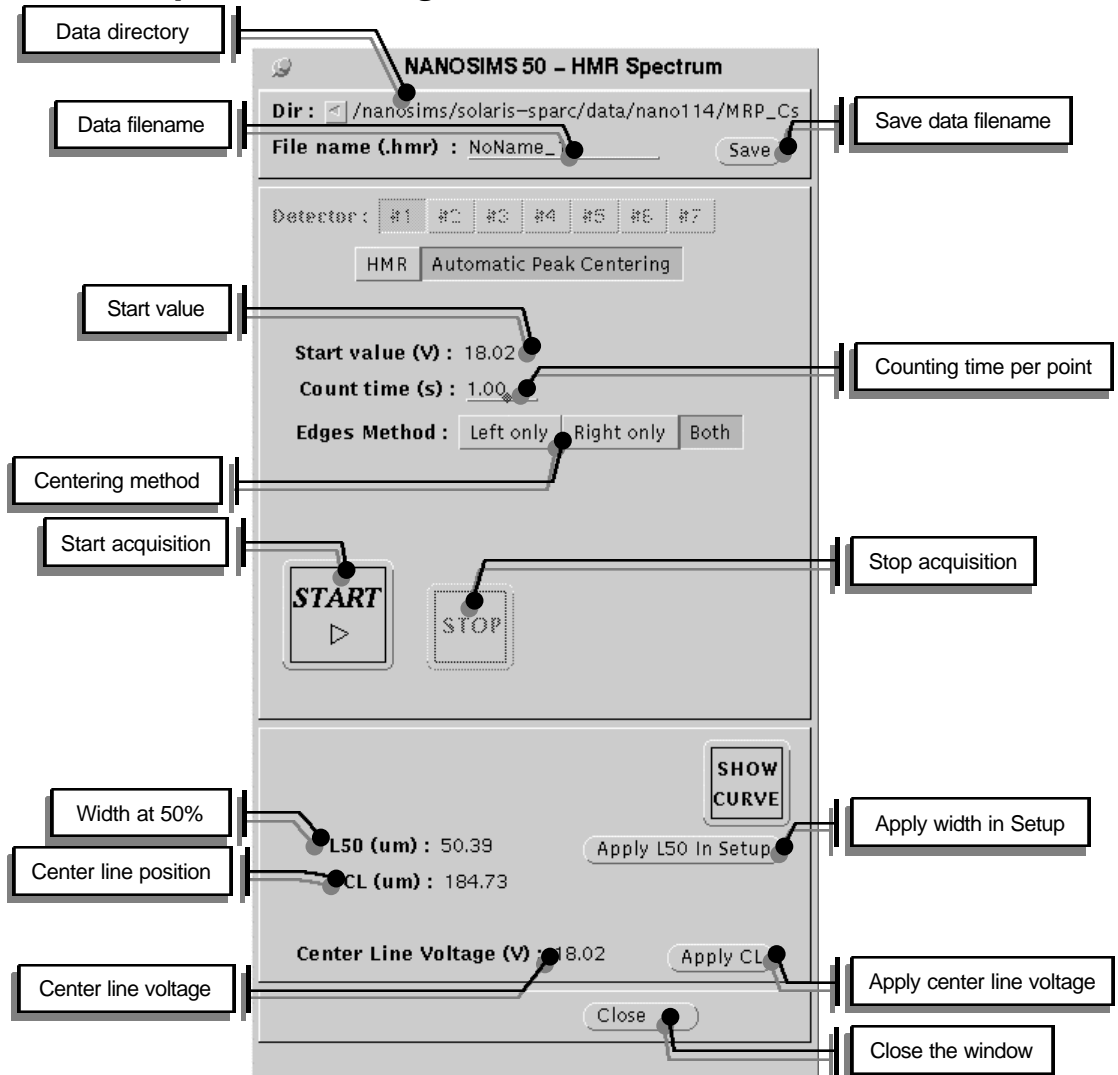
This High Mass Resolution acquisition is used to measure the variations of the EM counts as a function of the EM deflection plates.

EM deflection plates start value, step value, number of point and counting time are independently adjustable by user.

The following window displays settings for HMR acquisition.



## 8.1 Automatic peak centering

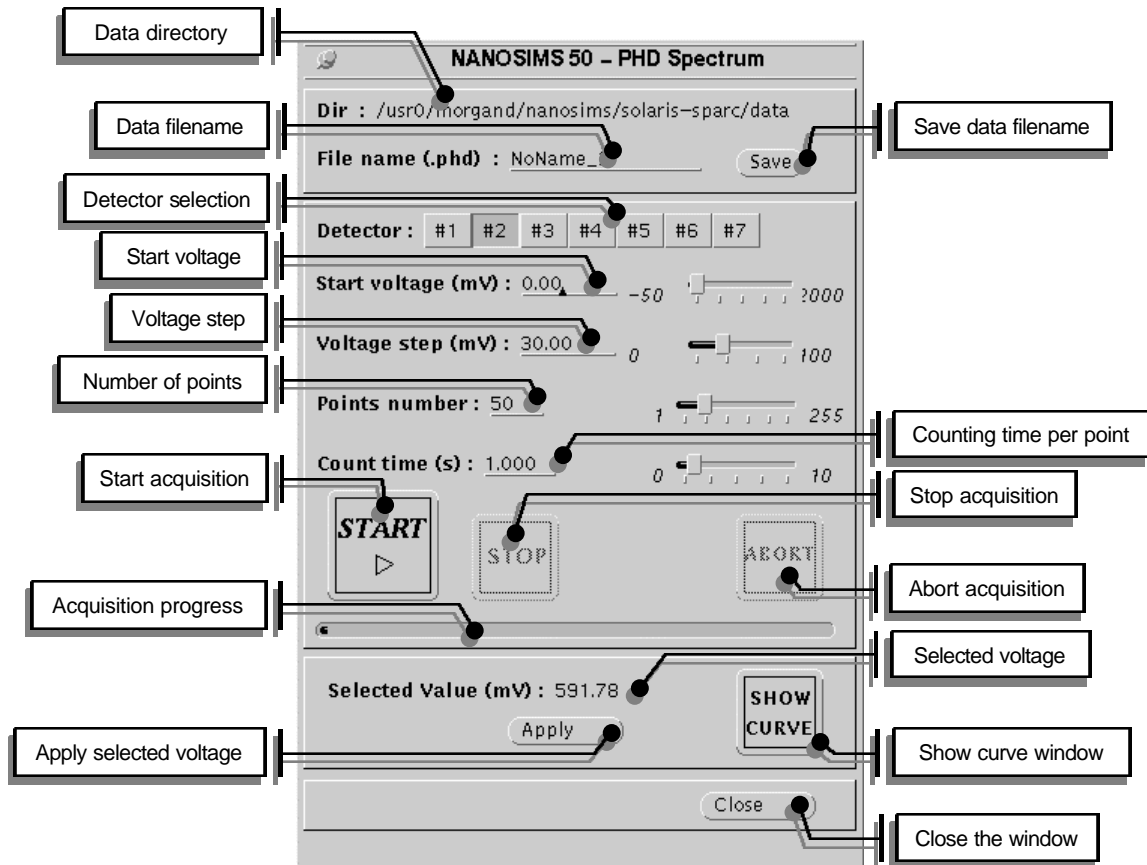


## 9. PHD ACQUISITION WINDOW

The Pulse Height Distribution acquisition is purposed to display the EM PHD distribution curve. The PHD routine is basically a scan-acquisition, where EM Threshold is the scanned parameter and the EM counts the acquired signal.

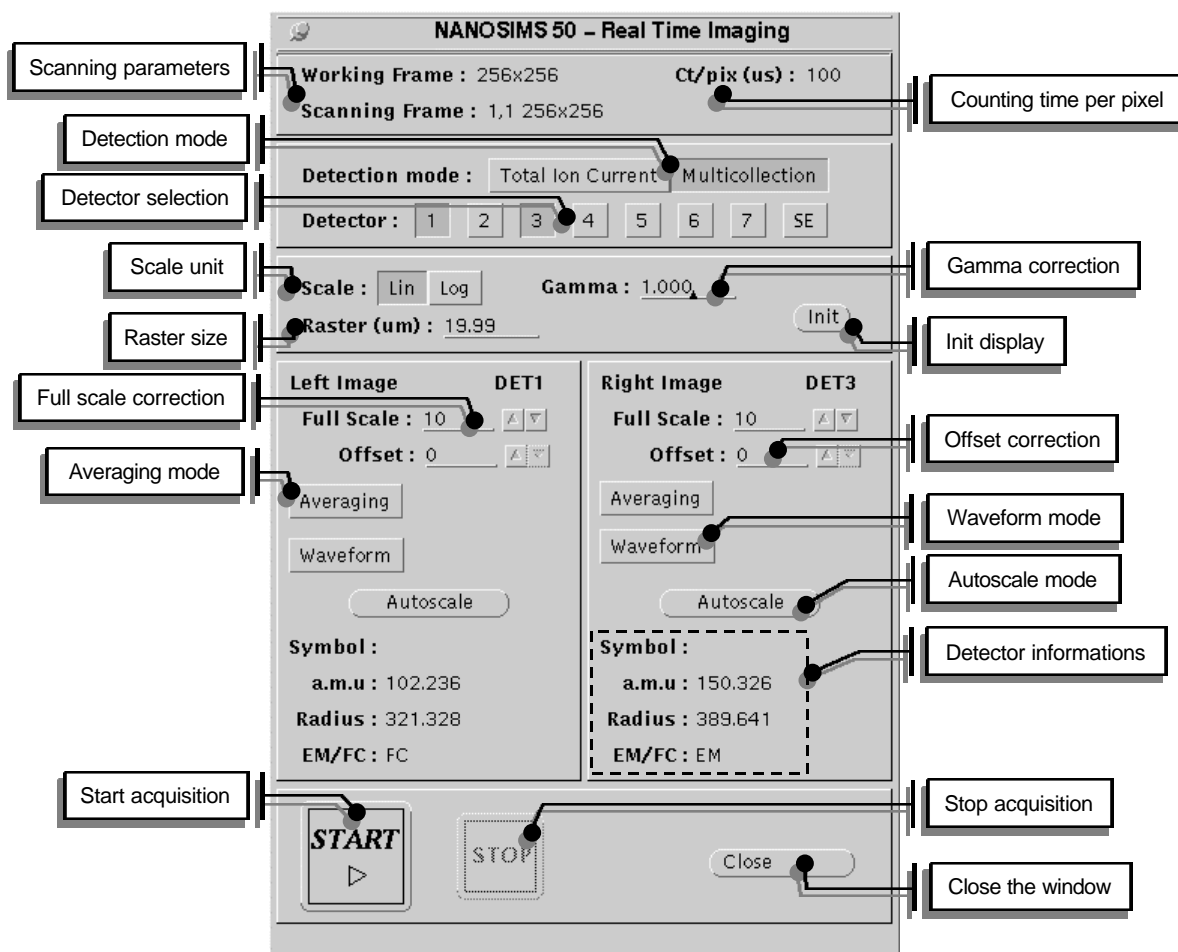
EM Threshold start value , step value, number of point and counting time are independently adjustable by user.

The following window displays settings for PHD acquisition.



## 10. REAL TIME IMAGING ACQUISITION WINDOW

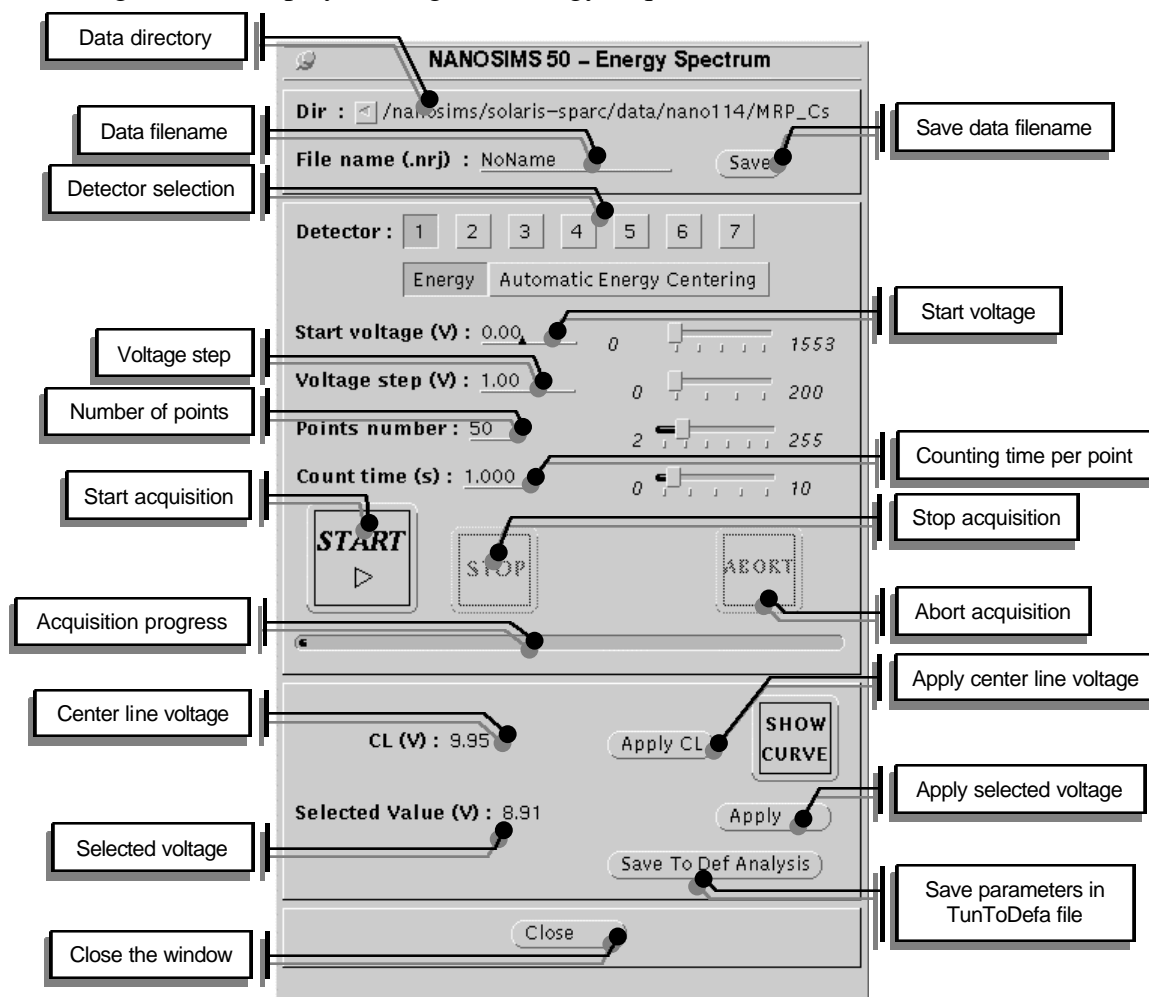
The following window displays settings for Real Time Imaging display.



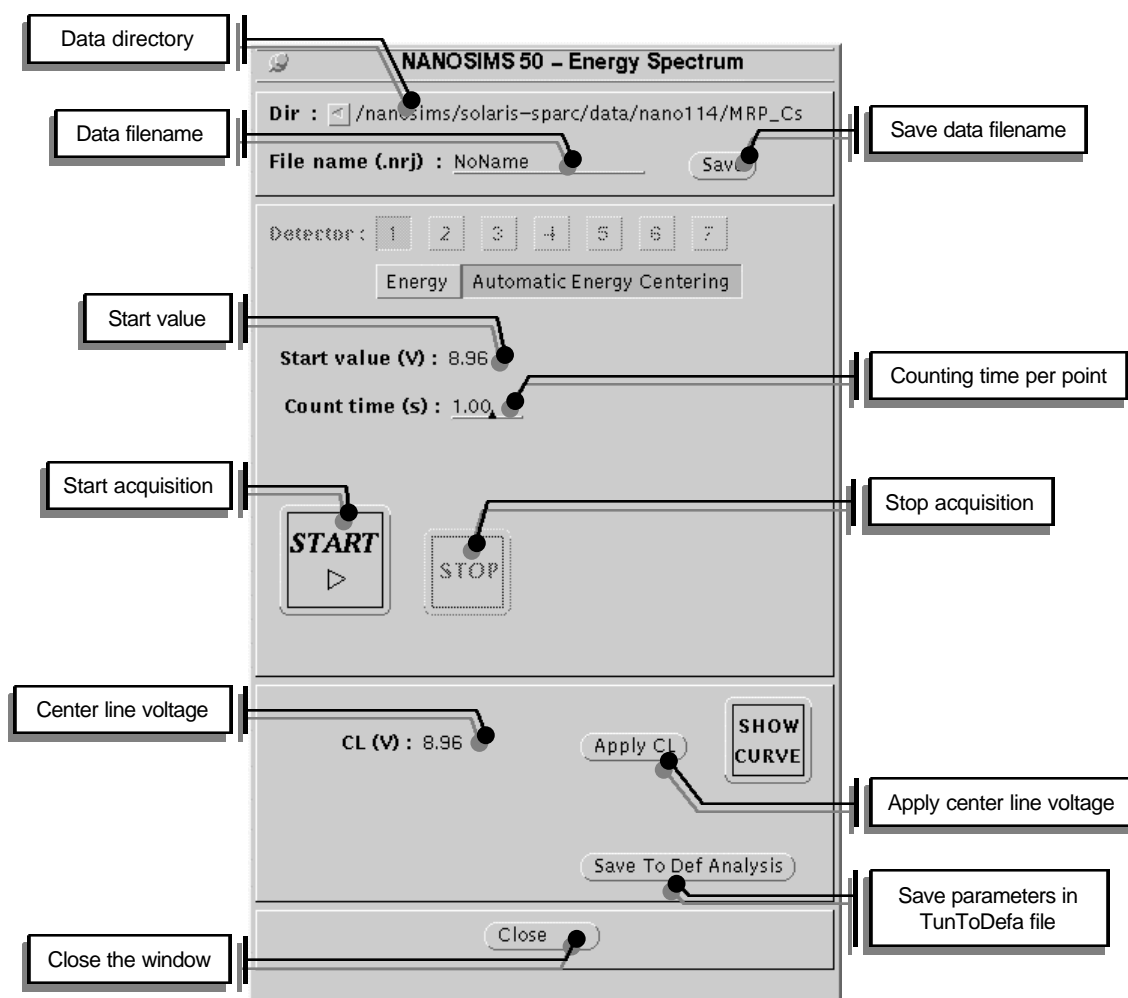
## 11. ENERGY ACQUISITION WINDOW

This analysis is used to measure the variations of the secondary ion intensity as a function of the E0W HV offset. The increment of the sample HV offset, the number of point and the counting time per point are independently adjustable.

The following window displays settings for Energy acquisition.



## 11.1 Automatic Energy centering

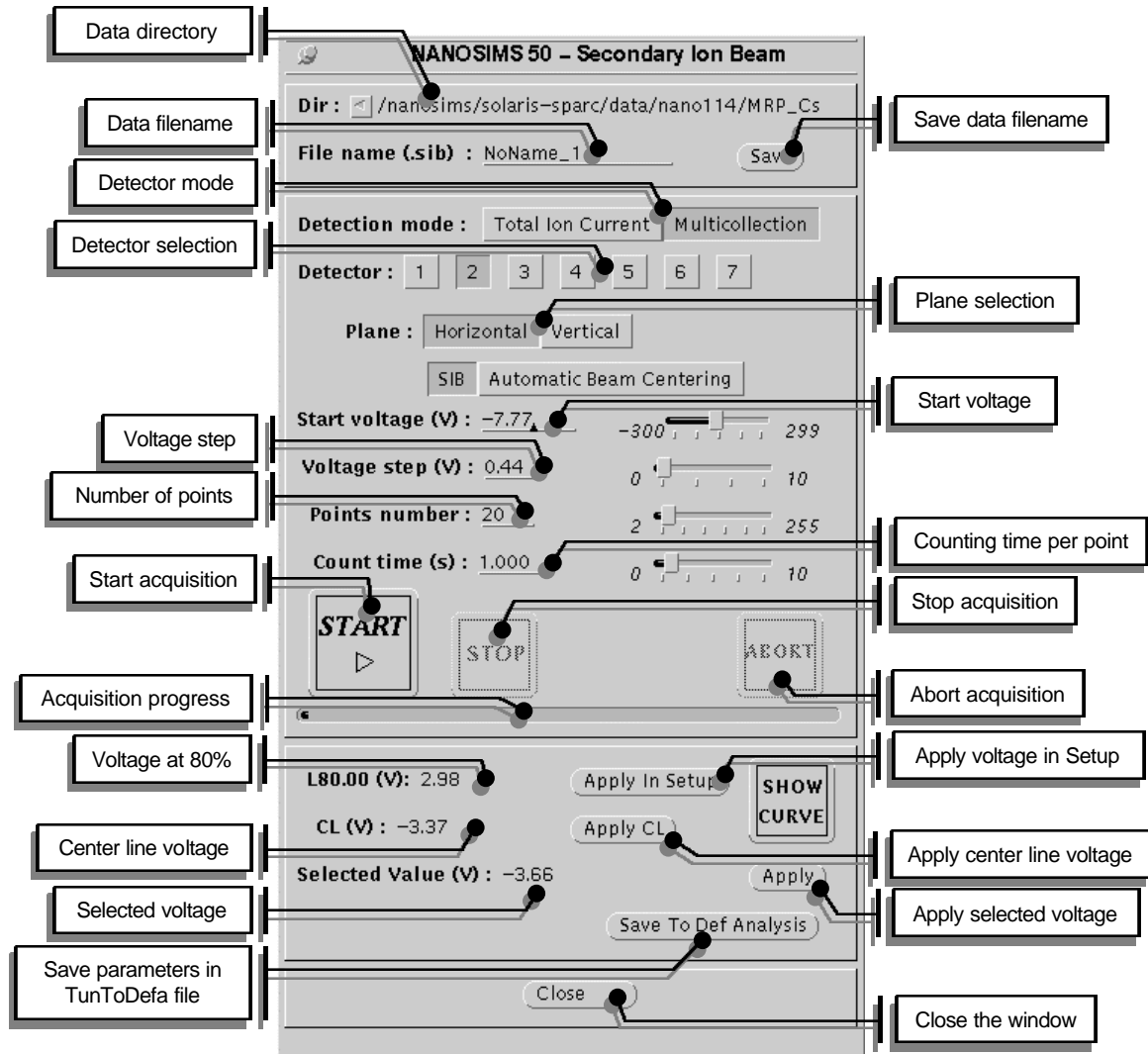


## 12. SECONDARY ION BEAM ACQUISITION WINDOW

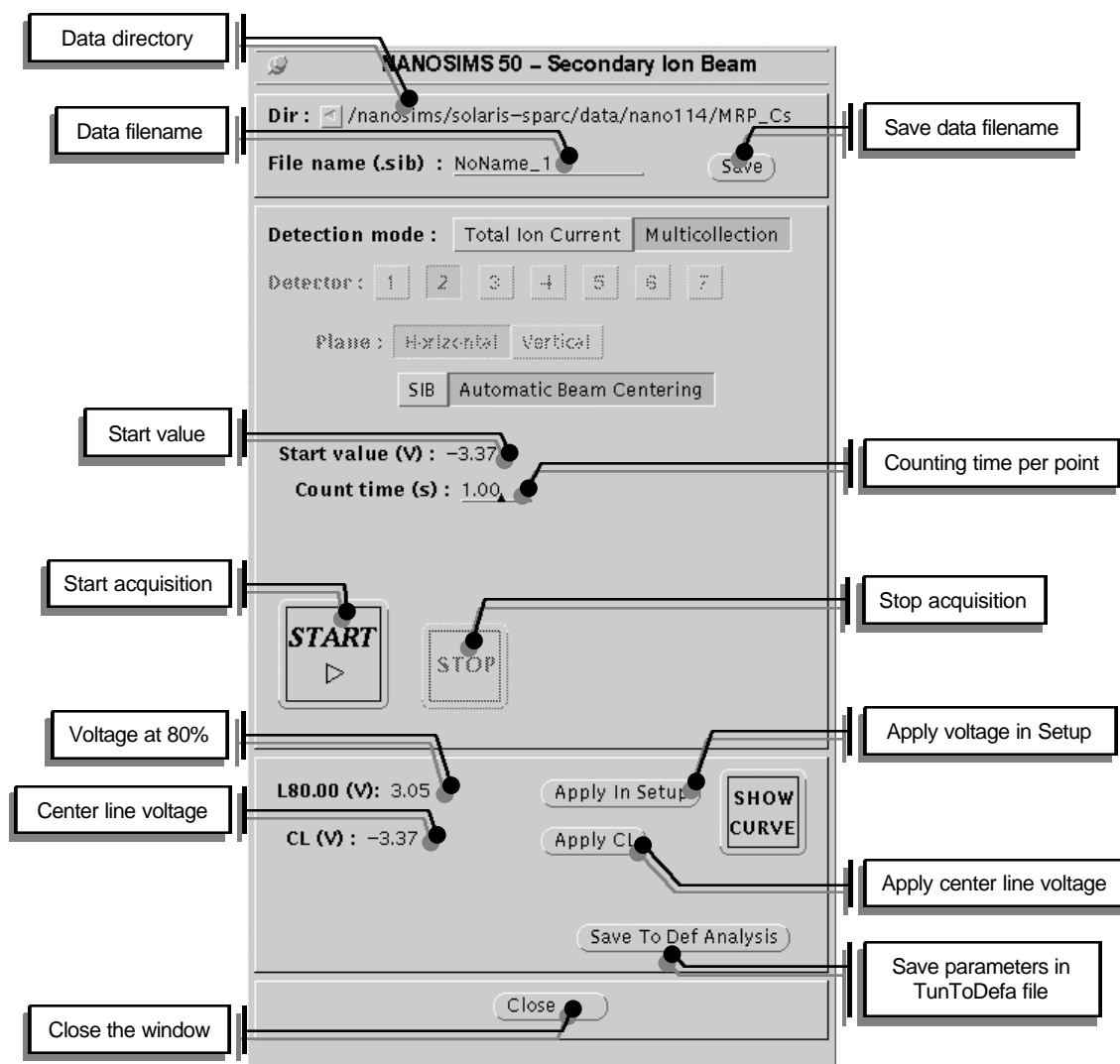
This Secondary Ion Beam acquisition is used to measure the variations of the EM counts as a function of Cy (Horizontal plane) or P3 (Vertical plane).

Start value, step value, number of point and counting time are independently adjustable by user.

The following window displays settings for Secondary Ion Beam acquisition.



## 12.1 Automatic Energy centering



### 13. BEAM STABILITY ACQUISITION WINDOW

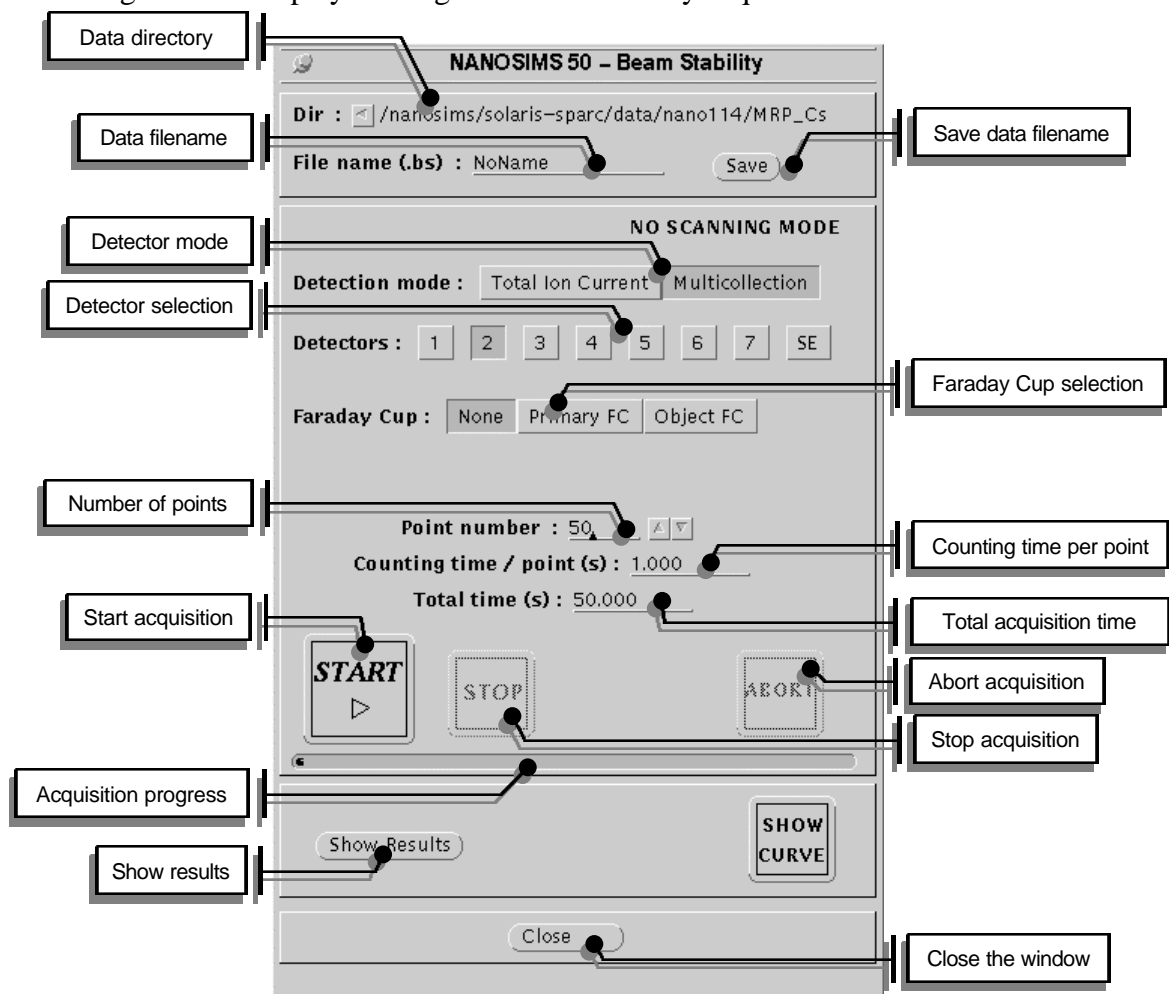
This program is used to check the primary beam intensity stability.

The primary beam intensity is measured as a function of the time. The intensity variations are plotted in the curve window display.

PROCEDURE TO START A PRIMARY BEAM STABILITY TEST:

1. Define a depth profile analysis with one or more species. The counting time entered for these species will be used as the counting time for every elementary primary beam intensity measurement. The total acquisition time or the number of points entered for the depth profile will be used for the stability test.
2. Click *start*. The analysis is running.
3. At the end of analysis, statistics are computed et displayed in the results window.

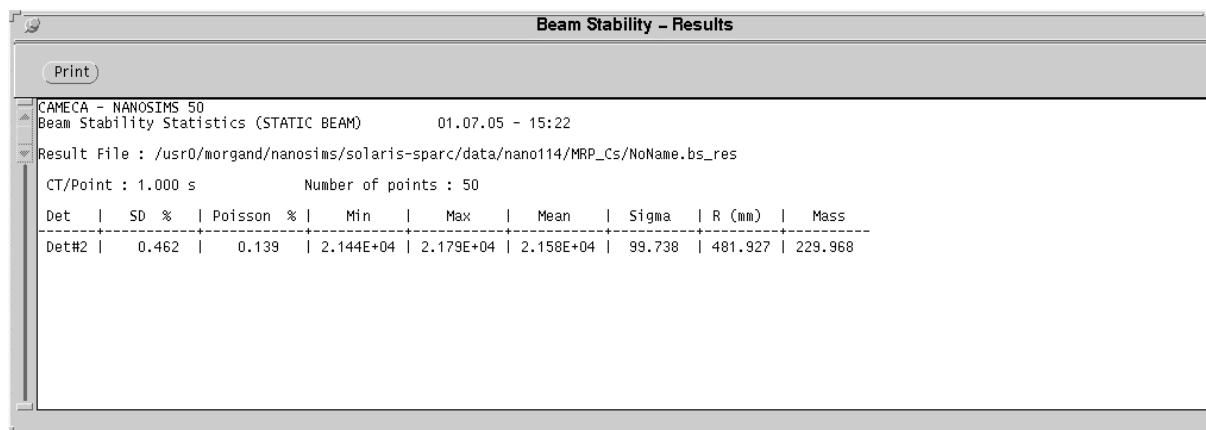
The following window displays settings for Beam stability acquisition.



## 13.1 Results window

For the stability measurement parameters are printed in the results window :

- *Maximum* : is the maximum intensity measured.
- *Minimum* : is the minimum intensity measured.
- *Mean* : is the mean intensity measured.
- *S.D (%)*: is the standard deviation computed for all data points.
- *Poisson (%)* : is the poisson statistic computed for all data points.
- *Sigma* : is the sigma computed for all data points.
- *Radius (mm)* : is the radius of the selected detector.
- *Mass (a.m.u.)* : is the mass of the selected detector.



The screenshot shows a window titled "Beam Stability - Results". It contains a "Print" button and a text area with the following information:

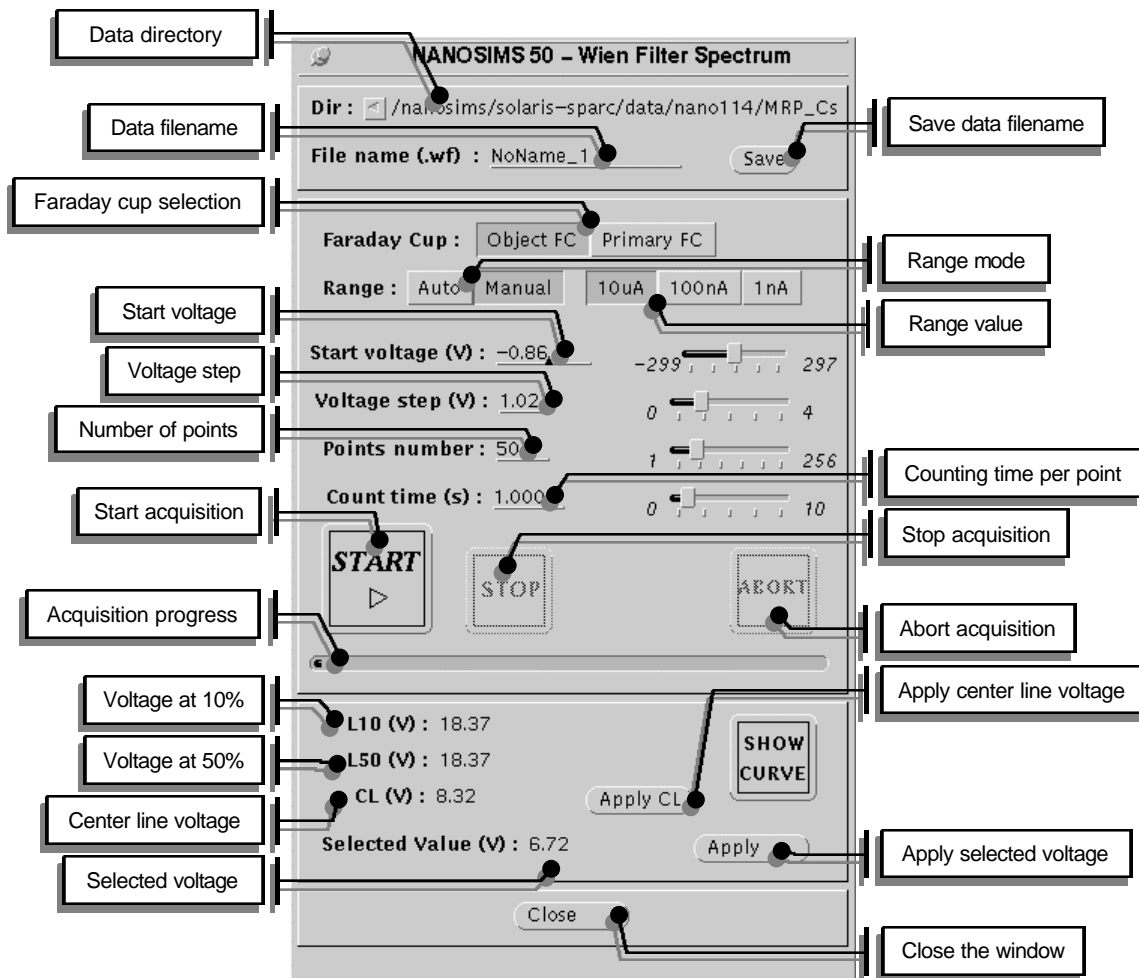
CAMECA - NANOSIMS 50  
Beam Stability Statistics (STATIC BEAM) 01.07.05 - 15:22  
Result File : /usr0/morgand/nanosims/solaris-sparc/data/nano114/MRP\_Cs/NoName.bs\_res  
CT/Point : 1.000 s Number of points : 50

Det	SD %	Poisson %	Min	Max	Mean	Sigma	R (mm)	Mass
Det#2	0.462	0.139	2.144E+04	2.179E+04	2.158E+04	99.738	481.927	229.968

## 14. WIEN FILTER ACQUISITION WINDOW

This Wien filter acquisition is used to measure the variations of the FC counts as a function of CWf. Start value, step value, number of point and counting time are independently adjustable by user.

The following window displays settings for Wien filter acquisition.



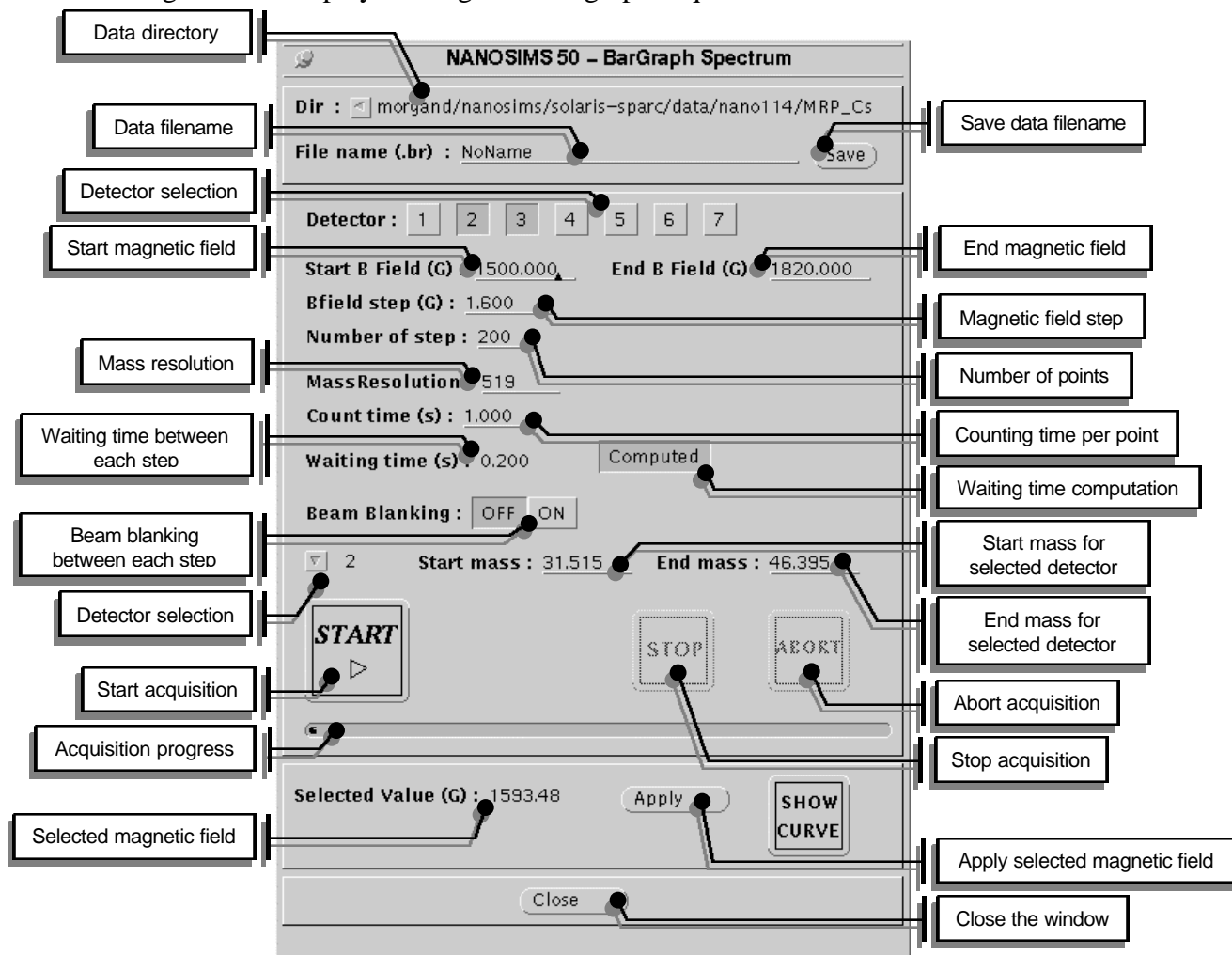
## 15. BAR GRAPH ACQUISITION WINDOW

This analysis is used to record a mass spectrum with a discrete B field scan corresponding to every integer mass included in different mass ranges defined by the operator. A *bargraph* analysis is recorded at a constant number of data points per peak width which means a variable B field step over the mass range. A *bargraph* analysis consists of the successive acquisition of elementary mass spectra.

$B_i$  and  $B_f$  are defined by user and over the B field range  $[B_i, B_f]$ , the B field is scanned with an increment  $\delta B$  computed with the relationship following :

$$\delta B = \frac{1}{2} \times \frac{B_f - B_i}{\text{Mass resolution}}$$

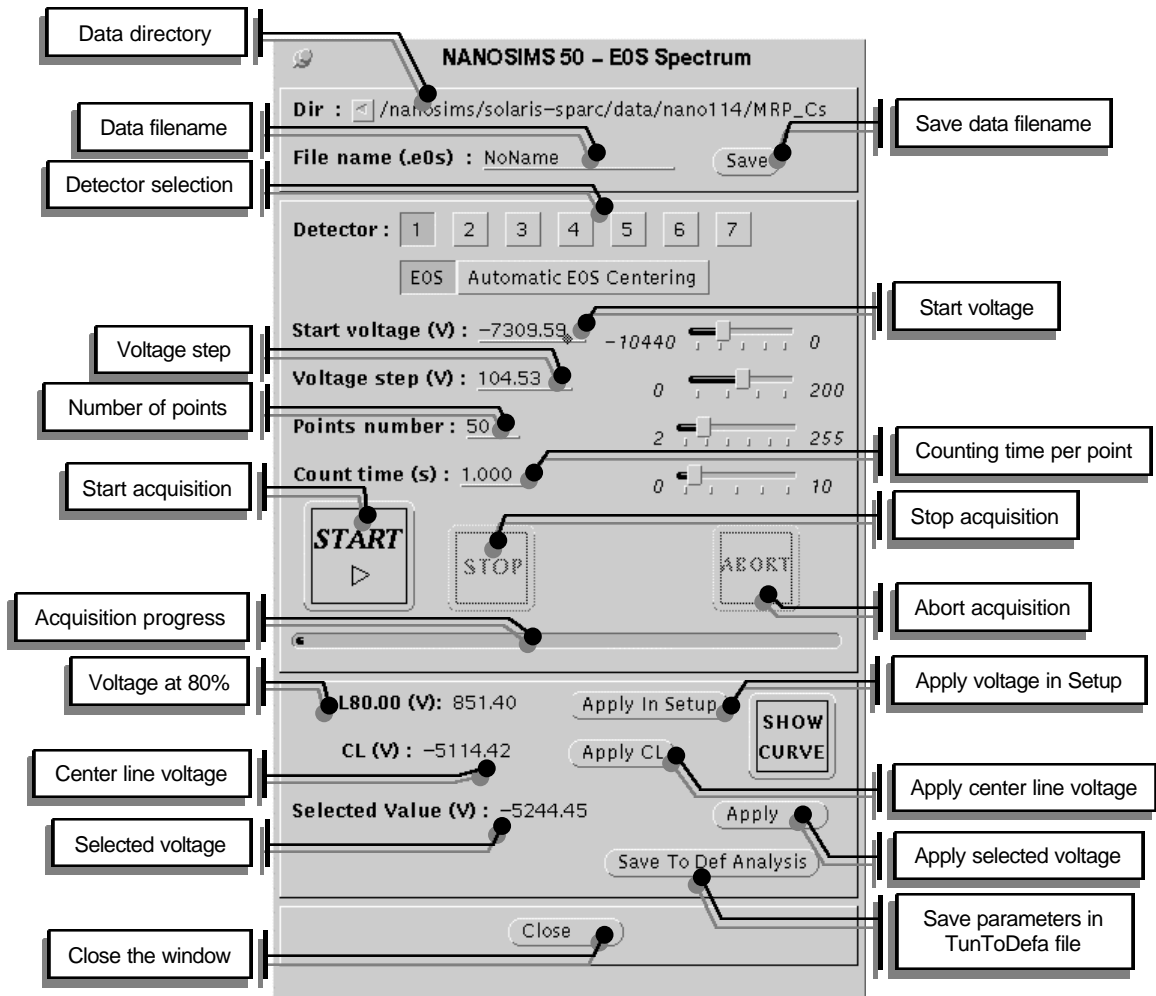
The following window displays settings for Bar graph acquisition.



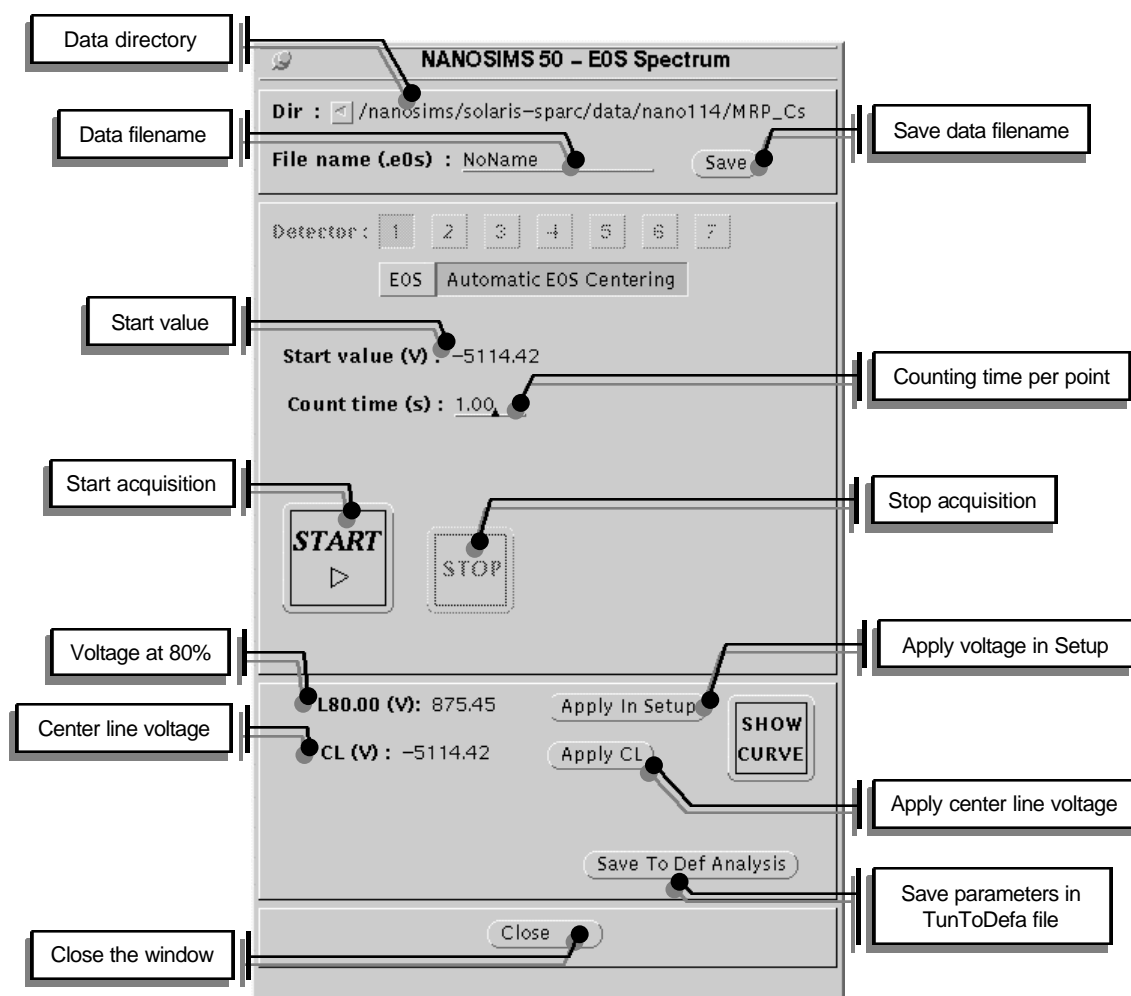
## 16. E0S ACQUISITION WINDOW

This E0S acquisition is used to measure the variations of the EM counts as a function of E0S. E0S start value, step value, number of point and counting time are independently adjustable by user.

The following window displays settings for E0S acquisition.



## 16.1 Automatic EOS centering

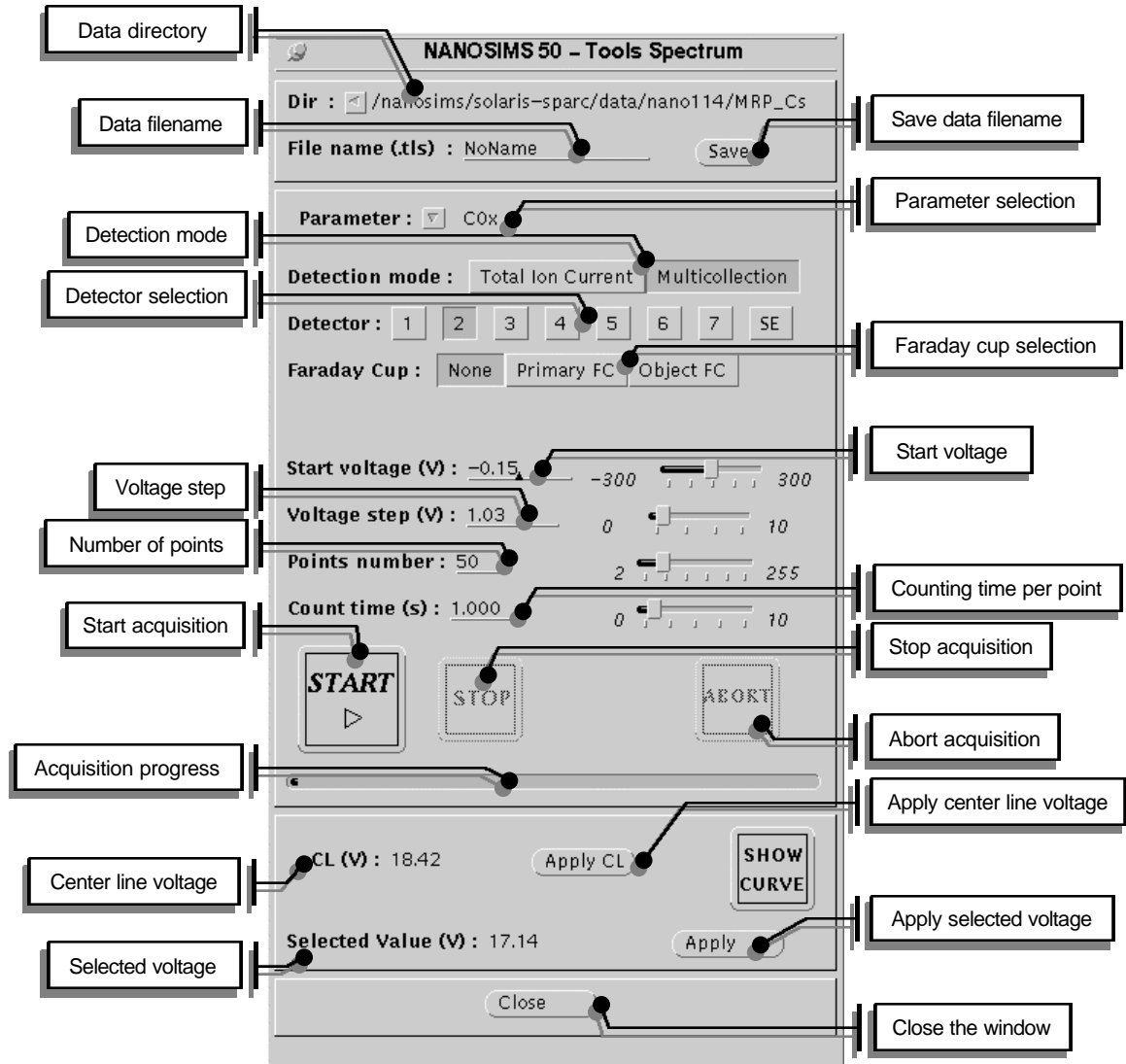


## 17. TOOLS ACQUISITION WINDOW

This Tools acquisition is used to measure the variations of the EM counts as a function of a selected parameter.

Start value , step value, number of point and counting time are independently adjustable by user.

The following window displays settings for Tools acquisition.





**The CAMECA NANOSIMS 50 L**  
**Def Analysis Software user's guide**

# Contents

<b>1.</b>	<b>INTRODUCTION .....</b>	<b>3</b>
1.1	ENTER/EXIT PROGRAM .....	3
1.2	DIALOG BOXES WINDOW.....	4
1.2.1	<i>Analysis type selection .....</i>	<i>4</i>
1.2.2	<i>Measurement conditions.....</i>	<i>5</i>
1.2.3	<i>Species table .....</i>	<i>6</i>
<b>2.</b>	<b>ANALYSIS TYPES.....</b>	<b>6</b>
2.1	DEPTH PROFILE .....	6
2.2	ISOTOPES .....	6
2.3	LINE SCAN (STAGE CONTROL) .....	6
2.4	IMAGE ACQUISITION .....	7
2.5	GRAIN MODE .....	7
2.6	LINE SCAN (BEAM CONTROL) .....	7
2.7	PROCEDURE TO DEFINE A NEW ANALYSIS .....	7
2.8	PROCEDURE TO REPEAT A FORMER ANALYSIS.....	7
2.9	PROCEDURE TO REPEAT THE LAST ANALYSIS .....	7
<b>3.</b>	<b>DEFINITION OF THE EXPERIMENTAL CONDITIONS .....</b>	<b>8</b>
3.1	FILES OF EXPERIMENTAL CONDITIONS .....	8
3.1.1	<i>Procedure to create a new file of experimental conditions .....</i>	<i>8</i>
3.1.2	<i>Procedure to load a former file of experimental conditions .....</i>	<i>8</i>
3.2	MEASUREMENT CONDITIONS.....	9
3.2.1	<i>Total analysis time / Number of cycles.....</i>	<i>9</i>
3.2.2	<i>Beam blanking.....</i>	<i>10</i>
3.2.3	<i>Preset.....</i>	<i>10</i>
3.2.4	<i>Pre-sputtering.....</i>	<i>10</i>
3.2.5	<i>X step, Y step, Number of steps.....</i>	<i>11</i>
3.2.6	<i>Number of blocks, Cycles per Block, Rejection .....</i>	<i>11</i>
3.2.7	<i>Ratios.....</i>	<i>11</i>
3.2.8	<i>Counting time .....</i>	<i>12</i>
3.2.9	<i>Magnetic field.....</i>	<i>12</i>
3.2.10	<i>Waiting time.....</i>	<i>12</i>
3.2.11	<i>Centering.....</i>	<i>13</i>



# 1. INTRODUCTION

This program is used to define the acquisition procedure for a given analysis. When the measurement conditions for a given analysis have been defined, they can be saved on the disk in order to repeat the same analysis later on.

There are 6 different analysis types available :

- Depth profile.
- Isotop.
- Image acquisition.
- Grain mode.
- Line scan (stage control).
- Line scan (beam control).

## 1.1 Enter/Exit Program

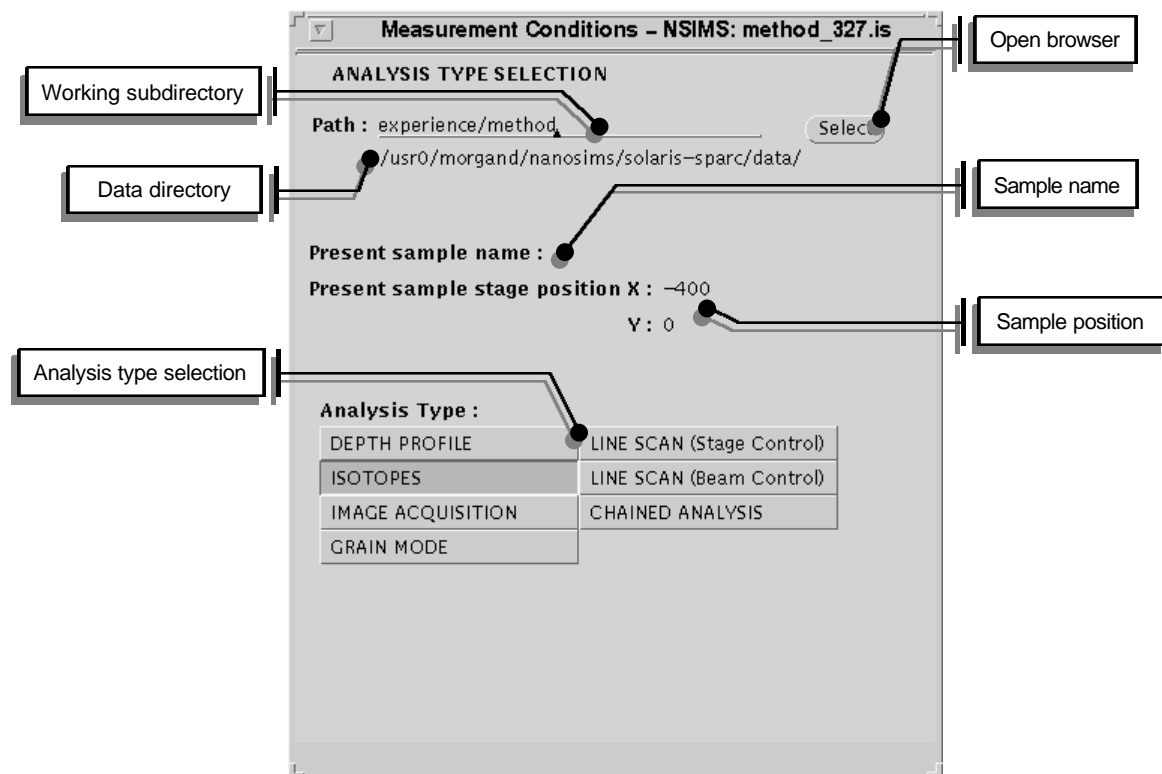
- In order to enter the *analysis definition* program click the *analysis definition* icon  in the main icon board. The icon must be red .
- In order to iconize the program click either *analysis definition* icon in the main icon board or the ▽ symbol in the header of the *analysis options* dialog box. All *analysis definition* windows and dialog boxes are closed. When the *analysis definition* program is re-opened all data included in different dialog boxes are restored with the same status as before iconizing the program.
- In order to quit the program, click the right mouse button in the *analysis option* window header and select *quit* in the pull down menu. All dialog boxes are erased and the *analysis definition* icon in the main icon board returns to the blue colour.

## 1.2 Dialog boxes window

The analysis definition program works with 2 main dialog boxes :

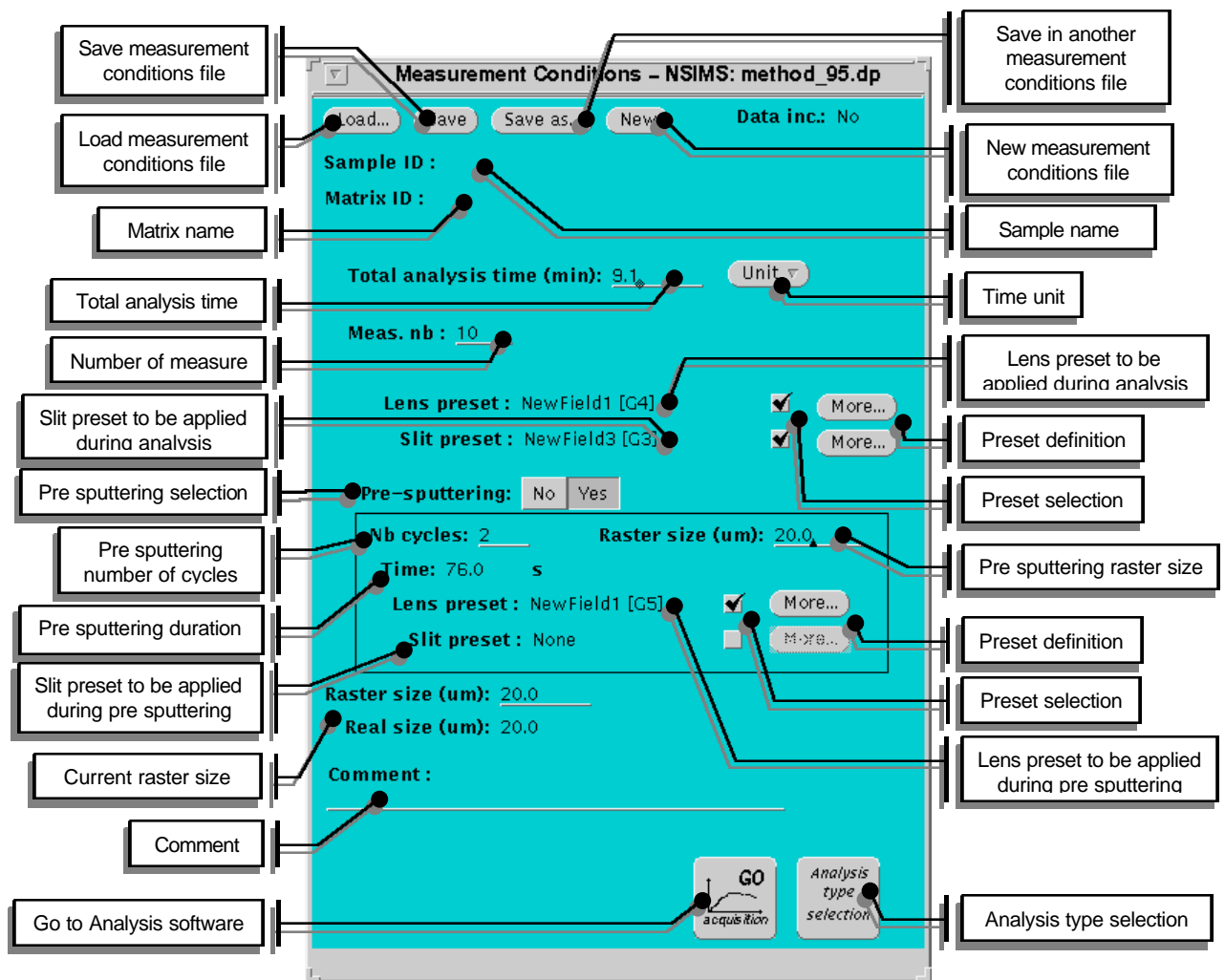
- Analysis type selection.
- Measurement conditions.
- Species table.

### 1.2.1 Analysis type selection



## 1.2.2 Measurement conditions

The following figure describes the measurement conditions window for Depth Profile analysis.



### 1.2.3 Species table

The screenshot shows the 'Nanosims 50 - DEPTH PROFILE' software interface. It features several control panels on the left and right, and a central area with a large frame overview and a detector list table.

**Left Panel Controls:**

- Scanning mode selection
- Working frame size
- Scanning frame size and position
- Blanking mode selection
- Counting frame size and position
- Magnetic field list selection
- E0W Offset
- Number of frame per cycle
- Detector list selection
- Energy Centering
- Second Ion Beam Centering
- E0S Centering

**Right Panel Controls:**

- Frames overview
- Waiting time for magnetic field change
- Computed waiting time selection
- Counting time
- Peak centering selection
- Peak centering correction
- After energy centering waiting time

**Central Interface Elements:**

- Scanning mode:** No Yes
- Working Frame:** Width: 256, Height: 256
- Scanning frame:** Start Col: 1, Start Row: 1, Width: 256, Height: 256
- Blanking:** No Yes
- Counting Frame:** Start Col: 64, Start Row: 64, Width: 128, Height: 128
- Magnetic Field List:**

B1	3000.000
B2	3436.584
B3	4000.000
- Wt (s):** 13.333 ☒ Computed
- Ct/px (us):** 10
- Offset (V):** 0.00
- Nb frame:** 1
- Energy Centering every (fr.):** 5
- Check every (fr.):** 1
- Wt (s):** 10.000
- Print results after acquisition:** ☐
- Detector List Table:**

Centering	N	Id	Species Symbol	a.m.u.	Radius
	Tr1			21.710	199.998
	Tr2	28Si		28.120	227.617
	Tr3			44.199	285.367
	Tr4	28Si2		56.000	321.210
	Tr5			145.223	517.265
	Tr6			152.134	529.430
- Peak List Table:**

Peak Num.	Ref. Peak Num.
<input checked="" type="checkbox"/> 1	1
<input checked="" type="checkbox"/> 2	2

## 2. ANALYSIS TYPES

### 2.1 Depth profile

This analysis is used to record the variations of the secondary ion intensity for different species as a function of the sputtering time. One cycle contains one intensity measurement for every species to be analyzed. A *depth profile* analysis consists of the successive acquisition of cycles.

### 2.2 Isotopes

This analysis works exactly with the same principle as the depth profile analysis, but in addition to the curves *Secondary ion intensity* vs. *Time*, there is an output of computation results for intensity ratios.

### 2.3 Line scan (stage control)

In this analysis, the secondary ion intensity for different species are measured for different position of the sample stage. One cycle contains one intensity measurement for every species to be analyzed. The sample stage can be moved by combining both X and Y motions together. A *line scan* analysis consists of the acquisition of one cycle at successive sample stage position.

## 2.4 Image acquisition

This analysis is used to acquire images. The images are acquired with a format of 2048 x 2048 pixels. The maximum number of images which can be stored in one image file is limited by the free space on the disk. One image plane contains one image recorded for every species to be analyzed. An *image acquisition* analysis consists of successive acquisition of image planes.

## 2.5 Grain mode

In this analysis, an isotopic analysis is done on a scanning area (grain) defined by the user on a previous image analysis.

## 2.6 Line scan (beam control)

In this analysis, the secondary ion intensity for different species are measured for different position of the beam. One cycle contains one intensity measurement for every species to be analyzed. The beam is moved according the user line selection on a previous image analysis. A *line scan* analysis consists of the acquisition of one cycle at successive beam position.

## 2.7 Procedure to define a new analysis

1. Click *analysis definition* icon in the main icon board. The *measurement conditions* dialog box opens for the analysis type of the last analysis run.
2. If required, click *analysis type selection* icon to open the *analysis type selection* dialog box. The present coordinates of the sample stage and the name of the corresponding sample are displayed.
3. Click on the new analysis type label. The corresponding *measurement conditions* dialog boxes opens.
4. In the *measurement conditions* dialog box, click *new* to restore all default status for the acquisition options and to erase all editing fields in the species table.
5. Select the status of the different acquisition options and enter the corresponding parameter values.
6. Click *go analysis* to open the analysis control dialog box. The program checks the coherency of the parameter set entered. If mismatching parameter values are detected, there is a prompt asking for correction(s).

## 2.8 Procedure to repeat a former analysis

1. Click *analysis definition* icon in the main icon board. The *measurement conditions* dialog box opens for the analysis type of the last analysis run.
2. If required, click *analysis type selection* icon to open the *analysis type selection* dialog box. The present sample stage coordinates and the name of the present sample fitted in the analysis position are displayed.
3. Click on the new analysis type label. The corresponding *measurement conditions* dialog boxes opens.
4. In the *measurement conditions* dialog box, click *load* to open the dialog box containing the file list of the former analyses of the present analysis type.
5. Click the file name of the analysis to be repeated in the item list. Click *load*. The editing fields of the *measurement conditions* dialog box are updated according to the file selected.
6. If required, modify some acquisition parameters
7. Click *go analysis* to open the analysis control dialog box. The program checks the coherency of the parameter set entered. If mismatching parameter values are detected, there is a confirmation prompt asking for correction(s).

## 2.9 Procedure to repeat the last analysis

1. Click *analysis* icon in the main icon board. The *analysis* dialog box opens for the analysis type of the last analysis run.

2. Enter a new file name. If the file name already exists there is a confirmation prompt.
3. Click *start* to start the analysis.

### 3. DEFINITION OF THE EXPERIMENTAL CONDITIONS

All parameter values and options required to fully defined the experimental conditions for a given analysis are divided in two groups :

- *Species table* : this group contains the species to be analyzed and their associated parameters (counting time, detector....).
- *Measurement conditions* : this group contains every option related to the computer control of the analysis procedure. For instance : beam blanking mode, pre-sputtering....

#### 3.1 Files of Experimental conditions

All parameter values contained in the editing fields of the *measurement conditions*, *species table* and *mass calibration* dialog boxes, which are required to define a given analysis, are automatically saved in the *raw data* file at the end of every analysis. Any *raw data* file can be therefore used later on to restore the same experimental conditions in order to repeat the same analysis, by using the *load* function of the *measurement conditions* dialog box.

By means of the *save* function of the *measurement conditions* dialog box, the experimental conditions can be saved before starting the analysis. This capability is helpful to define the experimental conditions of the next analysis, while the present one is still running. Note that, in that case the *raw data* file does not yet contain secondary ion intensities.

The file name entered to save the experimental conditions in the *analysis definition* program is selected as the default name of the *raw data* target file by the *analysis control* program. If required, this default name can be modified when entering the *analysis control* program.(see *analysis control* chapter).

In case of running several analyses with the same file of experimental conditions, the default name of the *raw data* target file must be changed by the operator to avoid overwriting the previous analysis.

##### 3.1.1 Procedure to create a new file of experimental conditions

1. Click *analysis definition* icon in the main icon board. The *measurement conditions* dialog box opens for the analysis type of the last analysis run.
2. If required, click *analysis type selection* icon to select a new analysis type.
3. Click *new* in the *measurement conditions* dialog box. All default status for the *measurement conditions* options are restored, and all species already entered in the *species table* are erased.
4. Define the new measurement conditions and species.
5. Click *save* in the *measurement conditions* dialog box. A dialog box opens.
6. The program suggests a default file name (*new#.analysis type extension*). If required enter a new file name. Hit *return* on the keyboard to save the file. If the file name already exists there is a confirmation prompt before overwriting. The *file name* editing field in the *measurement conditions* dialog box is updated with the new *raw data* file name.

##### 3.1.2 Procedure to load a former file of experimental conditions

The *load* function of the *measurement conditions* dialog box is used to load from the disk experimental conditions to run a new analysis with acquisition parameters already defined for a former analysis.

The file of experimental conditions to be loaded is selected in a file list provided in the *file list* dialog box of the *load* function. When a file name is clicked in the file list, the creation

date of the file and the name of the sample being analyzed when the file were saved, are displayed at the bottom of the load dialog box.

1. Click *analysis definition* icon in the main icon board. The *measurement conditions* dialog box opens with a default analysis type which is the one of the last analysis run.
2. If required, click *analysis type selection* icon to select a new analysis type.
3. Click *load* in the *measurement conditions* dialog box. A dialog box with a file list opens.
4. Only files containing experimental conditions consistent with to the present analysis type are listed. Click the file of interest to be loaded in the item list. Note that when a file name is clicked in the item list , the *date* and *sample* editing fields are updated
5. Click *load* to load the new experimental conditions. The present parameters entered in the *measurement conditions* and the *species table* dialog boxes are updated. The *file name* editing field in the *measurement conditions* dialog box is updated with the name of the file loaded.
6. If required, modify some of the parameters just loaded. Click *save* to save the new parameters in a new *raw data* file on the disk.

*Note : when experimental conditions are loaded from a raw data file, the analytical parameters table is not updated with the parameter values contained in the file. Actually, the analytical parameters are representative of the hardware configuration options which are not under computer control. So that, if the analytical parameters table was updated, it could involve disagreements of the values displayed in the table with the present hardware status of the instrument.*

## 3.2 Measurement conditions

### 3.2.1 Total analysis time / Number of cycles

Total Analysis time :

- Default value : none
- Maximum value : none

Number of cycles :

- Default value : 100
- Maximum value : 5600

In the case of the depth profile analysis, the analysis time for a given analysis can be adjusted in two different ways by the operator :

- either by entering directly the overall acquisition time and then the computer displays the number of cycles to be performed according to the parameters defined in the *species table*.
- or by entering the number of cycles following which the computer displays the total acquisition time according to the parameters defined in the *species table*.

For all other analyses the total analysis time cannot be directly entered by the operator. It is computed according to the experimental conditions entered by the operator and displayed in the *total acquisition time* editing field. If required, the total acquisition time can be adjusted by modifying the value of acquisition parameters (for instance, the number of point per peak width....)

*Note : the acquisition time can be modified during the analysis.*

### 3.2.2 Beam blanking

- Default status of the option : No

When this option is active (*yes* status), the primary beam is blanked just before any magnetic field change and remains blanked until the end of the waiting time entered in the *species table*. This acquisition mode improves the depth definition of the recorded profile when a large number of species have to be analyzed, but at the expense of the acquisition speed.

The beam blanking mode has no meaning when only one mass is analyzed.

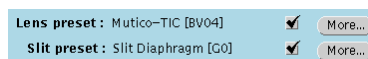
When the primary beam is blanked, the clock of the analysis is stopped. Therefore, the time scale of the graph displayed in the *acquisition control* program corresponds to sputtering time only.

PROCEDURE TO RUN AN ANALYSIS IN THE BEAM BLANKING MODE :

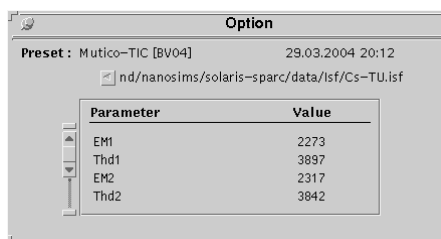
1. Click *yes* option for the beam blanking.

*Note : the beam blanking mode cannot be changed during the analysis.*

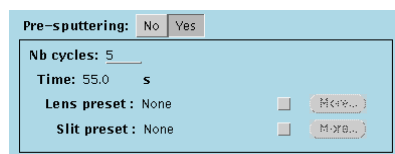
### 3.2.3 Preset



Lens Preset and/or Slit Preset can be applied for analysis. These presets are defined in *Preset*. The Preset definition and parameters values are displayed by selecting **More...** :



### 3.2.4 Pre-sputtering



- Default status of the option : No.
- Maximum value of the pre-sputtering number of cycles : 600.

When this option is active, the sample is sputtered for a number of cycle entered by the operator before acquiring data. As for analysis Lens Preset and/or Slit Preset can be applied for pre-sputtering.

At the end of the pre-sputtering, the analysis starts automatically.

PROCEDURE TO RUN AN ANALYSIS WITH A PRE-SPUTTERING :

1. Click *yes* option for the pre-sputtering. A box opens
2. Enter the number of cycles for the pre-sputtering.

3. Select Preset, if required.

### 3.2.5 X step, Y step, Number of steps

X step (microns):	10	Y step (microns):	10
Number of steps:	100		

These *measurement conditions* parameters are available for the *line scan* analyses only.

- *Xstep*, default value : 10  $\mu\text{m}$ , minimum value : 0  $\mu\text{m}$ , maximum value : 1000  $\mu\text{m}$ .
- *Ystep*, default value : 10  $\mu\text{m}$ , minimum value : 0  $\mu\text{m}$ , maximum value : 1000  $\mu\text{m}$ .
- *Number of steps*, default value : 100, minimum value : 1, maximum value : 5600.

During a line scan analysis, at the end of every cycle carried out to measure the secondary ion intensity for all species defined in the *species table*, the sample stage is moved in both X and Y directions according to the *Xstep* and *Ystep* parameters.

The number of cycles for a *line scan* analysis is fixed by the number of steps.

### 3.2.6 Number of blocks, Cycles per Block, Rejection

Block number:	10
Meas. per block:	10
Rejection at (sigma):	2

These *measurement conditions* parameters are available for the *isotopes* analysis only.

- *Number of blocks*, default value : 10, minimum value : 1, maximum value : 2800.
- *Cycles per block*, default value : 20, minimum value : 2, maximum value : must be such that the product *Number of blocks* x *Cycles per block* < 5600
- *Rejection*, default value : 2, minimum value : 1, maximum value : 99.

During an *isotopes* analysis, statistical computations are performed on the intensity ratios. These computation are carried out automatically at the end of every block which consists of a given number of cycles entered by the operator. The computations are performed within a block and for data accumulated for the first cycle. **The ratio mean values are computed with a rejection criteria (number of  $\sigma$ ) entered by the operator.**

The results of computation for intensity ratios are displayed in the *intensity ratios* window of the *analysis control* program (see *analysis control* chapter).

### 3.2.7 Ratios...

Ratios (ex: 1/2)			
1: 0 / 0	2: 0 / 0	3: 0 / 0	4: 0 / 0
5: 0 / 0	6: 0 / 0	7: 0 / 0	8: 0 / 0
9: 0 / 0	10: 0 / 0	11: 0 / 0	12: 0 / 0
13: 0 / 0	14: 0 / 0	15: 0 / 0	16: 0 / 0
17: 0 / 0	18: 0 / 0	19: 0 / 0	20: 0 / 0
Clear			

This option is available for *isotopes* analysis only.

- Default value : none.
- Maximum number of ratios : 20

At the end of every block, intensity ratios can be computed according to the ratio definitions entered by the operator in the *ratios* dialog box.

Every intensity ratio to be computed is defined as the ratio of the species numbers in the *species table* dialog box.

Click *clear* in the *ratios table* dialog box to erase all ratios already entered.

Example :

In the *species table* dialog box, the three silicon isotopes have been entered. 28Si is the species #1, 29Si the #2 and 30Si the #3.

If the ratios of interest are 29Si/28Si and 30Si/29Si, the ratio definition 2/1 and 3/2 must be entered in the *ratios table* dialog box.

### 3.2.8 Counting time

In No Scanning mode the counting time per point limits are:

- Default value :1 s
- Minimum value : 250 ms
- Maximum value : 20 s

In Scanning mode the counting time per pixel limits are:

- Default value :1000  $\mu$ s
- Minimum value : 2  $\mu$ s
- Maximum value : 1 s

For each magnetic field a counting time per cycle must be entered.

### 3.2.9 Magnetic field

In Magnetic Peak Switching Mode or Combined Analysis Mode, magnetic fields values are displayed in a list:

B1	3000.000
B2	3436.584
B3	4000.000

For each magnetic field selected in the list, the program displays the mass species and the detectors entered in the *TunToDefa.dat* file coming from *Tuning* (see *Tuning User's Guide*).

N	Id	Species Symbol	a.m.u.	Radius
1	Tr1		21.710	199.998
2	Tr2	28Si	28.120	227.617
	Tr3		44.199	285.367
3	Tr4	28Si2	56.000	321.210
	Tr5		145.223	517.265
	Tr6		152.134	529.430

### 3.2.10 Waiting time

In Magnetic Peak Switching Mode or Combined Analysis Mode, a waiting time for the magnet stabilization must be entered for each magnetic field switch. By default this value is automatically computed, but it's possible to enter a specific value by uncheck the *Computed* graphical item.


The waiting time is computed with the empirical relationship :

$$\text{Waiting time (s)} = \frac{|B(\text{final}) - B(\text{initial})|}{B(\text{final})} * \text{Slope} + \text{Offset}$$


where B(initial) and B(final) are the B fields value in bits, corresponding to the initial and final points of the magnetic field switching. Slope and Offset are two coefficients entered in the *Setup B Field* page (*Waiting Time Computed* parameters). These parameters differs according the mode NMR or Hall.

### 3.2.11 Centering


#### 3.2.11.1 Automatic Peak Centering

The Automatic Peak Centering can be applied by selecting the check . The parameters of this centering are entered in the *TunToDefa.dat* file coming from *Tuning* (see *Tuning User's Guide*).

##### Decription du centrage


The correction done on the deflecting plate can be applied on other detector by entering the peak number as following .

#### 3.2.11.2 Automatic Energy Centering

The Automatic Energy Centering can be applied by selecting the check . The parameters of this centering are entered in the *TunToDefa.dat* file coming from *Tuning* (see *Tuning User's Guide*).


##### Decription du centrage

#### 3.2.11.3 Secondary Ion Beam Centering

The Secondary Ion Beam Centering can be applied by selecting the check . The parameters of this centering are entered in the *TunToDefa.dat* file coming from *Tuning* (see *Tuning User's Guide*).

##### Decription du centrage

#### 3.2.11.4 EOS Centering

The EOS Centering can be applied by selecting the check . The parameters of this centering are entered in the *TunToDefa.dat* file coming from *Tuning* (see *Tuning User's Guide*).

##### Decription du centrage



**The CAMECA NANOSIMS 50 L**  
**Analysis Software user's guide**

# Contents

<b>1.</b>	<b>INTRODUCTION.....</b>	<b>3</b>
1.1	ENTER/EXIT PROGRAM.....	3
1.2	DIALOG BOXES WINDOW.....	4
1.2.1	<i>Analysis control</i> .....	4
1.2.2	<i>Curves display</i> .....	5
1.2.3	<i>Images display</i> .....	5
1.2.4	<i>Results</i> .....	6
<b>2.</b>	<b>DIALOG BOX FOR THE ANALYSIS CONTROL PROGRAM.....</b>	<b>6</b>
2.1	FILE NAME.....	6
2.2	SHOW CURVE.....	7
2.3	START.....	8
2.4	STOP.....	9
2.5	ABORT.....	9
2.6	CHANGE TIME.....	9
2.7	CONTROL $\nabla$ .....	9
2.8	ANALYTICAL PARAMETERS.....	10
2.9	CHANGE MC.....	11
<b>3.</b>	<b>DIALOG BOX FOR THE CURVE DISPLAY.....</b>	<b>11</b>
3.1	PRINT.....	11
3.2	LOG / LIN.....	11
3.3	UNITS.....	12
3.4	X AND Y.....	12
3.5	AXIS LIMITS.....	12
3.6	CURVE OPTIONS.....	12
<b>4.</b>	<b>DIALOG BOX FOR THE IMAGE DISPLAY.....</b>	<b>12</b>
4.1	PIXEL INFORMATION.....	12
4.2	AUTOSCALE.....	13
4.3	COLOR SCALE.....	13
4.4	SPOT COLOR.....	13
<b>5.</b>	<b>DIALOG FOR ISOTOPE ANALYSIS RESULTS.....</b>	<b>13</b>
5.1	TERMINOLOGY.....	14
<b>6.</b>	<b>GRAIN MODE SPOT SELECTION.....</b>	<b>15</b>
6.1	NO SCANNING MODE.....	15
6.2	GRAPHIC OR SEMI GRAPHIC MODE.....	15
<b>7.</b>	<b>LINESCAN BEAM CONTROL.....</b>	<b>16</b>

# 1. INTRODUCTION

This program is used to control the present acquisition. Functions are available :

- to define the file name to save data on the disk at the end of the acquisition.
- to start, stop or abort the present acquisition.
- to display curves of species being analyzed, with basic capabilities for the data paging.
- to modify the total acquisition time of the present analysis.
- to update the *analytical parameters* table.

## 1.1 Enter/Exit Program

- In order to start an analysis, windows must be opened by clicking either the *Analysis* icon



in the main icon board (in case of re-starting with previous analytical parameters) or *go*



*analysis* icon after defining a new analysis in the *analysis definition* program. The icon



must be red.

- In order to iconize the program click the *analysis* icon in the main icon board.
- In order to quit the program, click the right mouse button in the *analysis* window header and select *quit* in the pull down menu. All dialog boxes are erased and the *analysis* icon in the main icon board returns to the blue colour.

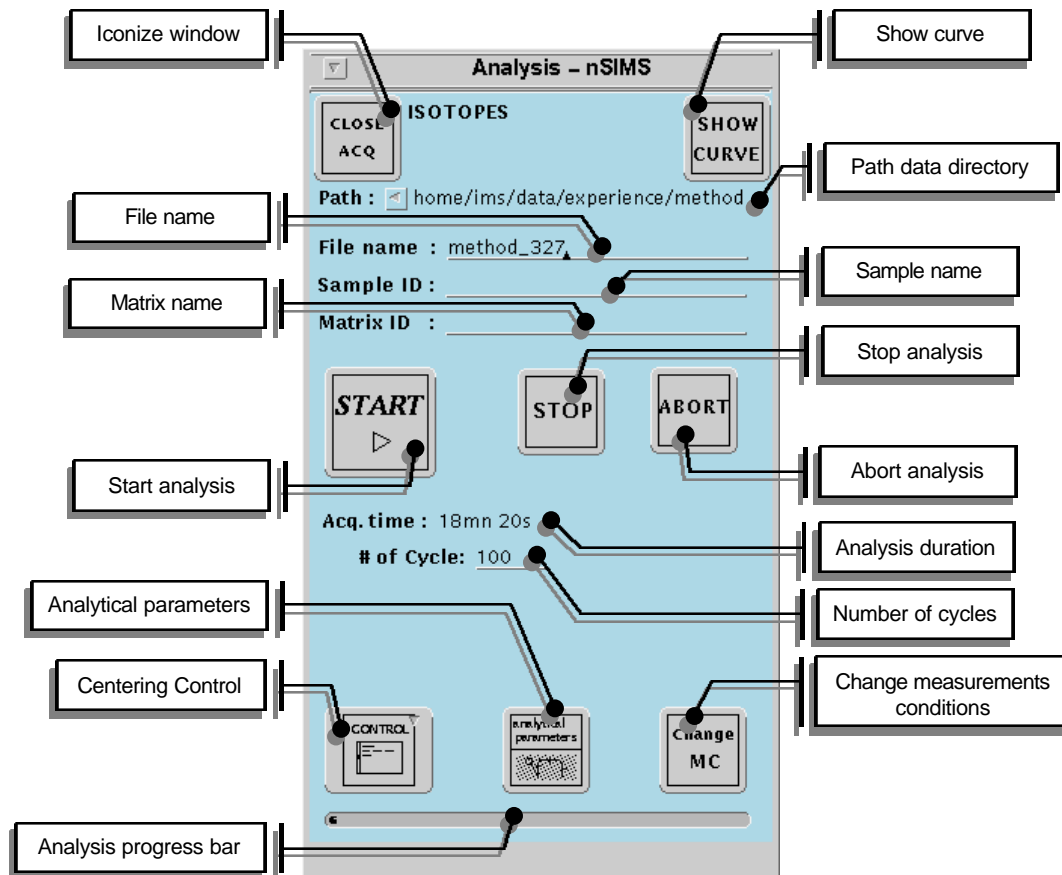
## 1.2 Dialog boxes window

When entering the *analysis control* program two or three dialog box open :

- Analysis control
- Curves or Images display
- Results (only for *isotopes*)

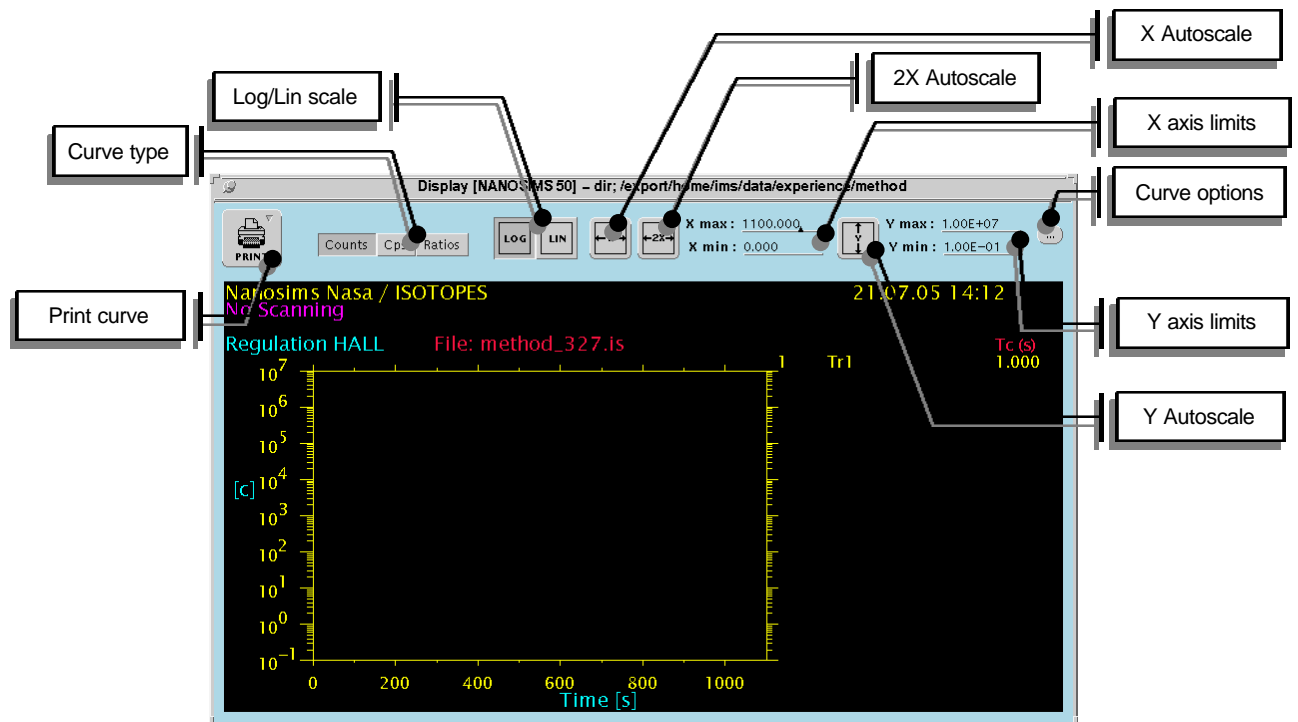
### 1.2.1 Analysis control

The following figure describes the analysis control window for Isotopic analysis.



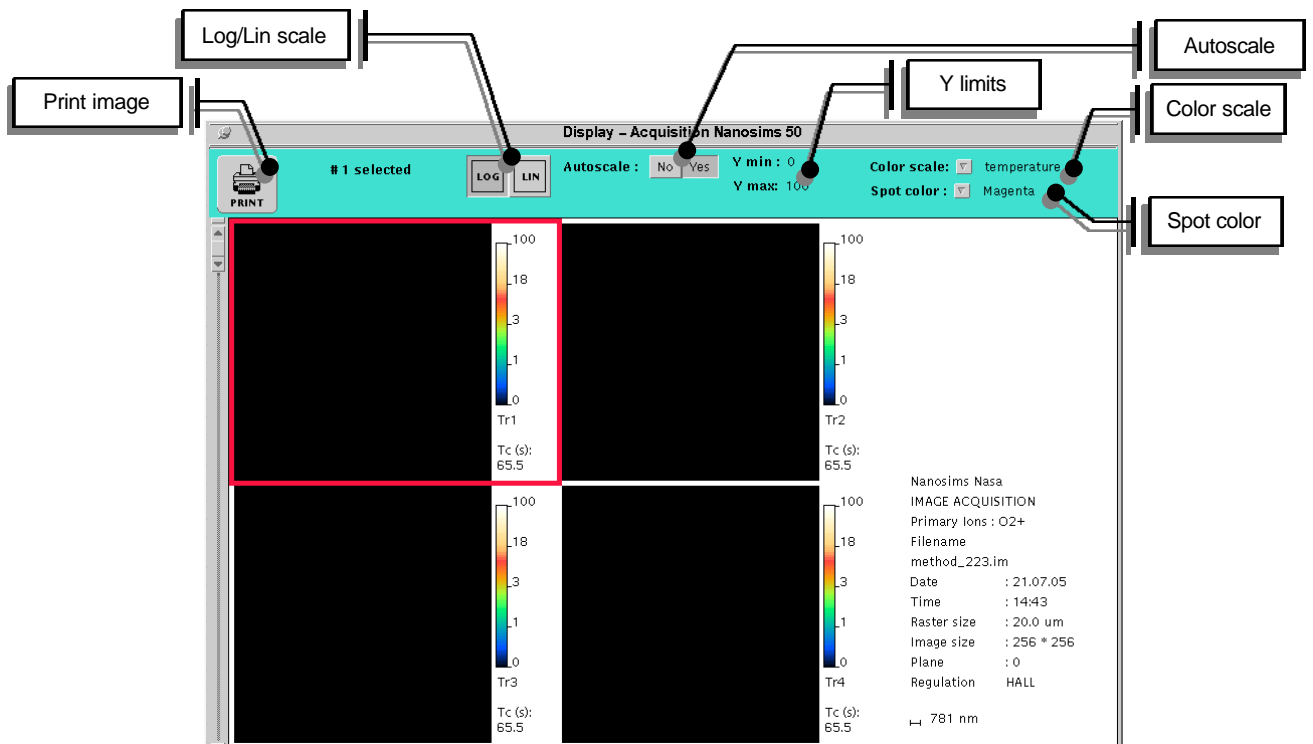
### 1.2.2 Curves display

The following figure describes the analysis curve display for Isotopic analysis.



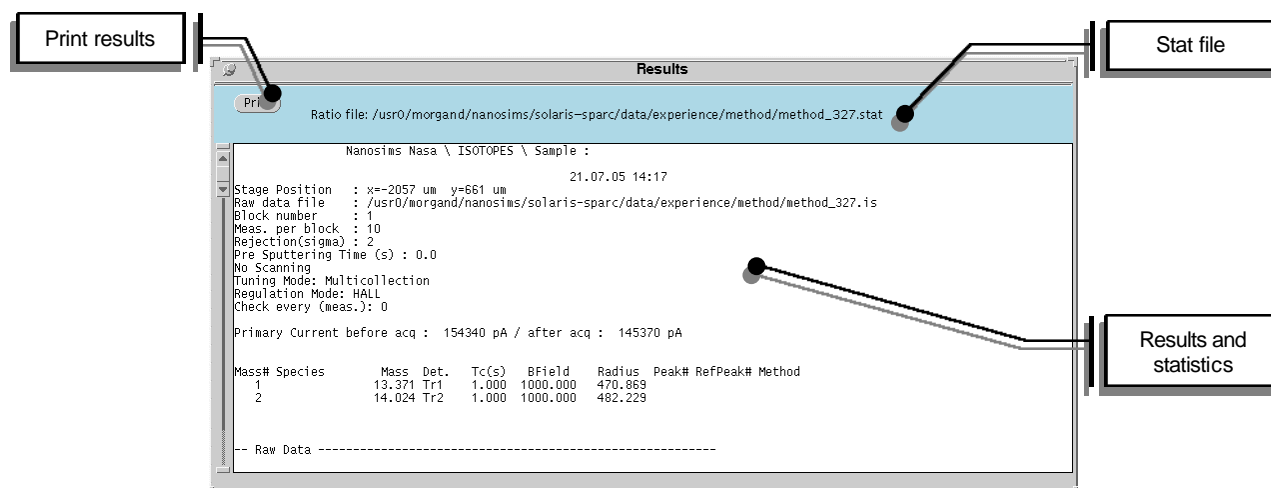
### 1.2.3 Images display

The following figure describes the analysis display for Image analysis.



## 1.2.4 Results

The following window displays results for the intensity ratios and the statistical computations of these ratios for Isotopic analysis.



## 2. DIALOG BOX FOR THE ANALYSIS CONTROL PROGRAM

### 2.1 File name

The *file name* editing field, , is used to enter the name of the *raw data* target file opened for every analysis started. At the end of the analysis, the *raw data* file is closed and saved on the disk. It contains : the secondary ion intensities measured and all the experimental conditions.

The name of a *raw data* file consists of two parts : *filename.analysis type extension*

A new *filename* must be entered without extension. The extension is automatically added to the *filename* by the program, according to the analysis type to be run.

The different analysis type extensions are reported in the table following :

Analysis	Analysis type extension
Image	.im
Depth profile	.dp
Isotope	.is
Line scan	.ls

When the *analysis control* dialog box opens, the default *raw data* target file of a given analysis is the file which already contains the present measurement conditions defined in the *analysis definition* program.

Note that, if the file contains already secondary ion intensities data in addition to the *measurement conditions* parameters (see *analysis definition* chapter), the *filename* is updated by added an increment number order.

The different types of data are written in the *raw data* target file at different steps of the overall analysis procedure. The writing procedure of the data is summarized in the table following :

Step of the analysis procedure	Content of the target file for raw data
Analysis definition	Open of the raw data target file Measurement conditions Detector parameters
Start analysis	Measurement conditions Detector parameters Analytical parameters
Stop analysis	Measurement conditions Detector parameters Analytical parameters (updated) Centering procedures (if applied) Secondary ion intensities Save of the raw data target file

When the default name of the *raw data* target file is modified, the data already contained in the default file are copied into the new one. At the end of the analysis, this new defined target file contains both secondary ion intensities and all present experimental conditions.

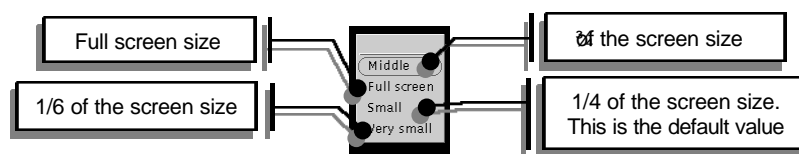
## 2.2 Show curve



The button toggles between "show" and "hide" status for the *curve display* window.

The *curve display* window can be re-sized by using the mouse. There are also 4 size presets. They are selected by pressing the right mouse button in the background of the curve display window.


A pop-up menu opens, offering 4 choices :



*Note : when the size of the window is reduced, the graph in the window is automatically refreshed every minute. In order to refresh immediately, click right mouse button in the window header and select refresh.*

## 2.3 Start



The button  starts a new analysis, to be run with the present measurement conditions defined in the *species table* of the *analysis definition* program.

During the analysis, messages are displayed in the footer of the dialog box :

- Analysis status : *running analysis* (beam on) or *measuring primary current* (beam off).
- The present analyzed species for depth profiles, line scans, image acquisition.
- The present cycle for the depth profiles, image acquisitions and isotopic ratios.

### PROCEDURE TO START A NEW ANALYSIS :

1. Click *analysis definition* icon in the main icon board.
2. Define new *measurement conditions* (see *analysis definition* chapter).
3. Click *go acquisition* icon in the *measurement conditions* dialog box of the *analysis definition* program. All dialog boxes linked to the *analysis definition* program are closed. The *analysis control* dialog box opens.
4. If required, enter a new name for the *raw data* target file.
5. Click *start*
6. Click the confirmation prompt.
7. The primary beam is switched OFF to measure the primary beam intensity, then switched ON to start the acquisition.

### PROCEDURE TO RE-START THE SAME ANALYSIS :


1. If required, click *analysis* icon in the main icon board to open the *analysis control* dialog box.
2. Click *start*
3. Click the confirmation prompt.
4. The primary beam is switched OFF to measure the primary beam intensity, then switched ON to start the acquisition.

### PROCEDURE TO RE-START THE SAME ANALYSIS TYPE BUT WITH DIFFERENT MEASUREMENTS CONDITIONS :

1. If required, click *analysis* icon in the main icon board to open the *analysis control* dialog box.
2. Click *change MC* in the *analysis control* dialog box. All dialog boxes linked to the *analysis control* program are closed. The dialog boxes of the *analysis definition* program are opened with the parameter values corresponding to the last analysis run..
3. Modify the *measurement conditions* set-up. If required save the new *measurement conditions* set-up.
4. Click the *go acquisition* icon in the *measurement conditions* dialog box of the *analysis definition* program. All dialog boxes linked to the *analysis definition* program are closed. The *analysis control* dialog box opens.
6. If required, enter a new name for the *raw data* target file.
7. Click *start*
8. Click the confirmation prompt.
9. The primary beam is switched OFF to measure the primary beam intensity, then switched ON to start the acquisition.

## 2.4 Stop




The button  stops the present analysis. All acquired data are saved on the disk and the raw data target file is definitively closed.

The *stop* command is applied either just at the end of the cycle being recorded (for depth profile, isotope, image acquisition analyses). The stop procedure consists of :

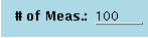
- switching off of the primary beam.
- measuring the primary beam intensity.
- saving all analytical parameters and raw data in the target file on the disk.

## 2.5 Abort




The button  aborts immediately the present analysis. Acquired data are not saved on the disk.

## 2.6 Change time

The field  allows to increase or decrease the number of measure for the present analysis. It is available for *depth profile* and *isotopes* analysis.

## 2.7 Control $\tilde{N}$



The button  is used to display the results in case of the *centering* procedures executed during the present analysis.


There are two display modes : *text* or *graphic*.

- *Text* mode: the corrections done with selected centering are displayed.
- *Graphic* mode: a graphic window opens to display a graph for each correction done with the automatic peak centering procedure.

In order to select the display mode click right mouse button *control*  $\nabla$  to open the pull-down menu.

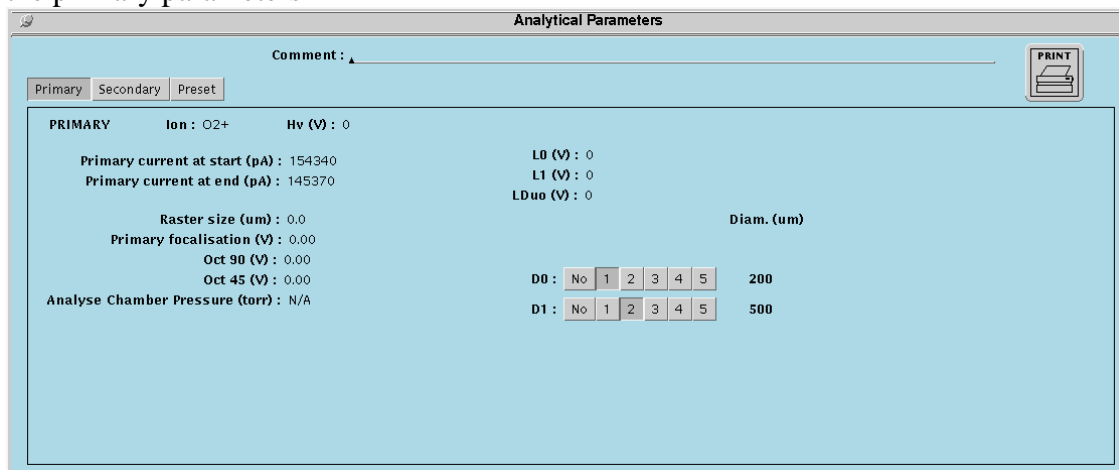
## 2.8 Analytical parameters



The button  edits the *analytical parameters* table of the present analysis. It can be opened at any time either to read or to enter values. In order to close the table click the *analytical parameters* button.

This table is divided in three categories :

- the primary parameters



**Analytical Parameters**

Comment : \_\_\_\_\_

Primary Secondary Preset

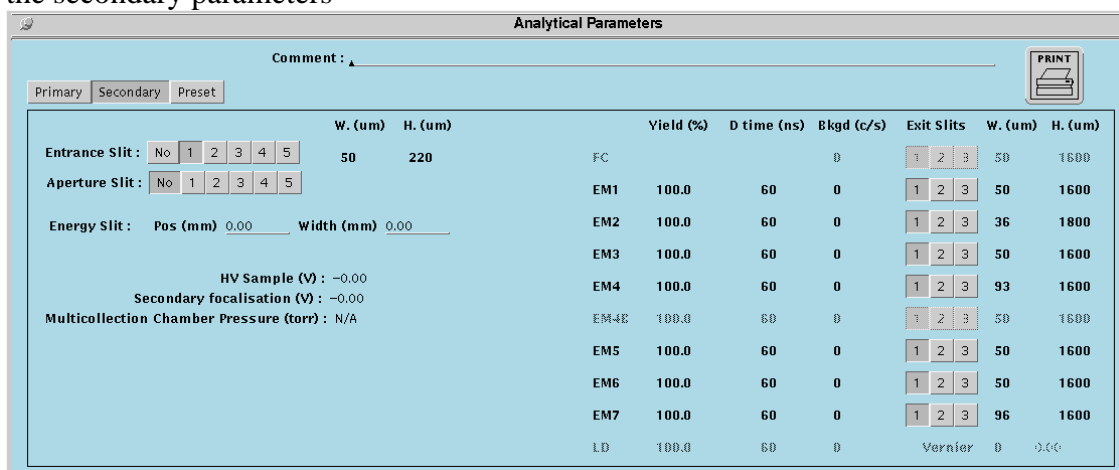
**PRIMARY** Ion : O2+ Hv (V) : 0

Primary current at start (pA) : 154340 L0 (V) : 0  
 Primary current at end (pA) : 145370 L1 (V) : 0  
 LDuo (V) : 0

Raster size (um) : 0.0 Diam. (um)  
 Primary focalisation (V) : 0.00  
 Oct 90 (V) : 0.00  
 Oct 45 (V) : 0.00  
 Analyse Chamber Pressure (torr) : N/A

D0 : No 1 2 3 4 5 200  
 D1 : No 1 2 3 4 5 500

- the secondary parameters



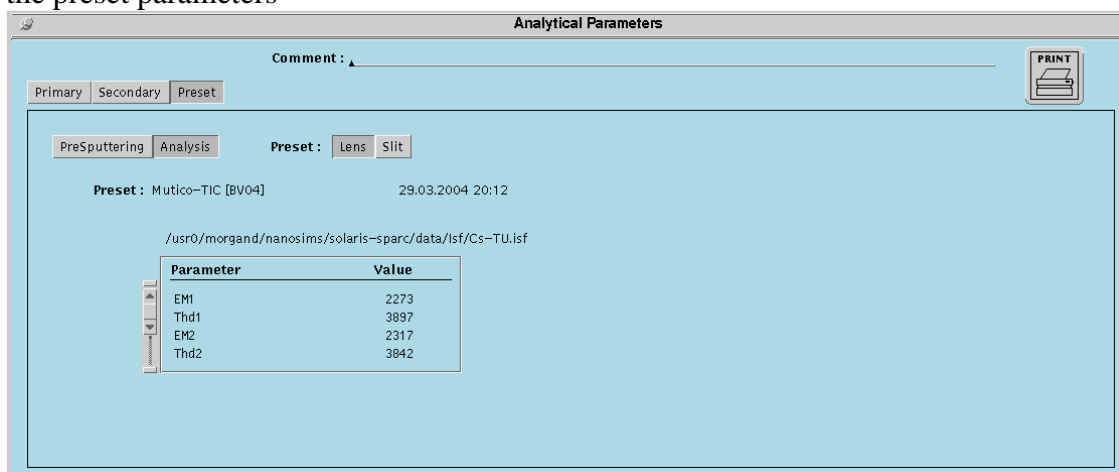
**Analytical Parameters**

Comment : \_\_\_\_\_

Primary Secondary Preset

Entrance Slit : No 1 2 3 4 5 W. (um) 50 H. (um) 220 Yield (%) FC D time (ns) 0 Bkgd (c/s) 0 Exit Slits 1 2 3 W. (um) 50 H. (um) 1600  
 Aperture Slit : No 1 2 3 4 5 EM1 100.0 60 0 1 2 3 50 1600  
 Energy Slit : Pos (mm) 0.00 Width (mm) 0.00 EM2 100.0 60 0 1 2 3 36 1800  
 HV Sample (V) : -0.00 EM3 100.0 60 0 1 2 3 50 1600  
 Secondary focalisation (V) : -0.00 EM4 100.0 60 0 1 2 3 93 1600  
 Multicollection Chamber Pressure (torr) : N/A EM4B 100.0 60 0 1 2 3 50 1600  
 EM5 100.0 60 0 1 2 3 50 1600  
 EM6 100.0 60 0 1 2 3 50 1600  
 EM7 100.0 60 0 1 2 3 96 1600  
 LD 100.0 60 0 Vernier 0 0.00

- the preset parameters



**Analytical Parameters**

Comment : \_\_\_\_\_

Primary Secondary Preset

PreSputtering Analysis Preset : Lens Slit

Preset : Mutico-TIC [BV04] 29.03.2004 20:12


/usr0/morgand/nanosims/solaris-sparc/data/Isf/Cs-TU.isf

Parameter	Value
EM1	2273
Thd1	3897
EM2	2317
Thd2	3842

*Note : the update of the table must be carried out before the end of the present analysis to be saved together with raw data on the disk.*

## 2.9 Change MC




The button  loads the measurement conditions of the last analysis stopped (or aborted) in the *species table* dialog box of the *analysis definition* program. The *Change MC* function is not available while running an analysis.

Note that the *species table* dialog box of the *define analysis* program can be opened at any time while acquiring data, by clicking the *analysis definition* icon in the main icon board. So that, new measurement conditions for the next analysis can be entered and to saved on the disk. However, it is very important to use a file name for the new measurements conditions different from the file name of the present analysis to avoid an overwriting of the present analysis data. When the same name is entered, there is a confirmation prompt.

## 3. DIALOG BOX FOR THE CURVE DISPLAY

### 3.1 Print



The button  prints direct the graph of the present analysis displayed in the *curve* or *image display* window. Two output devices can be selected: postscript printer or HPGL plotter. The print function can be activated whatever the present analysis status is (running, stopped, paused).

For the postscript printer two output formats are offered : *landscape* and *portrait*.

The graph of the present analysis can be also stored in a print file to be printed later on with three different formats : postscript, HPGL and ASCII. The print files are saved in the directory */space/ims/data/plot*.

#### PROCEDURE TO PLOT THE GRAPH OF THE PRESENT ANALYSIS :

1. Press right mouse button to open the *print* ▾ pull-down menu.

Either

2. Select the output device and release the mouse button. The printing starts.

Or

- 2a. If required click *options...* to check the default value of the printing format (landscape or portrait).
  - 2b. Click the required printing format.
  - 2c. Click *print* to start the printing.
3. Click the pin in the header of dialog box to close it.

#### PROCEDURE TO CREATE A FILE PRINT OF THE GRAPH OF THE PRESENT ANALYSIS :

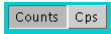
1. Press right mouse button. to open the pull-down menu *print* ▾.
2. Select *options...* A dialog box opens.
3. Click the required file type.
3. Click the required printing format.
4. Enter a file name. The file name extension is automatically entered by the routine according to the file type selected.
5. Click *save* to create the file on the disk.
6. Click the pin in the header of dialog box to close it.


### 3.2 LOG / LIN



These two buttons  toggle from linear to logarithmic scale for Y scale.

### 3.3 Units

In *Depth profile* or *Linescan acquisition mode*, these two buttons  toggle unit from counts to count/s.

In *Isotopic acquisition mode*, these three buttons  toggle unit from counts to count/s or ratios.

### 3.4 X and Y



: executes an auto-scale of the X axis.




: executes an auto-scale of the double X axis limit .




: executes an auto-scale of the Y axis.

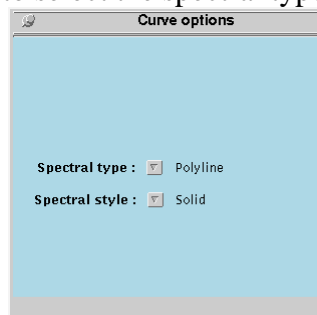
*Note : these functions do not exist for the image acquisition mode.*

### 3.5 Axis Limits

These field  are used to manually adjust the low and high limits of the X and Y axes of the graph of the present analysis.

### 3.6 Curve options

The button  opens a dialog box to select the spectral type and style :



The spectral type available  are displayed by clicking ▽ button. Idem for the spectral type available .

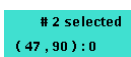
## 4. DIALOG BOX FOR THE IMAGE DISPLAY

This window contains a grid with the number of species to be analyzed.



The default values for the low and high limits of the color scale of each image are the minimum and maximum count number per pixel measured in the image.

The *Print* and *Lin/Log* buttons are the identical to the *Curve Display*.

### 4.1 Pixel information

The pixel information  are related to the image surrounded with a red frame. By moving the mouse on this image the pointed pixel coordinates and intensity are displayed with the selected image id.


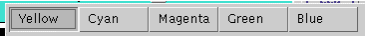
## 4.2 Autoscale

The autoscale selection  and limits values of the color scale  are related to the image surrounded with a red frame. In *No autoscale* mode the color scale limits values fields can be adjusted .

## 4.3 Color scale

The selection  is used to change the *LUT* common to all images by clicking the ▾ button : 

## 4.4 Spot color

The selection  is used to change the color of the mouse spot by clicking the ▾ button : 

## 5. DIALOG FOR ISOTOPE ANALYSIS RESULTS

When an *isotope* analysis is running, there is an extra window which is opened in the analysis control program. The window displays results for the intensity ratios and the statistical computations of these ratios.

This window consists of two different *intensity ratios* tables :

- Raw data.
- Corrected data

In these tables the following results are displayed :

- *Block to block results* : this table contains the results for intensity ratio computation for data recorded within one block only.
- *Accumulated results* : this table contains the results for intensity ratio computation for data recorded for the first cycle.

The data displayed are updated at the end of each block.

At the end of the analysis, the *intensity ratios* tables are saved on the disk with an ASCII format in *current\_filename.stat* file.

Click *print* button to print the content of the file on the printer.

In order to open or close the *intensity ratios* window click the *show curve* button.

## 5.1 Terminology

- **N\_cycles** : it is the number of cycles accumulated after rejection.
- **Mean** : it is the mean value of the ratio computed after rejection.
- **SD** : it is the standard deviation computed on the N\_cycles.
- **N\_rej**: it is the number of rejected ratios to compute the mean ratio.
- **Err mean (%)** : it is the standard error of the mean computed with the relationship :

$$Err \text{ mean } (\%) = 100 \times \frac{\text{Standard deviation}}{\text{mean}} \times \frac{1}{\sqrt{n}}$$

where  $n = N_{\text{cycle}} - N_{\text{rej}}$

- **Poisson(%)** : it is the Poisson's statistics computed over  $N_{\text{cycles}}$  with the relationship :

$$Poisson(\%) = 100 \times \left( \sqrt{\frac{1}{\sum_{i=1}^n N_i(A)}} + \sqrt{\frac{1}{\sum_{i=1}^n N_i(B)}} \right)$$

where  $n = N_{\text{cycle}} - N_{\text{rej}}$ ,  $N_i(A)$  and  $N_i(B)$  are the number of counts integrated in the cycle # i not rejected for the species A and B, *respectively* .

- **Khi2** : it is the  $\chi^2$  statistics computed with the relationship :

$$c^2 = \left( \frac{\text{Err mean}}{\text{Poisson}} \right)^2$$

- **Corr data** : the corrected datas in the cycle #i for the species A are with the relationship :

$$\text{Corr data}_i(A) = \left( \frac{N_i(A) - \text{Background}(DetA) \times Ct}{1 - (N_i(A) - \text{Background}(DetA) \times Ct) \times \left( \frac{\text{Deadtime}(DetA) \times 10^{-9}}{Ct} \right)} \right)$$

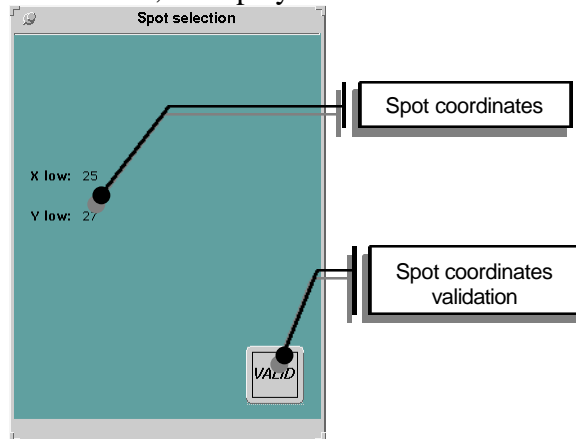
where  $N_i(A)$  is the number of counts in the cycle #i for the species A,  $Ct$  is the counting time in s,  $\text{Background}(DetA)$  is the background of the detector dedicated to species A,  $\text{Deadtime}(DetA)$  is the dead time of the detector dedicated to species A

## 6. GRAIN MODE SPOT SELECTION

After acquiring images and defining isotopes analysis two modes for grain mode spot selection are available : *No scanning* and *Scanning*.

### 6.1 No scanning mode

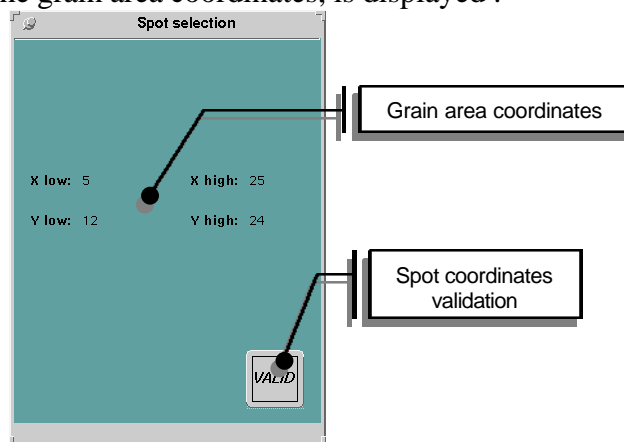
In this mode, the spot selection is done by clicking on the image the grain to be analyzed. The following window, containing the spot coordinates, is displayed :



### 6.2 Graphic or Semi graphic mode

In this mode, the spot selection is done by clicking on the image the grain area to be analyzed. In the *graphic* mode, the area is defined by selecting the center of this area and enlarging it with the mouse. In the *semi graphic* mode, the area size is defined in *defanalysis* and the position by selecting the center on the image

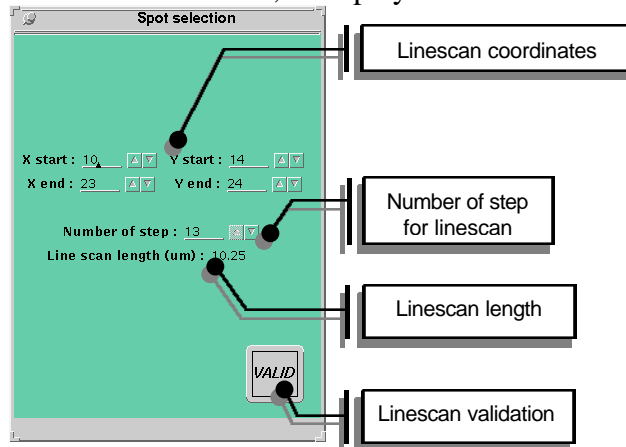
The following window, containing the grain area coordinates, is displayed :



## 7. LINESCAN BEAM CONTROL

After acquiring images, the *Linescan beam control* size definition is done by select the start point and drag the mouse to the end point.

The following window, containing the linescan definition, is displayed :





**The CAMECA NANOSIMS 50 L**  
**Chained Analysis Software user's guide**

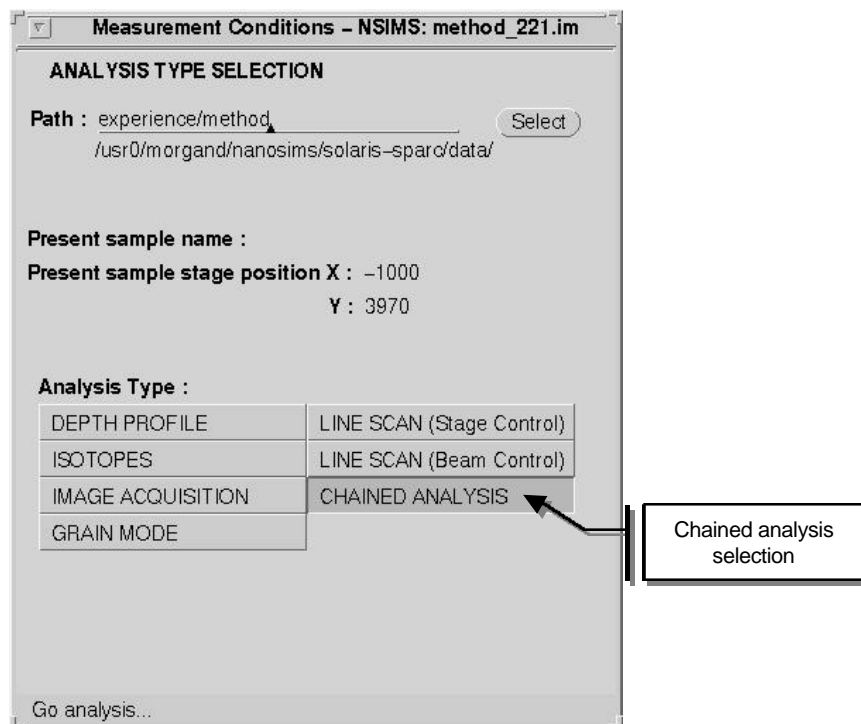
# Contents

<b>1.</b>	<b>CHAINED ANALYSIS PRINCIPLES.....</b>	<b>3</b>
<b>2.</b>	<b>THE MAIN WINDOW .....</b>	<b>3</b>
2.1	EDIT MODE .....	3
2.2	EXECUTION MODE.....	4
<b>3.</b>	<b>CHAINING DEFINITION.....</b>	<b>4</b>
3.1	FILE MANAGEMENT.....	4
3.2	CHAINING MANAGEMENT.....	4
3.3	ANALYSIS AND MOVE DEFINITION .....	5
3.3.1	<i>Measurement conditions file selection.....</i>	<i>5</i>
3.3.2	<i>Simple analysis.....</i>	<i>5</i>
3.3.3	<i>Sample Move and analysis.....</i>	<i>5</i>
3.3.4	<i>Scan Move and analysis.....</i>	<i>5</i>
3.3.5	<i>Square Move and analysis .....</i>	<i>6</i>
3.3.6	<i>Analysis, Move and return.....</i>	<i>6</i>
3.3.7	<i>Move to.....</i>	<i>6</i>

## 1. Chained Analysis principles

This software allows the user to configure and execute chained analysis with sample move.

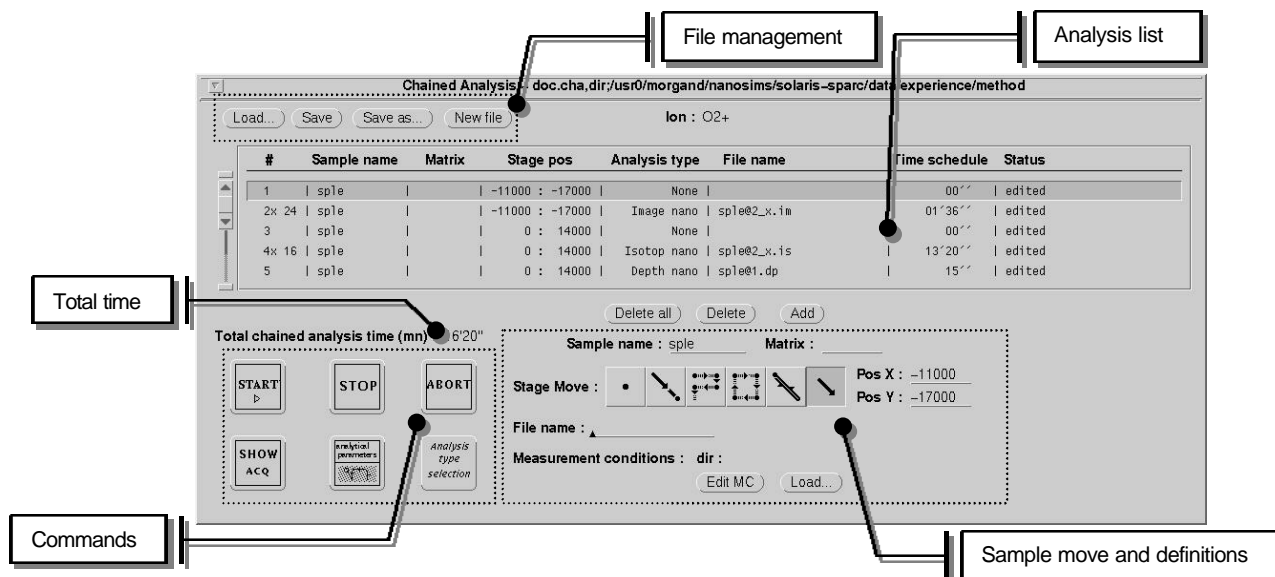
It is activated by the "Chained Analysis" button in "Analysis type selection" from Def\_analysis software



## 2. The Main window

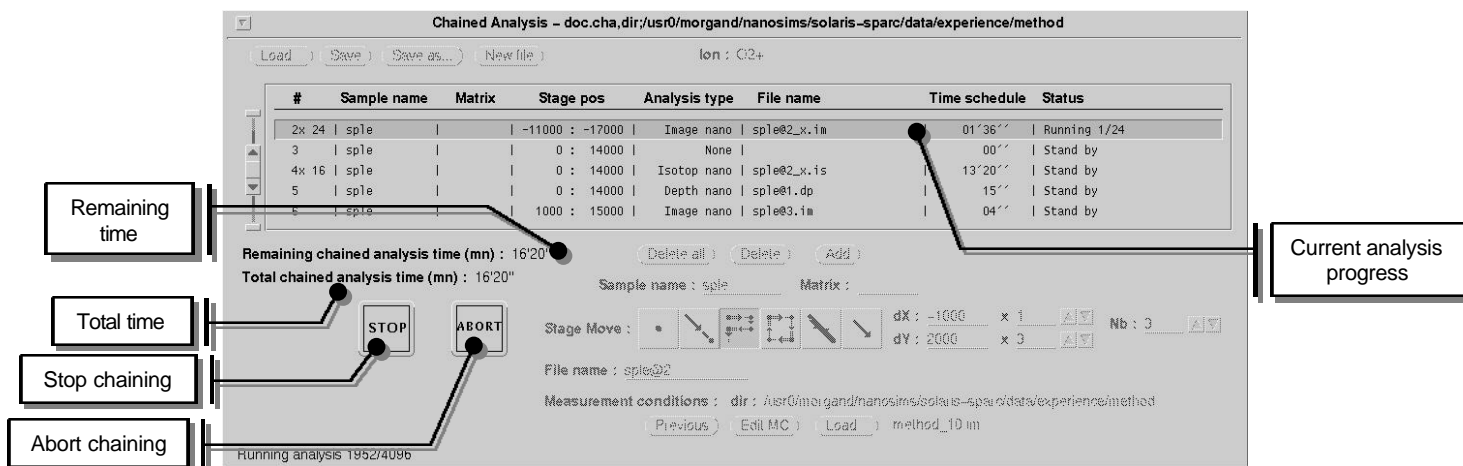
### 2.1 Edit mode



This mode is used to select and configure the analysis to be executed.



## 2.2 Execution mode

This mode is activated when the user select the  button, the following interface is displayed




The user can Stop ( button) or Abort ( button) the chaining.

## 3. Chaining definition

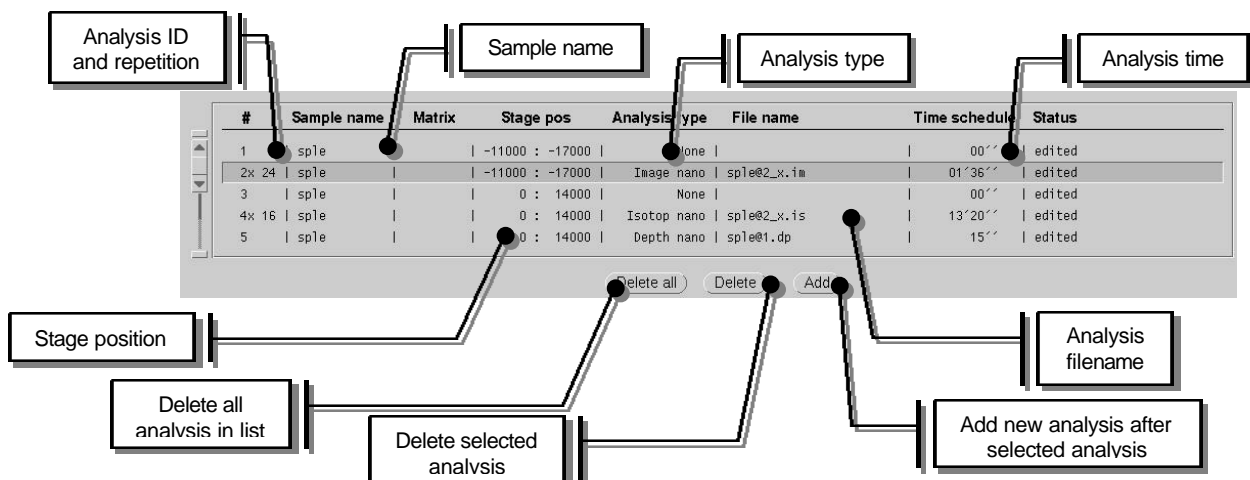
### 3.1 File management

The chaining definition is stored in a file (.cha extension)

With the following interface  the user can :

- load a previous defined chaining file (.cha).
- save the current chaining definition file (.cha).
- create an empty chaining definition file (.cha).

### 3.2 Chaining management

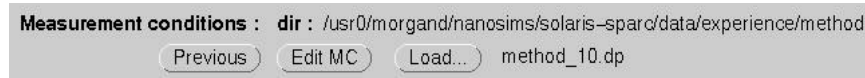


### 3.3 Analysis and move definition


With the following interfaces the user can associate sample move and analysis

#### 3.3.1 Measurement conditions file selection

The following interface allow the user to select a measurement conditions file and modify it, if necessary.



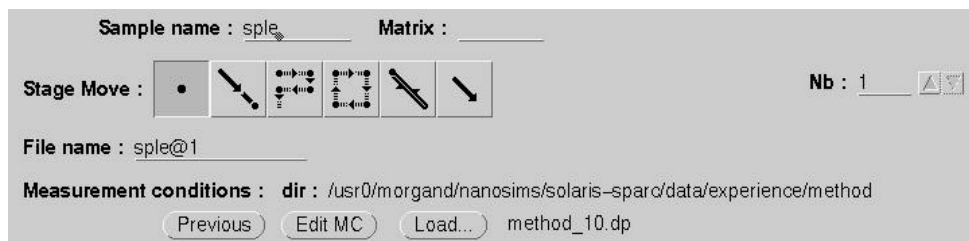
Select the  button to load an MC file

Select  button to edit and modify the selected file if necessary

#### 3.3.2 Simple analysis


An analysis is done at the current sample position.

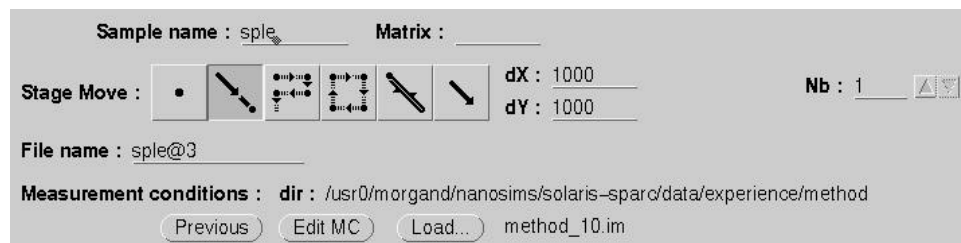
Select the  button, and define the number of repetition



#### 3.3.3 Sample Move and analysis



An analysis is done after a sample move.

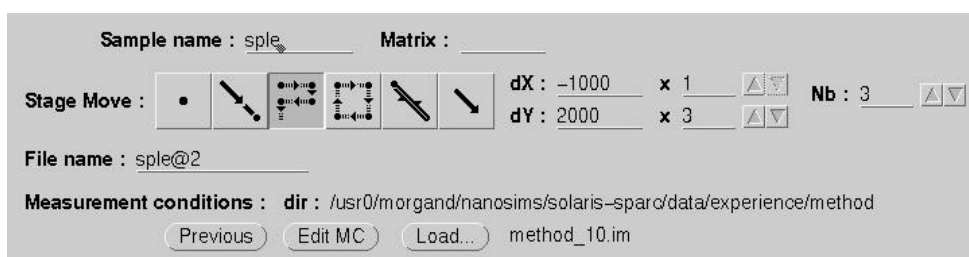
Select the  button, define the X axis move and Y axis move and then define the number of repetition



#### 3.3.4 Scan Move and analysis



An analysis is done for every Y sample , then for every X sample move, then for every -Y sample move, and then for every X sample move.

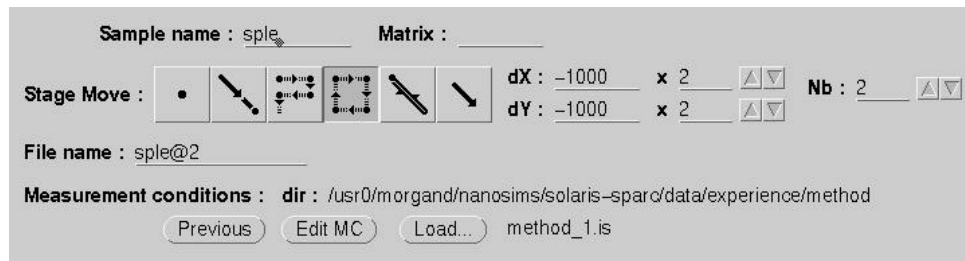
Select the  button, define the X axis move and repetition then the Y axis move and repetition. This move, like a scan, can be repeated many times with  item




### 3.3.5 Square Move and analysis

An analysis is done for every Y sample, then for every X sample move, then for every -Y sample move, and then for every -X sample move.

Select the  button, define the X axis move and repetition then the Y axis move and repetition. This move, like a square, can be repeated many times with  item



Sample name : sple Matrix : \_\_\_\_\_

Stage Move :  dX : -1000 x 2 Nb : 2

dY : -1000 x 2


File name : sple@2

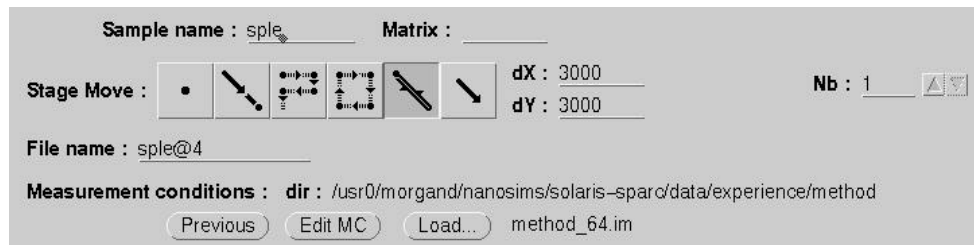
Measurement conditions : dir : /usr0/morgand/nanosims/solaris-sparc/data/experience/method

Previous Edit MC Load... method\_1.is


### 3.3.6 Analysis, Move and return

An analysis is done and after a sample move (X and Y offset) and go back to the initial position (-X and -Y offset).

Select the  button, define the X axis move and Y axis move and then specify the number of repetition



Sample name : sple Matrix : \_\_\_\_\_

Stage Move :  dX : 3000 Nb : 1

dY : 3000


File name : sple@4

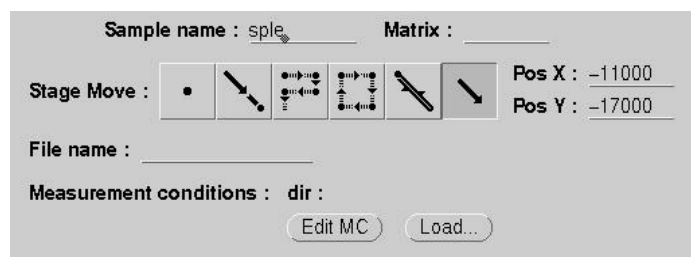
Measurement conditions : dir : /usr0/morgand/nanosims/solaris-sparc/data/experience/method

Previous Edit MC Load... method\_64.im


### 3.3.7 Move to

Move the sample to the defined position.

Select the  button, define the X and Y sample position



Sample name : sple Matrix : \_\_\_\_\_

Stage Move :  Pos X : -11000

Pos Y : -17000

File name : \_\_\_\_\_

Measurement conditions : dir :

Edit MC Load...



# **The CAMECA NANOSIMS 50 L**


## **Holder Software user's guide**

# Contents

<b>1.</b>	<b>ENTER/EXIT SAMPLE HOLDER PROGRAM.....</b>	<b>3</b>
<b>2.</b>	<b>SAMPLE HOLDER FUNCTIONS.....</b>	<b>3</b>
<b>3.</b>	<b>PRESENT HOLDER WINDOW.....</b>	<b>4</b>
3.1	THE MAIN WINDOW .....	4
3.2	ICONS : NAME AND FUNCTION, EDITING FIELD .....	5
3.3	SAMPLE HOLDER SYNOPTIC .....	6
3.4	SAMPLE HOLDER MOTION .....	7
3.4.1	<i>Mouse Control.....</i>	<i>7</i>
3.4.2	<i>Stepped Motion .....</i>	<i>7</i>
3.4.3	<i>Sample To Sample Motion .....</i>	<i>7</i>
3.4.4	<i>Go to X and Y Coordinates .....</i>	<i>7</i>
3.5	HOLDER MODE SIMS/CCD/FCO .....	8
3.6	LOCK/UNLOCK.....	8
3.7	BACKLASH.....	8
3.8	LOCAL AXIS.....	8
3.9	MOTOR INITIALIZATION AND RESET PROCEDURE .....	8
3.10	REFERENCE POINTS .....	9
3.10.1	<i>Reference Point Dialog Box.....</i>	<i>9</i>
3.10.2	<i>Icons : Name and Function, Editing Fields.....</i>	<i>10</i>
3.10.3	<i>Procedure to Create Reference Point .....</i>	<i>10</i>
3.10.4	<i>Procedure to go to a Preset Positions.....</i>	<i>11</i>
3.10.5	<i>Procedure to Delete Preset Positions.....</i>	<i>11</i>
3.11	CRATER MAPPING .....	11
3.11.1	<i>Crater Dialog Box.....</i>	<i>12</i>
3.11.2	<i>Icons : Name and Function, Editing Fields.....</i>	<i>12</i>
3.11.3	<i>Procedure to Go to a Previous Crater Position.....</i>	<i>13</i>
3.11.4	<i>Procedure to Delete Crater Positions .....</i>	<i>13</i>
3.12	LOAD / UNLOAD FUNCTIONS .....	13
<b>4.</b>	<b>EDITING SAMPLE HOLDER WINDOW.....</b>	<b>14</b>
4.1	ICONS, EDITING FIELDS, PULL-DOWN MENUS .....	15
4.2	SAMPLE HOLDER SYNOPTIC .....	15
4.3	PROCEDURE TO ENTER A SAMPLE HOLDER.....	16
4.4	PROCEDURE TO DELETE A SAMPLE HOLDER EDITION .....	16

## 1. Enter/Exit Sample Holder Program

Click the *holder* icon  in the main icon board in order to enter in the *sample holder* routine.

When it's well started and connected, the *holder* icon in the main board seems like .  
In order to open or iconize the application click on this icon.

## 2. Sample Holder Functions

The functions of the *sample holder* program are:

- Enter the name(s) of the sample loaded in different sample holders. These names will be automatically stored in the data file.
- Display of the present position of the sample holder.
- Control of sample holder exchange operations.
- Move from one point to another on the sample holder by either entering coordinates or mouse control.
- Save and load preset positions.
- Display of the crater mapping.

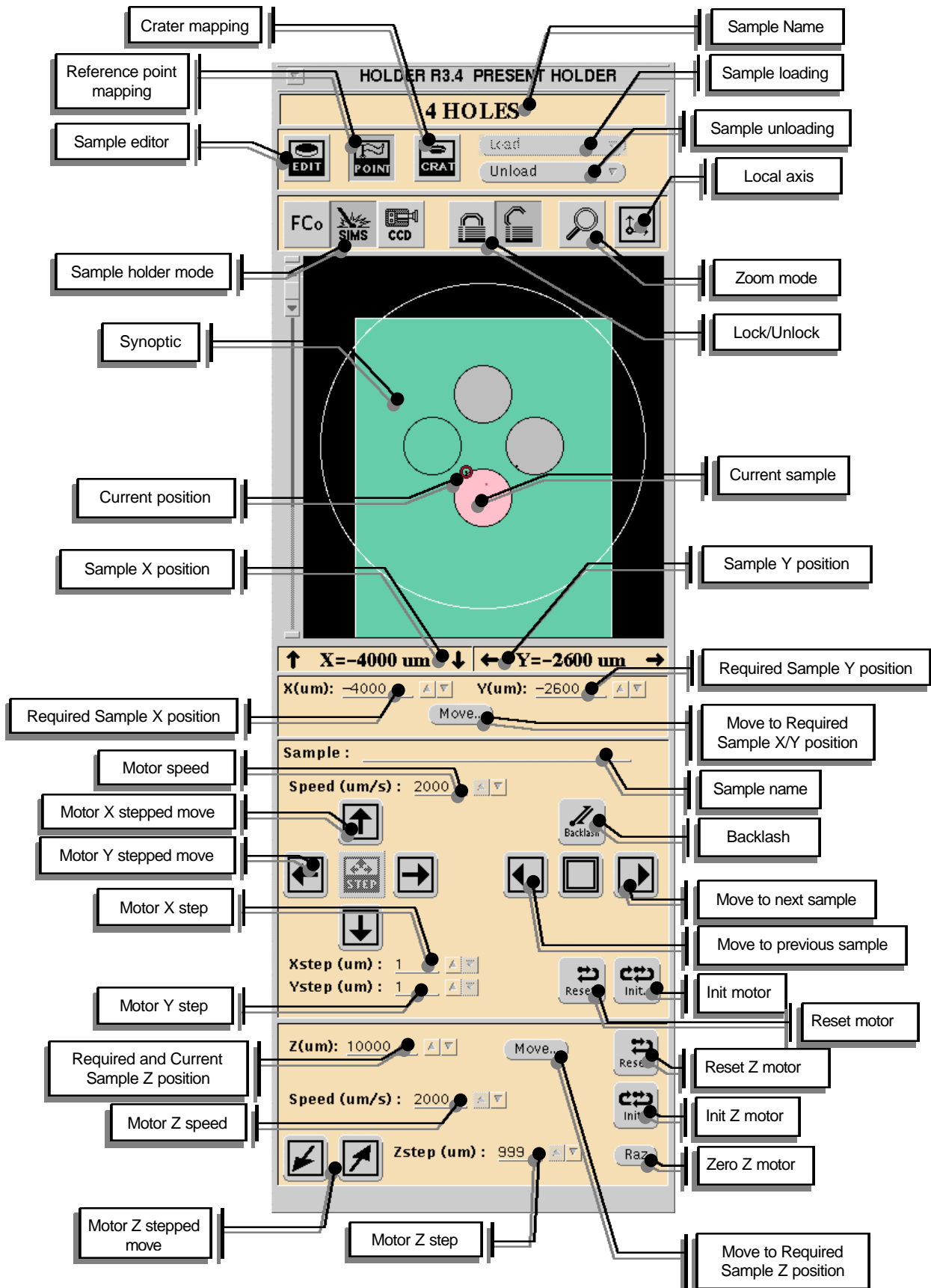
This program is divided in two main function groups :

- Functions relative to the control of the sample stage motion. There are grouped in the window named *Present holder*.
- Functions to define samples fitted in the different sample holders. They are grouped in the widow named *Edit sample holder*.




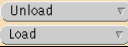





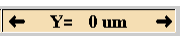
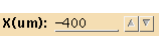
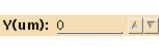


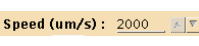


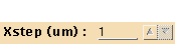
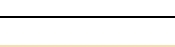





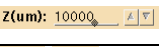

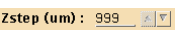

### 3. Present Holder Window

#### 3.1 The main window

The *Present holder* window is represented below :

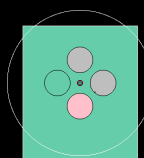
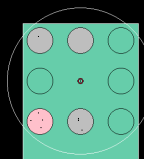
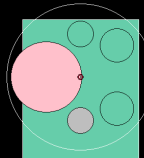
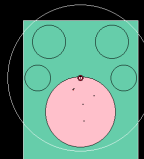
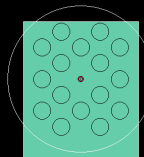


### 3.2 Icons : Name and Function, Editing field

	<i>Edit</i> , to open <i>edit holder</i> window.
	<i>Crater mapping</i> , to print a crater mapping and move the sample holder onto crater positions.
	<i>Reference point</i> , to define and move the sample holder onto reference position.
	<i>Unload, Load</i> , to define the present sample holder.
	<i>FCo/SIMS/CCD</i> , to move the sample holder in different position predefined in the Setup software.
	<i>Lock/Unlock</i> , to lock or unlock sample move.
	<i>Zoom</i> , to represent full scale the present sample in the <i>synoptic</i> field.
	<i>Local axis</i> , to change the origin of the X and Y coordinates.
	<i>X position</i> , display the current motor X position.
	<i>Y position</i> , display the current motor Y position.
	<i>Required X position</i> , to enter a new motor X position.
	<i>Required Y position</i> , to enter a new motor Y position.
	<i>MoveTo</i> , to move the sample holder to the required position.
	<i>Sample name</i> , to set the sample name.
	<i>Motor speed</i> , to change the X,Y motors speed.
	<i>Stepped motion</i> , Stepped motion $Y < 0$ and $Y > 0$ .
	<i>Stepped motion</i> , Stepped motion $X > 0$ and $X < 0$ .
	<i>X Step size</i> , to define step size for stepped X motion of the sample holder.
	<i>Y Step size</i> , to define step size for stepped Y motion of the sample holder.
	<i>BackLash</i> , to decrease mechanical residual uncertainties.
	<i>Previous or Next</i> , to move from one sample to another (circular permutation).
	<i>Centering</i> , to move the sample holder to the center of the present sample.
	<i>Initialization</i> , to initialize the motors.
	<i>Reset</i> , to reset the motors.
	<i>Required Z position</i> , to enter a new motor Z position.
	<i>Stepped motion</i> , Stepped motion $Z > 0$ and $Z < 0$ .
	<i>Motor speed</i> , to change the Z motor speed.
	<i>Zero position</i> , to reset the Z movement to the zero position.

### 3.3 Sample Holder Synoptic

When a sample holder is defined as "loaded" in the sample chamber by the operator (see load/unload function in this chapter), a sample holder synoptic is displayed in the window. Different kind of sample holder can be load :

	Standard : 4 Holes of 10 mm.
	Biology : 8 holes of 10mm
	Geology : 1 hole 1", 2 holes ½, 2 holes of 10 mm.
	Geology 90 : same as Geology but turned by 90°.
	Harvard : 16 housing for Si square (5x5 mm).

#### PRESENT SAMPLE :

- The present sample is the sample in the analysis position (that is, centered on the axis of the secondary ion optics). The present sample synoptic is drawn in pink color.
- Information about the present sample (name, origin) is displayed in the window.

#### MARKERS :

- The *red dot* indicates the relative position of the secondary ion optic axis on the sample holder.
- The *green frame* represents a field of view of 1 x 1 mm<sup>2</sup> covered by the optical microscope
- The *green squares* indicate preset positions of the sample holder defined by the operator.

#### ZOOM :

- Click on the *zoom* icon provides full scale synoptic of the present sample.

### 3.4 Sample Holder Motion

There are several modes to move the sample holder from one position to another. First at all, set the speed for the motor, it must be a positive whole value in [80 $\mu$ m/s, 2000 $\mu$ m/s].

#### 3.4.1 Mouse Control

1. Set the mouse cursor on the point of the synoptic corresponding to the area to be analyzed.
2. Click left mouse button
3. The sample holder is moved to center the selected point on the secondary ion axis. The time required to move towards the new position is displayed into the footer of the *present holder* window.
4. X, Y coordinate display and markers positions are refreshed on the synoptic.

#### 3.4.2 Stepped Motion

1. Either enter a step size in the X and/or Y fields. It must be a positive whole value in [1 $\mu$ m, 99 $\mu$ m].
2. Click one of the four *stepped motion* icons in order to move the sample holder according to the step size. One click executes one step. Click as much as required. X and Y coordinate display and markers positions are refreshed on the synoptic.
3. Continuous moving can be done by let click down on the stepped motion icon.

#### 3.4.3 Sample To Sample Motion

The sample holder moves from the present sample position towards the previous or the next sample defined in the sample list attached to the present sample holder. The center of the previous or next sample is the default target position.

1. Click *previous or next* icon. The sample stage moves. The time required to move towards the new position is displayed into the footer of the *present holder* window.
2. X and Y coordinate display and markers positions are refreshed on the synoptic.

*Note : In order to come back on the center of the present sample click the "centering" icon.*

#### 3.4.4 Go to X and Y Coordinates

1. Enter the new X and/or new Y position in the dedicated field.
2. Click *move*. The sample stage moves. The time required to move towards the new position is displayed into the footer of the *present holder* window.
3. X, Y coordinate display and markers positions are refreshed on the synoptic.

*Note : When the sample stage is moved by means of the sample holder functions, the primary beam is automatically switched off before moving the sample stage. When the stage is moved by means of the joystick or the tracker ball the beam is left in its present status.*

### 3.5 Holder mode SIMS/CCD/FCo

1. SIMS: default mode for the N50. The sample stage is moved to set the analysis area in front of the primary ion beam.
2. CCD: Click CCD icon and the sample stage is moved to set the analysis area in front of the optical microscope, the image recorded by the CCD camera is displayed in a particular window.
3. FCo: Click FCo icon and the sample stage is moved to set the primary ion beam in the Faraday Cup localized in the analysis chamber. The primary ion beam current is displayed in the FC part of the Tuning window.

### 3.6 Lock/Unlock

1. Click *lock* icon to disable any sample holder moves. It's automatically done when an analysis is running.
2. Click *unlock* icon to enable sample holder moves.

### 3.7 Backlash

1. Click *backlash* icon to reduce residual uncertainties in the sample stage displacement. The sample stage will be moved by a fixed amount of steps in X and Y and sending back to the initial position. This amount of steps is defined in the Setup software.

### 3.8 Local Axis

1. Click *local axis* icon to assign the coordinate (0,0) to the present position of the sample holder. This point becomes the new origin of the X, Y axis system of the sample holder motion.
2. Click *local axis* icon to go back to the standard axis system.

### 3.9 Motor Initialization and Reset Procedure

For the N50 instrument, the initialization and Reset procedure are under the control of the 68030 microprocessor.

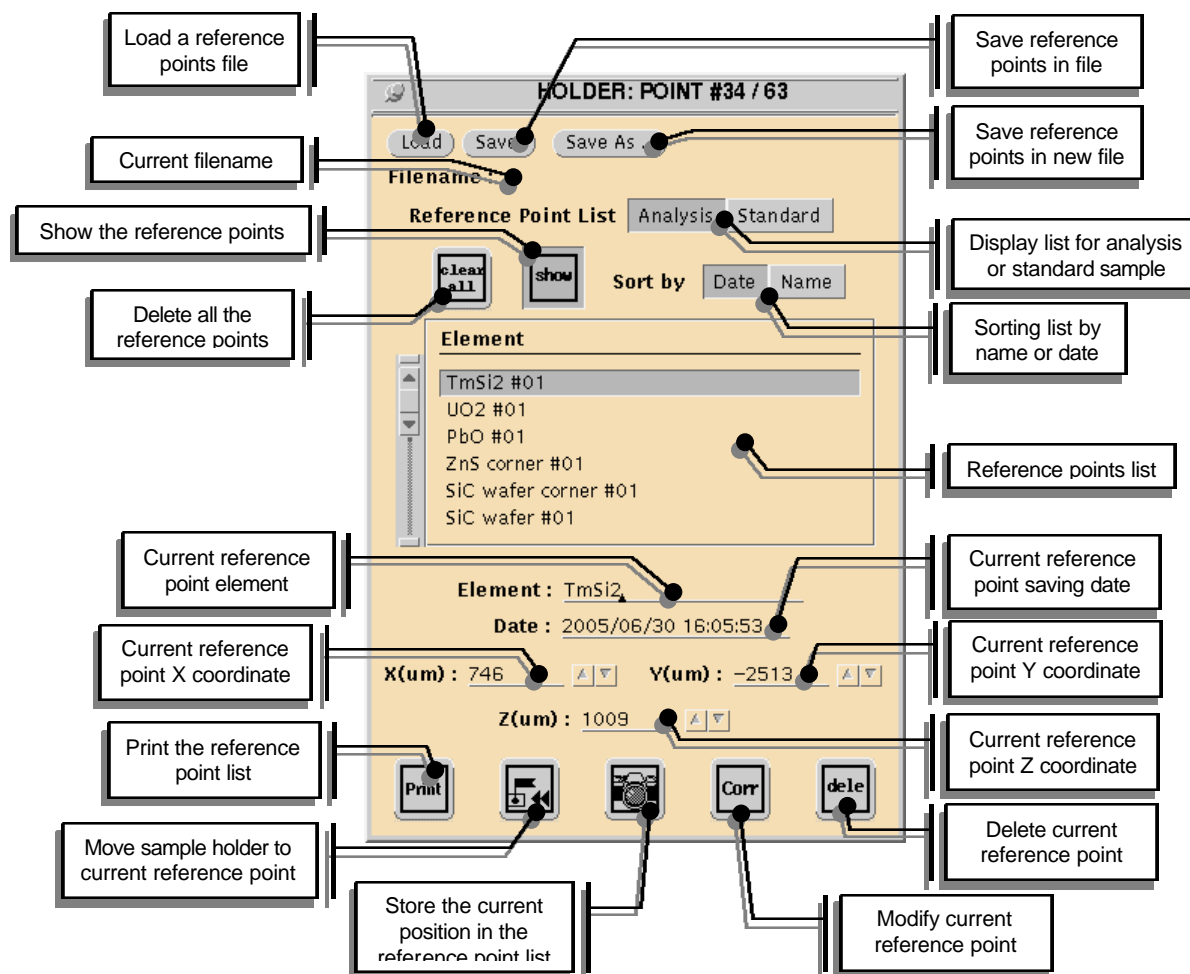
1. Click the *Init* or *Reset* icon in the *present holder window*.

### 3.10 Reference points










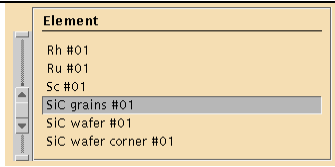

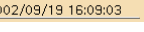
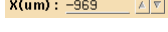







This function creates a file which contains coordinates of reference points. The reference positions defined by the operator are marked on the synoptic by means of dark green squares. The present one is larger and light green in color.

A reference points file is attached to each sample holder. The content of each file is erased when the function *Clear all* is applied either in the *Editing* window or in the *reference point* dialog box.

#### 3.10.1 Reference Point Dialog Box



### 3.10.2 Icons : Name and Function, Editing Fields

	<i>Load</i> , to open browser window to load a reference points list file.
	<i>Save</i> , to save the reference points list in current file.
	<i>Save As</i> , to save the reference points list in new file.
<b>Filename :</b>	Current filename.
<b>Reference Point List</b>  	To display <i>Analysis</i> or <i>Standard</i> sample reference points.
	<i>Clear all</i> , to delete all reference points.
	<i>Show</i> , to show/hide preset markers on the sample holder synoptic
<b>Sort by</b>  	To sort reference points list by <i>Date</i> or by <i>Name</i> .
	Display reference points list.
<b>Element :</b> 	<i>Element</i> , to display and/or set reference point name.
<b>Date :</b> 	<i>Date</i> , to display the reference point date was st01 lored.
<b>X(um) :</b> 	<i>X position</i> , to display and/or set reference point X coordinate.
<b>Y(um) :</b> 	<i>Y position</i> , to display and/or set reference point Y coordinate.
<b>Z(um) :</b> 	<i>Z position</i> , to display and/or set reference point Z coordinate.
	<i>Print</i> , to print the reference point list.
	<i>Go to</i> , to move the sample holder to the selected reference point.
	<i>Snapshot</i> , to store as a new reference point the present coordinates.
	<i>Correction</i> , to store in the current reference point the present coordinates.
	<i>Delete</i> , to delete the current reference point.

### 3.10.3 Procedure to Create Reference Point

1. Move the sample holder to a position of interest looking at either the sample holder synoptic or the optical microscope image.
2. Click *reference point* icon. The reference point dialog box opens.
3. Check that *show* mode is selected.
4. Click the *snapshot* icon to add a point to the present list. The present coordinates of the sample holder are stored as a new reference point. A light green squared appears on the synoptic.
5. Enter the reference point name. It can be left unnamed.

### 3.10.4 Procedure to go to a Preset Positions

1. Click *reference point* icon. The reference point dialog box opens.
2. Check that *show* mode is selected.
3. Select the reference point required in the reference point list. The selected reference point is displayed in light green color on the sample holder synoptic.
4. Click *go to* icon. The sample stage is moved to center the reference point on the secondary ion axis.
5. Click *reference point* icon to close the *reference point* box.

### 3.10.5 Procedure to Delete Preset Positions

#### DELETE ONE PRESET

1. Click *reference point* icon. The reference point dialog box opens.
2. Check that *show* mode is selected.
3. Select the reference point to be deleted in the reference point list. The selected reference point is displayed in light green color on the sample holder synoptic.
4. Click *delete* icon. The marker is erased.

#### DELETE ALL PRESETS

1. Click *reference point* icon. The reference point dialog box opens.
2. Click *clear all* icon. All markers are erased after confirmation prompt validation.

## 3.11 Crater Mapping

This function creates a file which contains the coordinates and the size of the crater sputtered for every started analysis. In the case of a *linescan* acquisition the trajectory coordinates are also saved.

The crater mapping is shown on the synoptic of the present holder. The craters are represented on the synoptic by means of dark brown squares. The crater corresponding to the present holder is light brown in color. A crater is represented by a square in the case of a rastered primary beam. The size of the square is proportional to the raster size entered by the operator in the *Analytical parameters* dialog box (see chapter *analysis definition*). In the case of the use of a static beam, the crater is represented by a circle with a size proportional to the beam diameter entered by the operator in the *Analytical parameters* dialog box

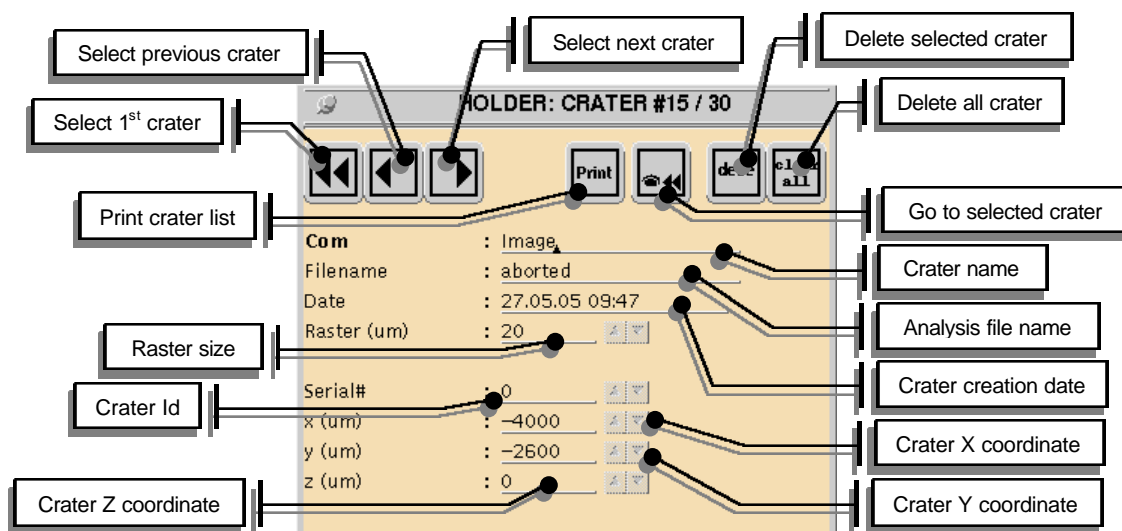
The crater mapping can be also printed on the printer. The correspondence between the crater number and the raw data file name is given on the print.

A crater mapping file is attached to every sample. The content of the file related to the present sample is erased only whether *Clear all* or *Delete* is applied in the *crater* dialog box or the *Editing* window, respectively. The *Clear all* function in the *Editing* window erases the overall set of crater mapping files.

30 craters can be memorized in one file for each sample. If a 31<sup>st</sup> analysis is run, the first crater will be erased and replaced by the 31<sup>st</sup>. A linescan analysis is considered as a single crater.

For a line scan, the present position of the sample stage between the starting and ending points is refreshed every 3". The *crater mapping* function can be therefore used to follow the status of a *linescan* analysis.

### 3.11.1 Crater Dialog Box



### 3.11.2 Icons : Name and Function, Editing Fields

	<i>Crater #1</i> , to select the crater #1.
	<i>Previous or Next</i> , to select the n-1 <sup>th</sup> or the n+1 <sup>th</sup> crater if n is the present one.
	<i>Print</i> , to print the crater map.
	<i>Go to</i> , the sample holder moves to the center of the selected crater. In the case of a <i>linescan</i> the sample holder moves to the starting point of the trajectory.
	<i>Delete</i> , to delete one crater in the crater mapping.
	<i>Clear all</i> , to delete the entire crater mapping.
	<i>Com</i> , crater name to be entered by the operator. (Default value = analysis type)
	<i>Filename</i> , the file name of the analysis corresponding to the present crater.
	<i>Date</i> , to display the date of the analysis corresponding to the present crater.
	<i>Raster</i> , raster size read in the <i>Analytical parameters</i> table.
	<i>Serial #</i> , the crater number. If the value is higher than 30, it means that the first crater have been erased in the crater mapping.
	<i>X position</i> , to display crater X coordinate.
	<i>Y position</i> , to display crater Y coordinate.
	<i>Z position</i> , to display crater Z coordinate.

### 3.11.3 Procedure to Go to a Previous Crater Position

1. Click *Crater mapping* icon. The *Crater* dialog box opens.
2. Click *previous* or *next* icons to select the crater position required in the crater list. The selected crater position is displayed in light brown color on the sample holder synoptic.
4. Click *go to* icon. The sample stage is moved in order to center the center of the crater onto the secondary ion axis. In the case of a *linescan* analysis the starting point is centered onto the secondary ion axis.
5. Click *crater mapping* icon to close the *crater* dialog box.

### 3.11.4 Procedure to Delete Crater Positions

#### DELETE ONE PRESET

1. Click *Crater mapping* icon. The *Crater* dialog box opens.
2. Click *previous* or *next* icons to select the crater to be deleted. The selected crater is displayed in light brown color on the sample holder synoptic.
3. Click *delete* icon. The marker is erased.

#### DELETE ALL PRESETS

1. Click *Crater mapping* icon. The *Crater* dialog box opens.
2. Click *clear all* icon. All markers are erased after confirmation prompt validation.

## 3.12 Load / Unload Functions

These functions are used to control the sample exchange procedure and to define the *present holder*.

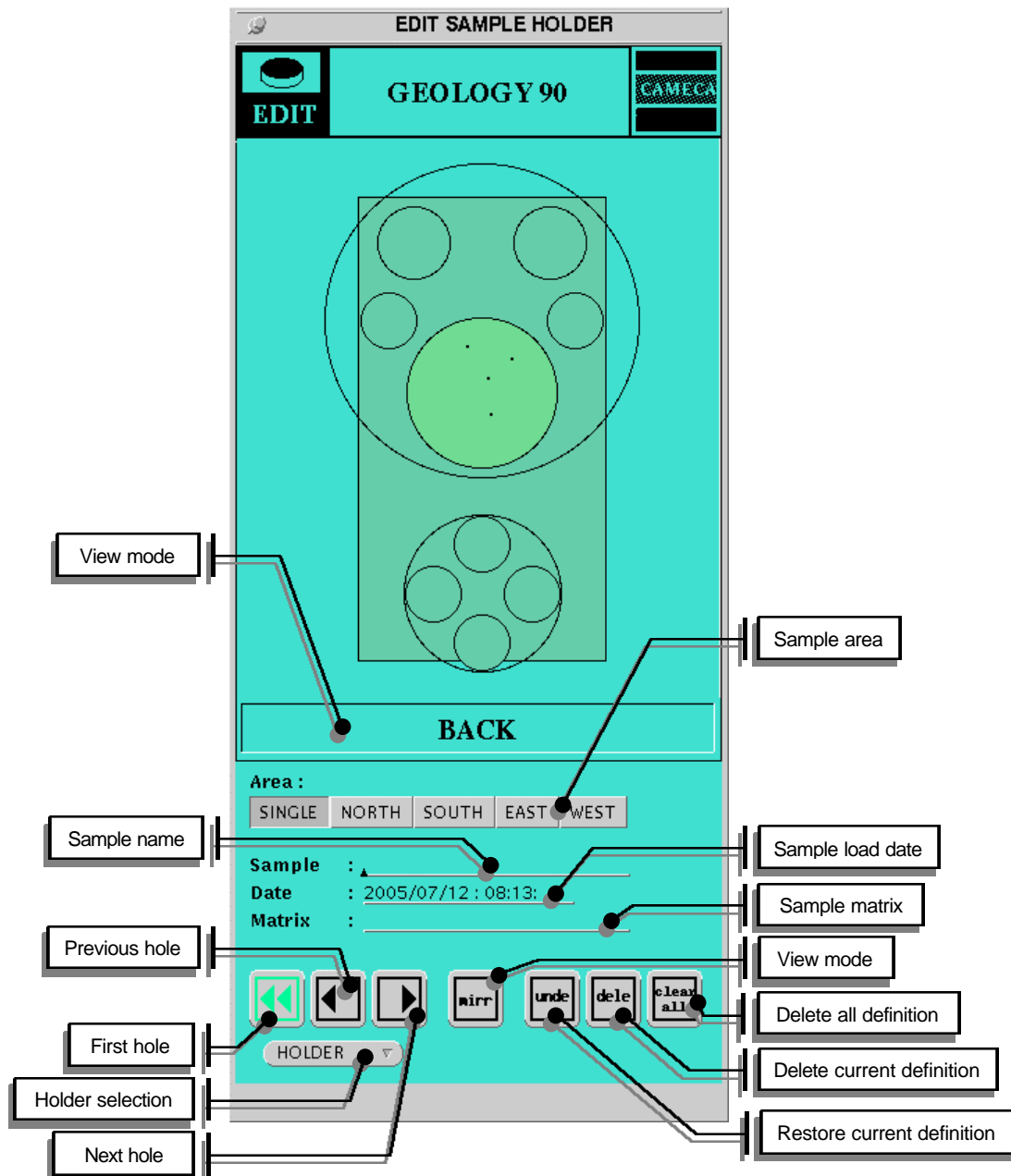
#### PROCEDURE TO EXCHANGE SAMPLE HOLDERS

1. Click *unload* icon. Select the *Analysis* or *Standard* holder to be unloaded. The *load* icon appears. The synoptic of the present sample holder is erased. The sample stage is moved to the coordinates defined in Setup software for the selected holder. The preset positions are erased.
2. Carry out the sample exchange.
3. Press the mouse right button to open the pull-down menu *load* ▾. The sample holder list appears. Select in the list the holder reference corresponding to the holder which has been just manually introduced in the analysis chamber.
4. Release the mouse right button. The synoptic of the new sample holder is displayed in the *present holder* window. The sample holder reference is displayed in the window header.
5. Everything is ready to move the sample stage.

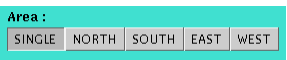

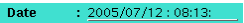







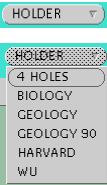
## 4. Editing Sample Holder Window

This window is used to define the sample configuration for the different sample holders. Up to 6 sample holders can be defined. The sample configurations are stored on the disk.

- Click *edit* icon in the *present holder* window to open the *edit* window on the left hand side of *present holder* window.
- Click *holder* icon in the header of the *edit* window to close it.



## 4.1 Icons, Editing Fields, Pull-down Menus

	<p><i>Area layout</i>, to select the sample layout in the present hole. There are three different configurations available : only one sample, two horizontal samples (<i>north/south</i>), two vertical samples (<i>east/west</i>).</p>
	<p><i>Sample</i>, this editing field is used either to enter a new sample name or to display the name of the present sample already entered. This name is saved in every raw data file of an analysis run with present sample stage coordinates corresponding to any point of the sample surface opened to analysis through the sample holder hole.</p>
	<p><i>Date</i>, it is used to display the date when the present sample has been entered in the sample holder configuration. When a new sample name is entered, the present-day date is automatically entered in the <i>date</i> editing field.</p>
	<p><i>Matrix</i>, to be completed.</p>
	<p><i>First</i>, to select the first hole of the sample holder front plate.</p>
	<p><i>Previous or Next</i>, to select the n-1<sup>th</sup> or the n+1<sup>th</sup> hole if n is the present one.</p>
	<p><i>Mirror</i>, to select either back or front view mode.</p>
	<p><i>Undelete</i>, to restore the status before the last <i>Delete</i> action.</p>
	<p><i>Delete</i>, to delete one sample definition.</p>
	<p><i>Clear all</i>, to delete the overall sample definition of the present sample holder.</p>
	<p>Pull-down menu to select the sample holder to be edited. When a sample holder has been selected its reference is displayed in the window header.</p>

## 4.2 Sample Holder Synoptic

COLOR CODE FOR HOLES AND SAMPLES:

- A hole with no samples defined is dark green (background color).
- A hole with a sample already defined is grey.
- The present sample is light green. Information displayed in the editing fields are relative to this sample.

PRESENT SAMPLE SELECTION

The present sample is selected by either clicking with the mouse directly on the synoptic or clicking *Previous*, *Next*, *First* icons.

### 4.3 Procedure to Enter a Sample Holder

ENTER A NEW SAMPLE HOLDER :

1. Select the sample holder to be entered in the *holder* ▾ pull-down menu.
2. Click *mirror* icon to select Front/Back mode. The back mode corresponds to the sample holder viewing for the sample mount operation.
3. Select the hole with a sample to be defined. Click on it on the synoptic or use *previous*, *next*, *first* icons.
4. Select the hole configuration (*single*, *north*, *south*,...)
5. Enter information relative to the sample into the editing fields. Hit *return* on the keyboard to validate each field.
6. Repeat the procedure from the step 3 in order to define the next sample.

MODIFICATION OF A SAMPLE HOLDER EDITION

1. Select the sample holder to be entered, from the *holder* ▾ pull-down menu.
2. Click *mirror* icon to toggle between *front/back* view mode.
3. Select the hole with a sample definition to be modified. Click on it on the synoptic or use *previous*, *next*, *first* icons.
4. Enter new information relative to the sample into the editing fields. Hit *Return* on the keyboard to validate.

*Note : if the modification is made on the present holder (declared to be loaded in the analysis chamber), the sample information displayed in the present holder window are updated.*

### 4.4 Procedure to Delete a Sample Holder Edition

DELETE ONE SAMPLE DEFINITION:

1. Select the sample holder to be entered, from the *holder* ▾ pull-down menu..
2. Select the hole with a sample definition to be delete. Click on it on the synoptic or use *previous*, *next*, *first* icons.
3. Click *delete* icon. All edition fields are erased, the hole is back to the background color.
4. In case of error, Click on *undelete* icon to restore the previous status.
5. Repeat from step 2 to delete another sample.

DELETE ALL SAMPLE DEFINITIONS :

1. Select the sample holder to be entered, from the *holder* ▾ pull-down menu.
2. Click *clear all* icon. Sample definition, preset positions and crater mapping are erased after the confirmation prompt validation.



# **The CAMECA NANOSIMS 50 L**

## **Preset Software user's guide**

# Contents

<b>1.</b>	<b>INTRODUCTION .....</b>	<b>3</b>
1.1	THE INSTRUMENT STATUS FILE (ISF) .....	3
1.2	ENTER/EXIT PROGRAM .....	3
<b>2.</b>	<b>THE PRESET PANELS DESCRIPTION .....</b>	<b>3</b>
2.1	THE MAIN MENU BAR .....	3
2.2	LOADING AN ISF FILE .....	4
2.3	MAIN PRESET DIALOG BOX .....	6
2.4	MODIFYING A PRESET GROUP .....	7
2.4.1	<i>Preset group label modification</i> .....	8
2.4.2	<i>Preset group definition</i> .....	8
2.4.3	<i>Preset group validation</i> .....	8
2.4.4	<i>Preset group calibration</i> .....	8
2.4.5	<i>Preset group edition</i> .....	9
2.5	SAVING AN ISF FILE IN ANOTHER NAME .....	10
2.6	CREATE A NEW ISF FILE .....	11
2.7	SUPER USER MODE .....	11
2.7.1	<i>Preset field customization</i> .....	12
2.8	FILE LIST .....	12
2.9	DISPLAY .....	13

## 1. Introduction





### 1.1 The Instrument Status File (ISF)

The Nanosims50 is entirely computer controlled. All the instrument parameters are contained either in the *Set-up file* or in the *Instrument Status File* (ISF).

An *Instrument Status File* (ISF) contains the set of the instrument settings corresponding to a required physical configuration. An ISF does not correspond to a single instrument configuration. Each preset consists of several parameters. The principle is to constitute a reduced set of selection for simplifying the way of operating the instrument.

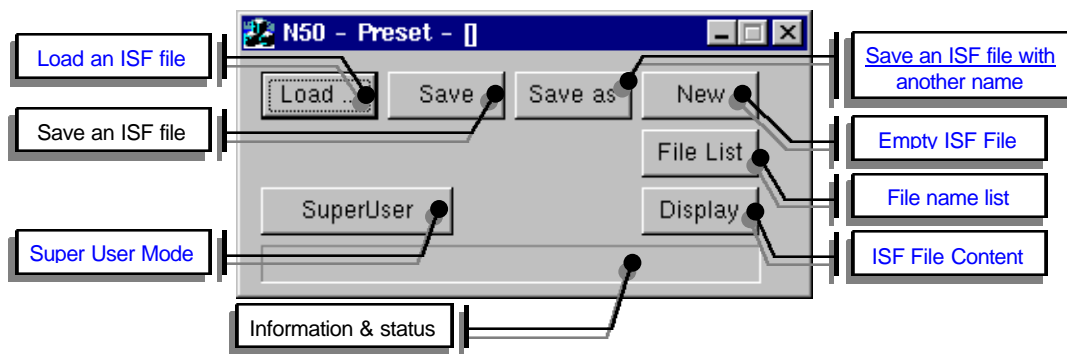
With the *Preset* interface, all the presets can be created, edited and selected separately.

### 1.2 Enter/Exit Program

- In order to enter the *Preset* program click the *preset* icon  in the main icon board. The icon must be red .
- In order to iconize the program click either *preset* icon in the main icon board or the  symbol in the header of the *Preset N50* dialog box.
- In order to quit the program, click the  symbol in the header of the *Preset N50* dialog box. The dialog box is erased and the *preset* icon in the main icon board returns to the blue colour.

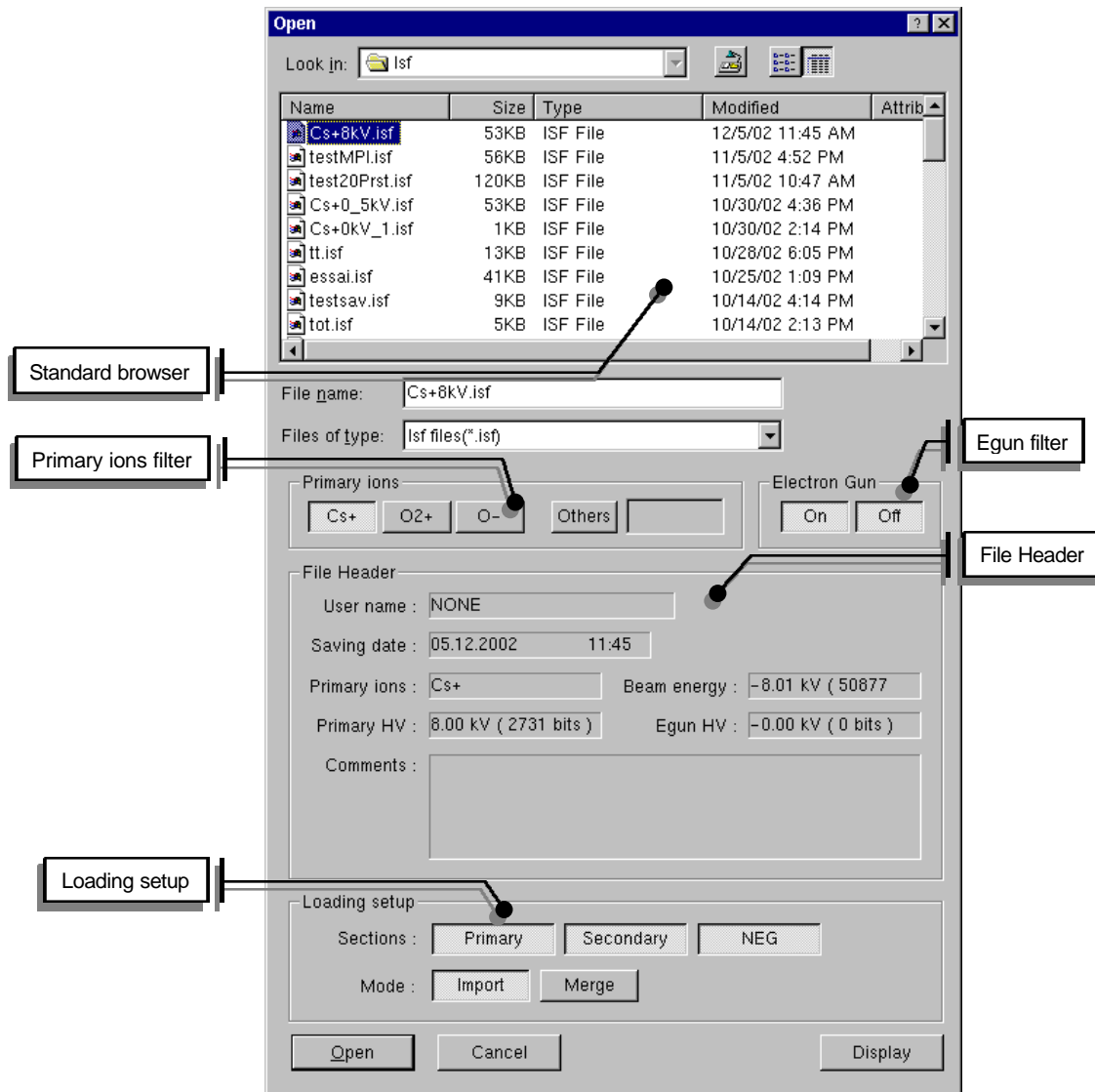
## 2. The Preset Panels Description

### 2.1 The main menu bar



## 2.2 Loading an ISF File

Select  button to Load an ISF file, and open the ISF loading dialog box.


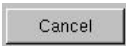


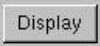
The standard browser allows to sort the ISF files by name, by size or by date.

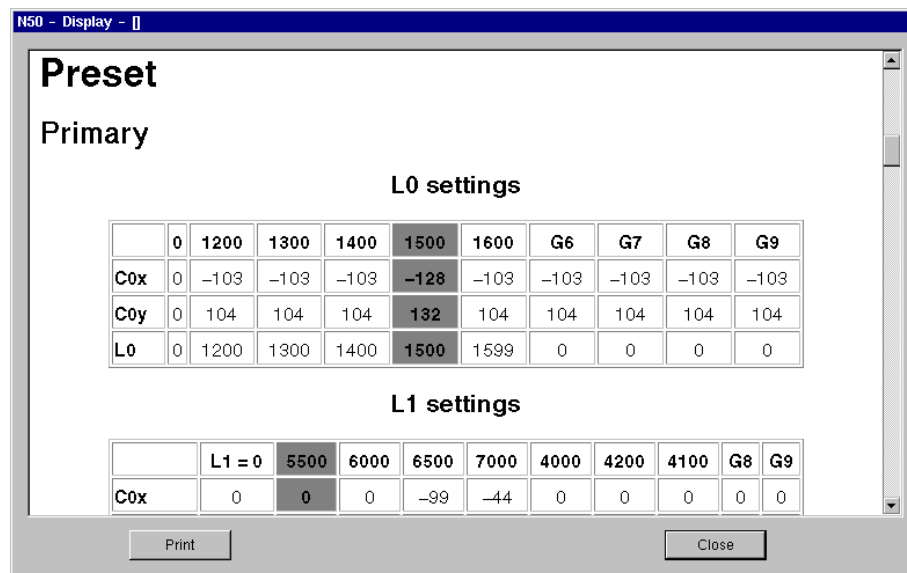
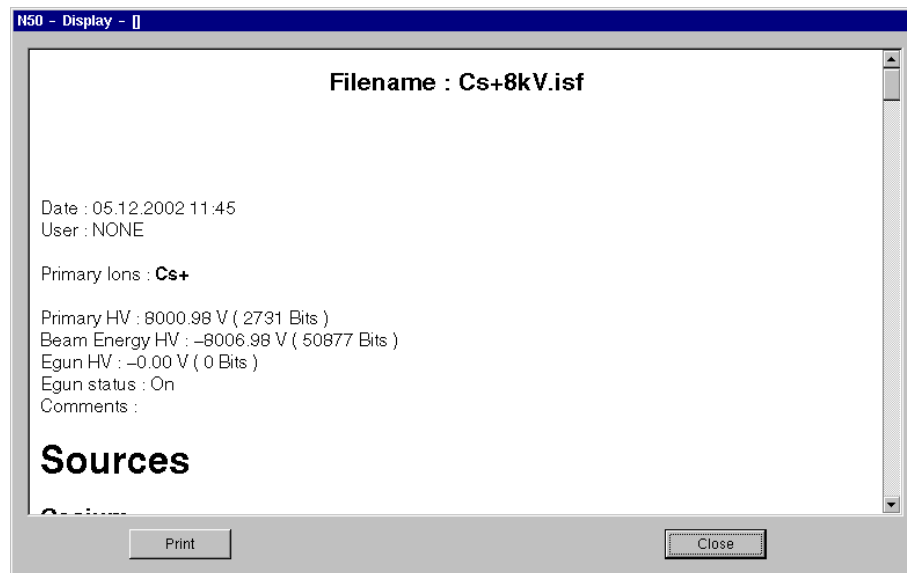
Additionally, the field *Primary ions* allows to filter the ISF files according to their primary ions (Cs, O<sub>2</sub>+, O-, Other ions) and the field *Electron gun* filters according to the Egun status.


Select an ISF file shows the file header content (User name, Saving date, Primary ions, Beam energy, Primary HV, Egun HV and Comments).


The *Loading setup* allows to set the sections (*Primary*, *Secondary*, *NEG*) to be loaded and the loading mode *Import* or *Merge*.

Select  button to load the selected file or the  button to return to the [main menu bar](#) without loading

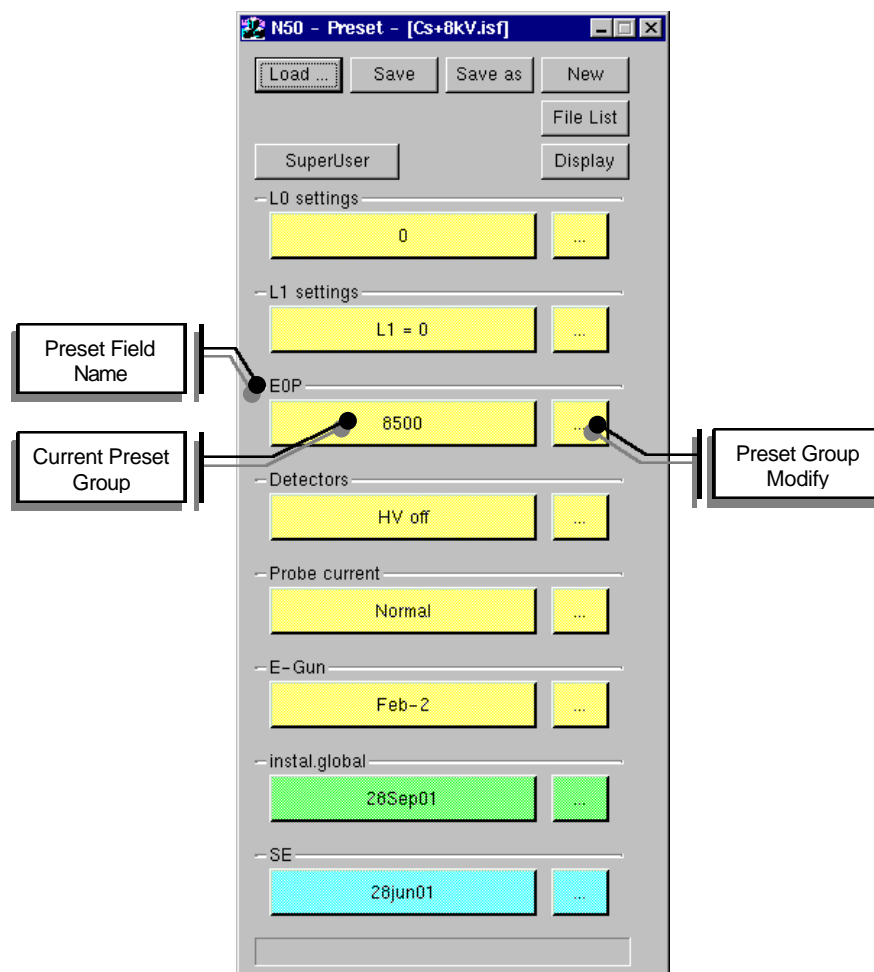
Select  button to see the content of the selected file:




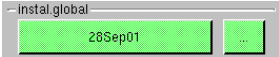
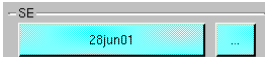
Select the  button to print the display window content.

Select the  button to return to the ISF loading dialog box.

## 2.3 Main Preset dialog box

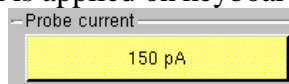


As shown above, there are three sections, displayed in different colors, for the presets :

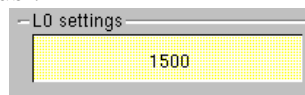
- ◆ Primary 
- ◆ Secondary 
- ◆ Electron Gun (NEG) 

In addition, there are two kind of preset :

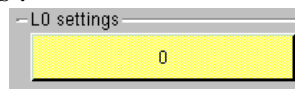
- ◆ The *monostable preset* which is applied on keyboard by clicking on the button.



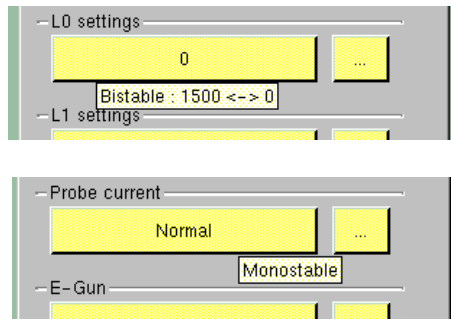
- ◆ The *bistable preset* which is a switch between two preset, clicking apply the second preset and click again restore previous :



and click again restore previous :



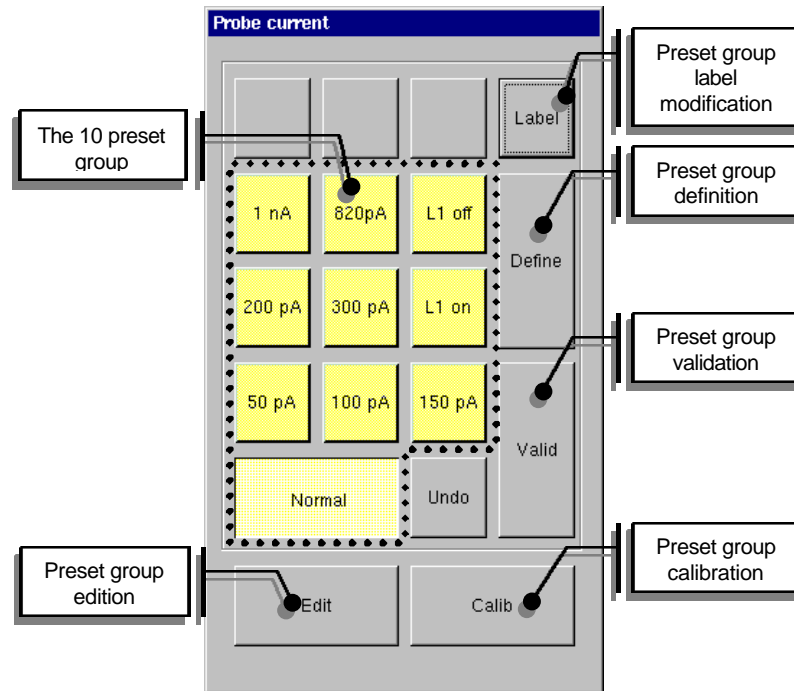
To know the kind of a preset, put the mouse on the preset button and let it on a few second. The following displays appear for a *bistable preset*



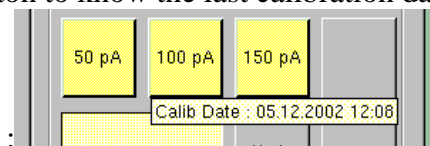
and for a *monostable preset*

## 2.4 Modifying a Preset group

Select button beside the preset group to modify. The following dialog box appears :




Let the mouse on a preset button to know the last calibration date :

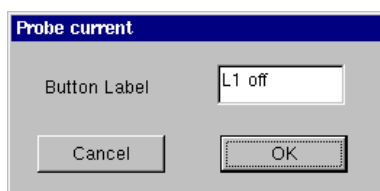


If a modification is done on a preset group, the owner preset field in the Main Preset Dialog box appears with a '\*' after the field name :



### 2.4.1 Preset group label modification

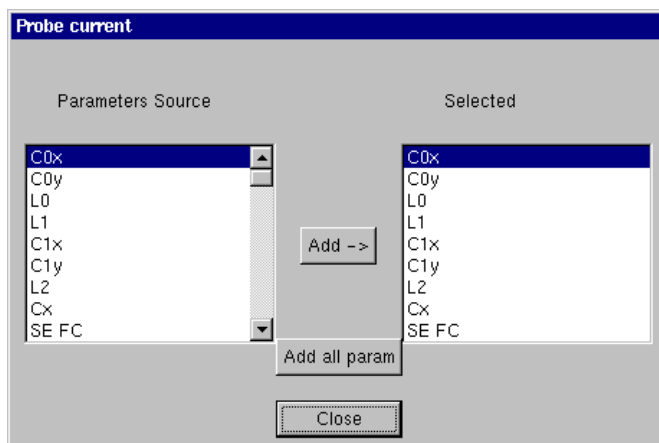
To modify a group label, select the button  and a preset group, then change the in the dialog box :




Select  button to validate the new label or button  to restore previous label.

### 2.4.2 Preset group definition


To define the preset group, select the  button, the dialog box appears:




Select the  button to add all the parameters in the preset list.

To add a single parameter, select the parameter in the "Parameter Source" list (left) and select the  button. Then the added parameter appears in the "Selected" list (right).

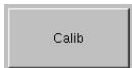
To delete a selected parameter in the "Selected" list, select this parameter and press the "Delete" key.

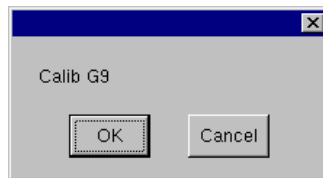
Select the  button to close the define dialog box.

### 2.4.3 Preset group validation

To validate a preset group, select a preset and press the  button. The preset parameters values are sent to the keyboard and the dialog box disappears. The validated preset replace the previous in the [preset main dialog box](#).

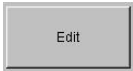
### 2.4.4 Preset group calibration

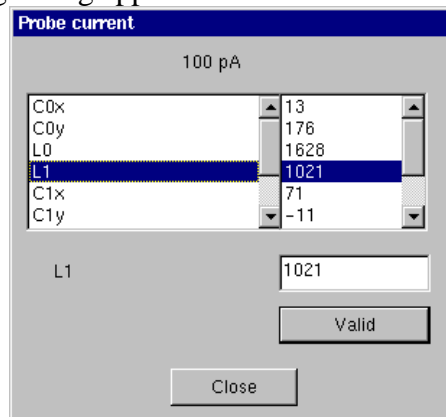
To calibrate a preset group, select a preset and press the  button. The following dialog appears :

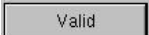


Select the  button, then the preset parameters values are retrieved from the keyboard. Otherwise to abort calibration, select the  button.

## 2.4.5 Preset group edition


To edit a preset group and modify parameters manually, select a preset and press the  button. The following dialog appears :

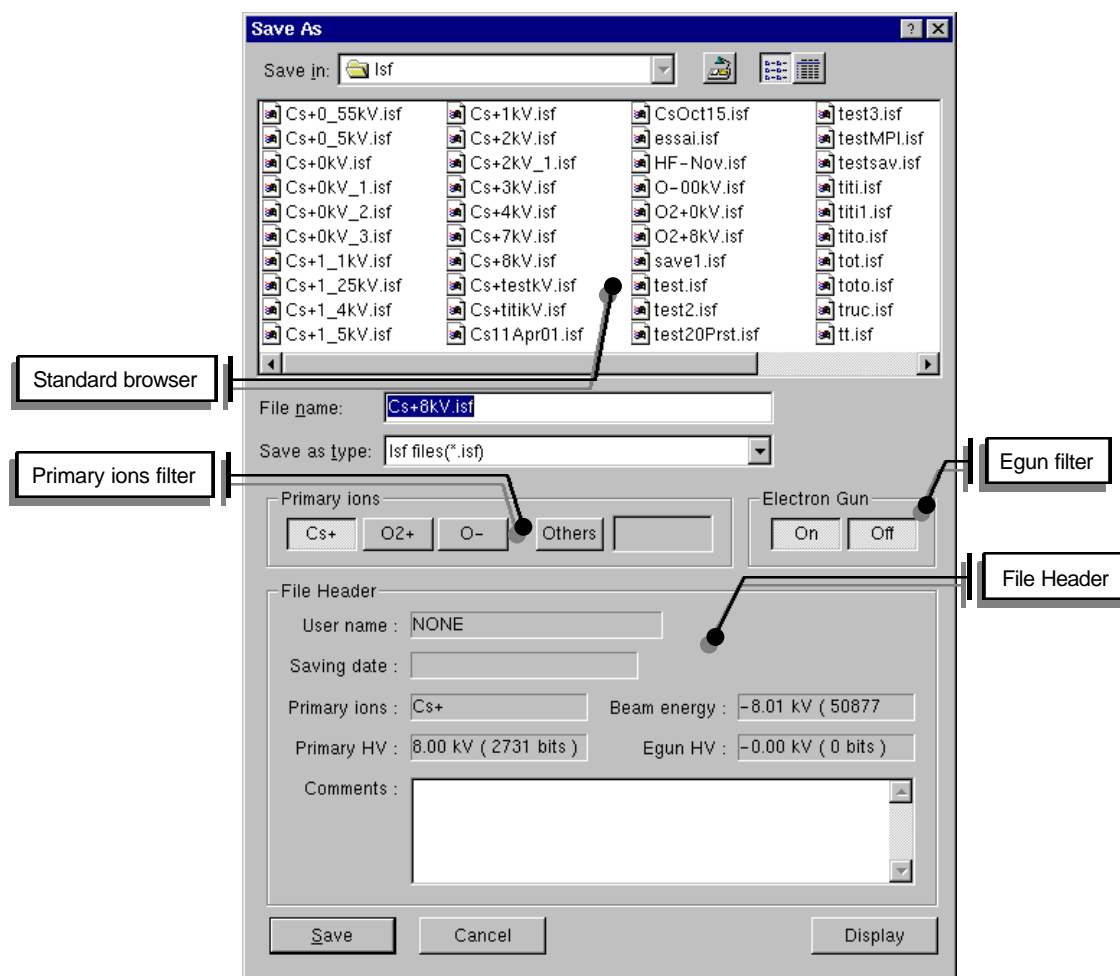


Select the parameter to modify in the left list, and change the new value in the editable text. To store the new value in the parameter list, select the  button.

Select the  button to exit the edition mode.

## 2.5 Saving an ISF File in another name



Select  button to Save an ISF file in another name, and open the ISF saving dialog box.




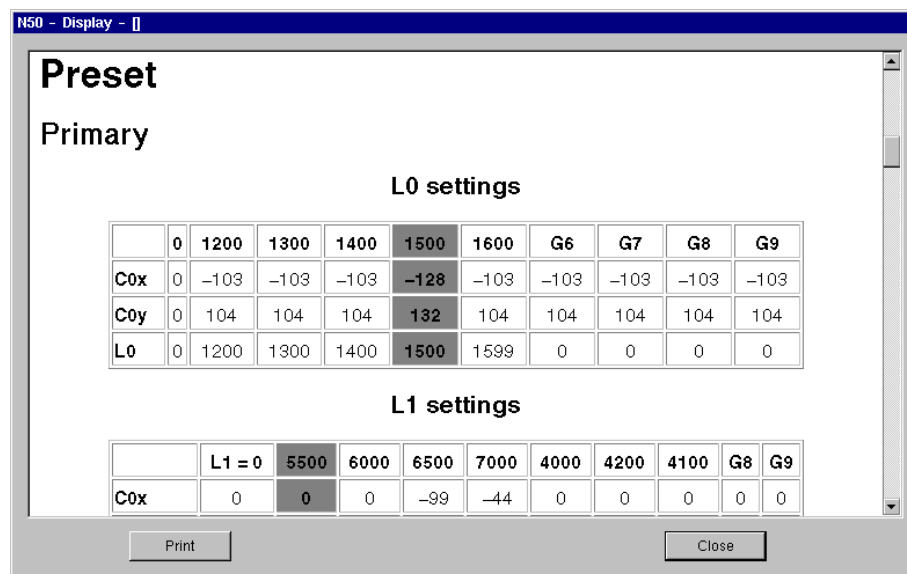
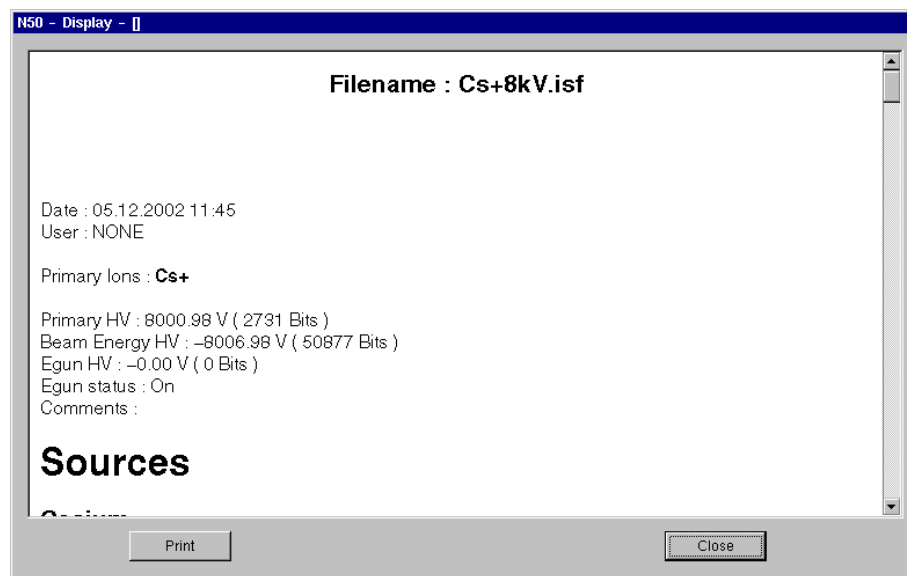
The standard browser allows to sort the ISF files by name, by size or by date.


Additionally, the field *Primary ions* allows to filter the ISF files according to their primary ions (Cs, O<sub>2</sub>+, O-, Other ions) and the field *Electron gun* filters according to the Egun status.

The file header content (User name, Primary ions, Beam energy, Primary HV, Egun HV and Comments) show the header values to be saved. The comment editable box allow to add a comment in the file.

Select  button to save the selected file or the  button to return to the [main menu bar](#) without saving


Select  button to see the content of the selected file:



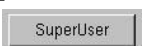
Select the  button to print the display window content.

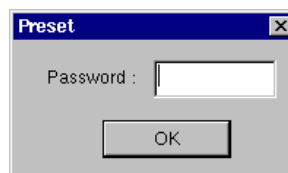
Select the  button to return to the ISF saving dialog box.

## 2.6 Create a new ISF File

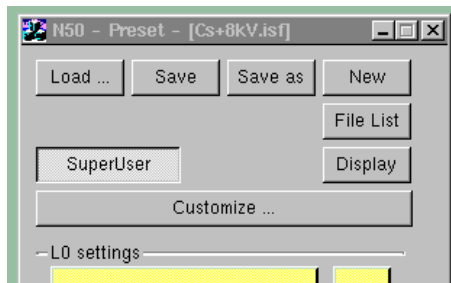
Select  button to create an empty ISF file.

## 2.7 Super user mode


Select  button to activate the super mode, enter the password :

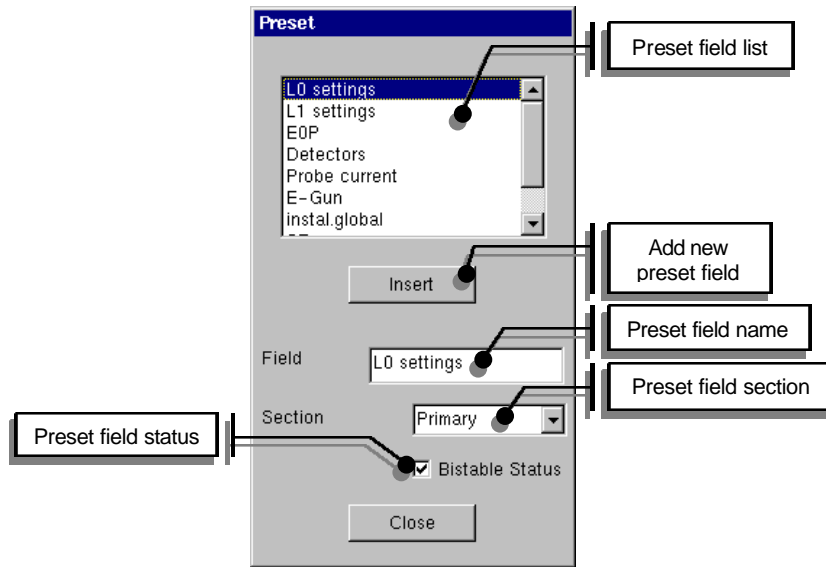


The following interface appears :



### 2.7.1 Preset field customization


The  button allow the modifications (add, delete or modify) of the current Preset fields :




To delete a preset field, select it in the preset field list and press the "delete" key.

To modify a preset field, select it in the preset field list and :

- Change the name in the *Field* edit box,
- Select the *Section* (*Primary*, *Secondary*, *Neg*),
- Check the status *Bistable* or not (*Monostable*).

To add a new preset field, select the position in the preset field list and select the  button. The new preset field is inserted before the selected position.


Select the  button to return to the [Main Preset dialog box](#).

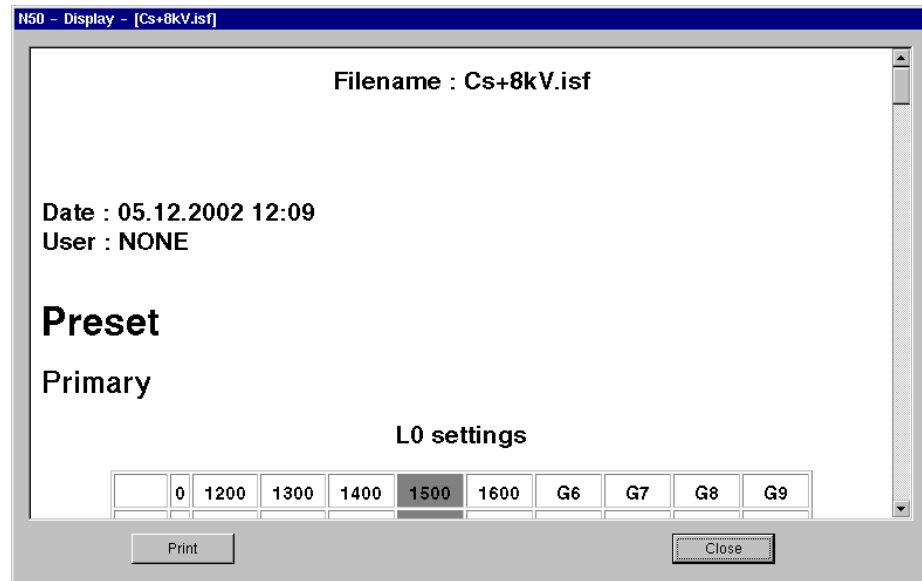
## 2.8 File list


Select  button to see the section files and display the following dialog box:




## 2.9 Display

Select  button to see the content of the preset file and display the following dialog box :



Select the  button to print the display window content.

Select the  button to return to the [Main Preset dialog box](#).



# **The CAMECA NANOSIMS 50 L**

## **Setup Software user's guide**





# Contents

<b>1.</b>	<b>INTRODUCTION.....</b>	<b>3</b>
1.1	ENTER/EXIT PROGRAM .....	3
1.2	SETUP BROWSER .....	3
<b>2.</b>	<b>HOLDER.....</b>	<b>6</b>
<b>3.</b>	<b>TUNING .....</b>	<b>7</b>
3.1	ACTIVE DETECTORS .....	7
3.2	TROLLEYS PARAMETERS .....	7
3.3	CHANGING SLIT POSITION.....	8
3.4	SECONDARY ION BEAM.....	9
3.5	E0S CENTERING.....	9
<b>4.</b>	<b>KEYBOARD.....</b>	<b>10</b>
4.1	PROPAGATION .....	10
4.2	PRIMARY FARADAY CUP .....	10
4.3	RASTER.....	11
4.4	LF4 DEPENDENCY.....	11
4.5	TOTAL ION CURRENT .....	12
4.6	HEXAPOLE.....	12
<b>5.</b>	<b>HARDWARE.....</b>	<b>13</b>
5.1	N50 TYPE.....	13
5.2	ACCESSORIES .....	13
5.3	OPTIONS .....	13
5.4	MOTORIZATIONS.....	14
5.5	EXIT SLITS .....	14
5.6	DETECTION .....	14
<b>6.</b>	<b>SLITS &amp; DIAPHRAGMS.....</b>	<b>15</b>
6.1	DIAPHRAGMS .....	15
6.2	SLITS.....	17
6.2.1	<i>Entrance Slit</i> .....	17
6.2.2	<i>Aperture Slit</i> .....	18
6.2.3	<i>Energy Slit</i> .....	19
6.2.4	<i>Exit Slit</i> .....	21
<b>7.</b>	<b>DETECTORS .....</b>	<b>26</b>
7.1	ELECTRON MULTIPLIER.....	26
7.2	PHOTO MULTIPLIER .....	27
7.3	FARADAY CUP .....	27
<b>8.</b>	<b>B FIELD.....</b>	<b>28</b>
8.1	WAITING TIME COMPUTED .....	28
<b>9.</b>	<b>DIRECTORIES.....</b>	<b>29</b>
<b>10.</b>	<b>SOURCES.....</b>	<b>30</b>
10.1	CESIUM.....	30

## 1. Introduction

The private setup file contains all the set of instrument configuration parameters. For each parameter, this file contains an identification number and the parameter value. Note that some parameters are editable only in super mode.

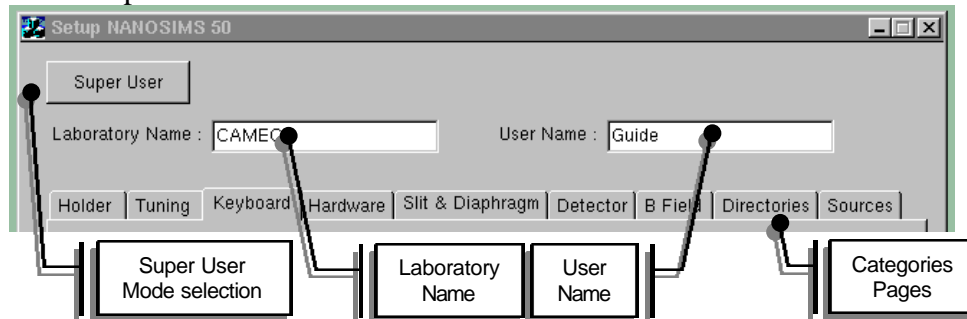
### 1.1 Enter/Exit Program

- In order to enter the *setup* program click the *setup* icon  in the main icon board. The icon must be red .
- In order to iconize the program click either *setup* icon in the main icon board or the  symbol in the header of the *Setup N50* dialog box.
- In order to quit the program, click the  symbol in the header of the *Setup N50* dialog box. The dialog box is erased and the *setupStpN50L-* icon in the main icon board returns to the blue colour.


### 1.2 Setup browser

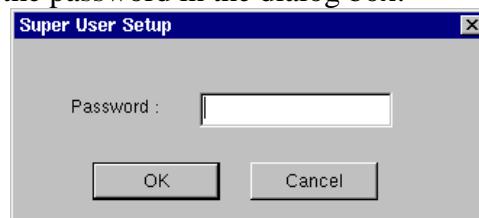
The setup browser allow you to modify these parameters easily. They are arranged in categories: [Holder](#), [Tuning](#), [Keyboard](#), [Hardware](#), [Slit & Diaphragm](#), [Detector](#), [B Field](#), [Directories](#) and [Sources](#).

The common setup user interface looks like :

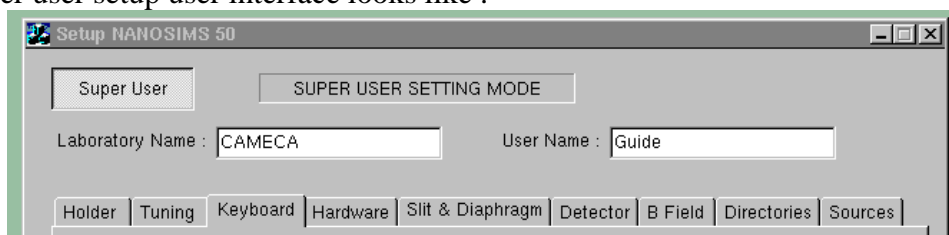


Some parameters needs super mode to be editable. To activate this mode, you've to select the

 button and enter the password in the dialog box:




The super user setup user interface looks like :



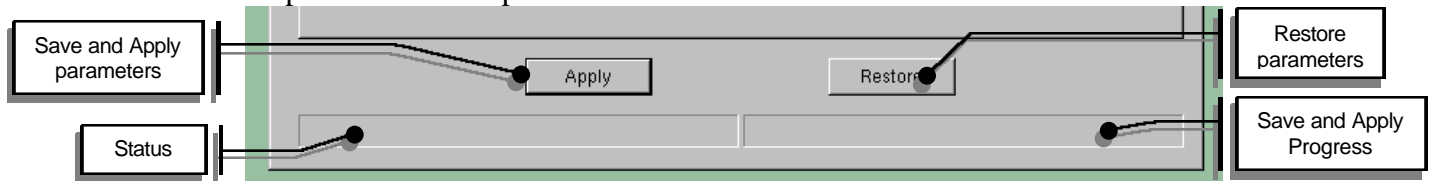


For all the parameters, you can have information (subject, min and max limits, unit) by positioning the mouse on the graphical item :

Standard sample X :  Y :   
Standard sample X position [-48000, -40000] (μm)

To apply your setup parameter you have to select the  button. All the parameter are saved in a private file and sended to all connected software.

To restore parameters from private file select the  button.



## 2. Holder

This page allow you to modify parameters used by the Holder and Ccd software. It contains :

- sample positions for the different holder modes
- voltages to be applied for the FCo mode
- CCD field of view
- backlash move
- Z motorization conversion parameters

The screenshot displays the 'Holder' configuration window. It features a central panel with various input fields and sliders, each associated with a specific ID. The parameters are organized into sections: Synoptic Offset, SIMS - CCD Offset, FCo, Analysis sample, Standard sample, FCo voltage, CCD Field of view, Backlash Move, and Z motor. The Z motor section includes a polarity selector (+/-) and an offset radius field. The IDs are listed on the left and right sides of the panel, with lines connecting them to the corresponding parameter fields.

ID	Parameter	Value
-2003	Synoptic Offset X	4000
-2004	Synoptic Offset Y	3000
-2005	SIMS - CCD Offset X	-34680
-2006	SIMS - CCD Offset Y	100
-2007	FCo X	-45500
-2008	FCo Y	-2000
-2011	Analysis sample X	-400
-2012	Analysis sample Y	0
-2009	Standard sample X	-44000
-2010	Standard sample Y	0
-2000	FCo voltage E0W (sample)	0
-2001	FCo voltage E0S	0
-2002	FCo voltage E0P	8191
-2013	CCD Field of view (μm)	750
-2014	Backlash Move (μm)	500
-2020	Z motor Slope (μm/step)	1.2
-2021	Z motor Offset radius	0
-2022	Z motor Offset radius	0

Id	Format	Comment	Min	Max	Unit
-2000	int	E0W (sample) for Fco	0	0	DAC
-2001	int	E0 Secondary for Fco	0	65535	DAC
-2002	int	E0 Primary for Fco	0	65535	DAC
-2003	int	X Synoptic Offset	-10000	10000	μm
-2004	int	Y Synoptic Offset	-10000	10000	μm
-2005	int	X SIMS-CCD Offset	-37000	-31000	μm
-2006	int	Y SIMS-CCD Offset	-3000	3000	μm
-2007	int	Fco X position	-50000	-40000	μm
-2008	int	Fco Y position	-5000	5000	μm
-2009	int	Standard sample X position	-48000	-40000	μm
-2010	int	Standard sample Y position	-10000	10000	μm
-2011	int	Analysis sample X position	-10000	10000	μm
-2012	int	Analysis sample Y position	-10000	10000	μm
-2013	double	Ccd field of view	200.0	2000.0	μm
-2014	int	Backlash move	1	1000	μm
-2020	double	Z motor slope	0.1	10.0	μm/s
-2021	double	Z motor offset for positive polarity	0	100.0	μm
-2022	double	Z motor offset for negative polarity	0	100.0	μm

### 3. Tuning

This page allow you to modify parameters used by the Tuning software.

#### 3.1 Active detectors

This graphical item allow to select active detectors for Tuning:

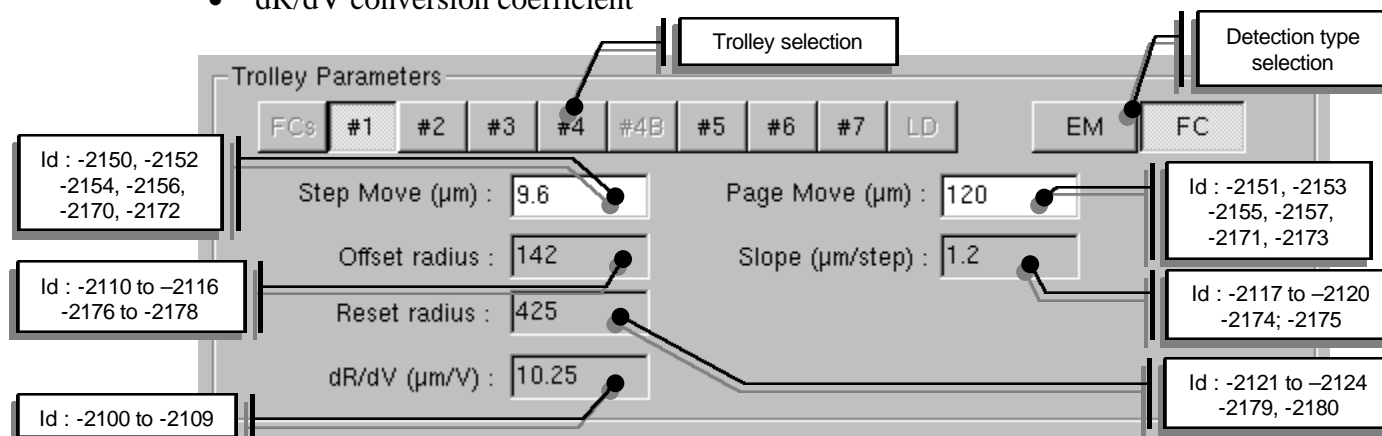


Id	Format	Comment	Min	Max	Unit
-2125	int	Active detector mask	0	2047	

#### 3.2 Trolleys parameters

This group is used to define the selected trolley parameters :

- Detection EM or FC
- Tuning scrollbar move (step by step, page by page)
- Slope and Offset parameters for step to  $\mu\text{m}$  conversion
- Reset radius
- dR/dV conversion coefficient



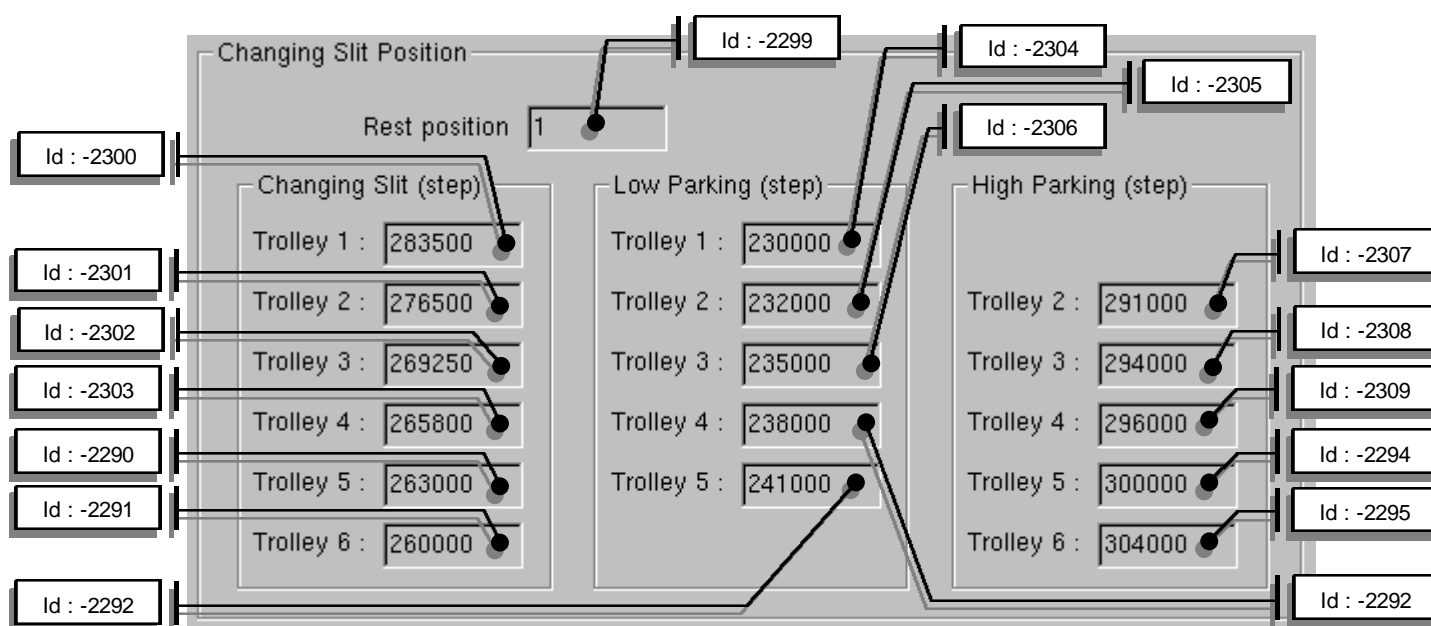
Id	Format	Comment	Min	Max	Unit
-2100	double	dR/dV for trolley #1	0.0	20.0	$\mu\text{m}/\text{V}$
-2101	double	dR/dV for trolley #2	0.0	20.0	$\mu\text{m}/\text{V}$
-2102	double	dR/dV for trolley #3	0.0	20.0	$\mu\text{m}/\text{V}$
-2103	double	dR/dV for trolley #4	0.0	20.0	$\mu\text{m}/\text{V}$
-2104	double	dR/dV for 5 <sup>th</sup> detector	0.0	20.0	$\mu\text{m}/\text{V}$
-2105	double	dR/dV for large detector	0.0	20.0	$\mu\text{m}/\text{V}$
-2106	double	dR/dV for secondary Fc	5.0	50.0	$\mu\text{m}/\text{V}$
-2107	double	dR/dV for det4B	0.0	20.0	$\mu\text{m}/\text{V}$
-2108	double	dR/dV for trolley #6	0.0	20.0	$\mu\text{m}/\text{V}$
-2109	double	dR/dV for detector #7	0.0	20.0	$\mu\text{m}/\text{V}$
-2110	double	Offset radius for secondary Fc	55.0	550.0	mm
-2111	double	Offset radius for trolley #1	55.0	550.0	mm
-2112	double	Offset radius for trolley #2	55.0	550.0	mm
-2113	double	Offset radius for trolley #3	55.0	550.0	mm
-2114	double	Offset radius for trolley #4	55.0	550.0	mm
-2115	double	Offset radius for 5 <sup>th</sup> detector	520.0	540.0	mm
-2116	double	Offset radius for large detector	540.0	570.0	mm
-2117	double	Slope for trolley #1	0.1	10.0	$\mu\text{m}/\mu\text{Step}$
-2118	double	Slope for trolley #2	0.1	10.0	$\mu\text{m}/\mu\text{Step}$
-2119	double	Slope for trolley #3	0.1	10.0	$\mu\text{m}/\mu\text{Step}$
-2120	double	Slope for trolley #4	0.1	10.0	$\mu\text{m}/\mu\text{Step}$
-2121	double	Reset radius for trolley #1	110.0	520.0	mm
-2122	double	Reset radius for trolley #2	110.0	520.0	mm

-2123	double	Reset radius for trolley #3	110.0	520.0	mm
-2124	double	Reset radius for trolley #4	110.0	520.0	mm
-2150	int	Step move for trolley #1 (Display is in mm according to slope value)	1	100	μStep
-2151	int	Page move for trolley #1 (Display is in mm according to slope value)	10	1000	μStep
-2152	int	Step move for trolley #2 (Display is in mm according to slope value)	1	100	μStep
-2153	int	Page move for trolley #2 (Display is in mm according to slope value)	10	1000	μStep
-2154	int	Step move for trolley #3 (Display is in mm according to slope value)	1	100	μStep
-2155	int	Page move for trolley #3 (Display is in mm according to slope value)	10	1000	μStep
-2156	int	Step move for trolley #4 (Display is in mm according to slope value)	1	100	μStep
-2157	int	Page move for trolley #4 (Display is in mm according to slope value)	10	1000	μStep
-2170	int	Step move for trolley #5 (Display is in mm according to slope value)	1	100	μStep
-2171	int	Page move for trolley #5 (Display is in mm according to slope value)	10	1000	μStep
-2172	int	Step move for trolley #6 (Display is in mm according to slope value)	1	100	μStep
-2173	int	Page move for trolley #6 (Display is in mm according to slope value)	10	1000	μStep
-2174	double	Slope for trolley #5	0.1	10.0	μm/μStep
-2175	double	Slope for trolley #6	0.1	10.0	μm/μStep
-2176	double	Offset radius for trolley #5	55.0	550.0	mm
-2177	double	Offset radius for trolley #6	55.0	550.0	mm
-2178	double	Offset radius for detector #7	650.0	750.0	mm
-2179	double	Reset radius for trolley #5	110.0	650.0	mm
-2180	double	Reset radius for trolley #6	110.0	650.0	mm

### 3.3 Changing slit position

This group is used to define the changing slit positions for each trolley :

- Rest position
- Changing slit position
- Low and high parking positions



Id	Format	Comment	Min	Max	Unit
-2299	double	Slit command rest position	0.0	1000.0	

-2300	double	Changing slit position for trolley #1	0.0	420000.0	μStep
-2301	double	Changing slit position for trolley #2	0.0	420000.0	μStep
-2302	double	Changing slit position for trolley #3	0.0	420000.0	μStep
-2303	double	Changing slit position for trolley #4	0.0	420000.0	μStep
-2290	double	Changing slit position for trolley #5	0.0	420000.0	
-2291	double	Changing slit position for trolley #6	0.0	420000.0	
-2304	double	Low parking position for trolley #1	0.0	420000.0	μStep
-2305	double	Low parking position for trolley #2	0.0	420000.0	μStep
-2306	double	Low parking position for trolley #3	0.0	420000.0	μStep
-2292	double	Low parking position for trolley #4	0.0	420000.0	μStep
-2293	double	Low parking position for trolley #5	0.0	420000.0	μStep
-2307	double	High parking position for trolley #2	0.0	420000.0	μStep
-2308	double	High parking position for trolley #3	0.0	420000.0	μStep
-2309	double	High parking position for trolley #4	0.0	420000.0	μStep
-2294	double	High parking position for trolley #5	0.0	420000.0	μStep
-2295	double	High parking position for trolley #6	0.0	420000.0	μStep

### 3.4 Secondary ion beam

This group is used to define the secondary ion beam centering parameters:

- Relative percentage for the center line computation.
- Apparent width and height of the corresponding graph at x %.
- Dependence coefficient for P3 and P2

Id	Format	Comment	Min	Max	Unit
-2160	double	dP3/dP2 for Secondary Ion Beam Acq	0.1	10.0	
-2161	double	% for Secondary Ion Beam Centering	10.0	95.0	%
-2163	double	Width for Secondary Ion Beam Centering	0.0	100.0	V
-2164	double	Height for Secondary Ion Beam Centering	0.0	100.0	V

### 3.5 E0S Centering

This group is used to define the secondary ion beam centering parameters :

- Percentage for the center line computation
- Apparent width of the corresponding graph at x %.

Id	Format	Comment	Min	Max	Unit
-2162	double	% for E0S Centering	10.0	95.0	%
-2165	double	Width for E0S Centering	0.0	100.0	V

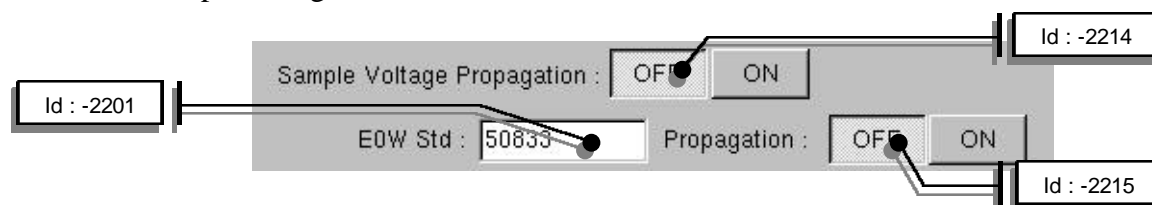
## 4. Keyboard

This page allow you to modify parameters used by the Keyboard.

### 4.1 Propagation

This group is used to define the propagation for:

- Sample voltage : E0WStd

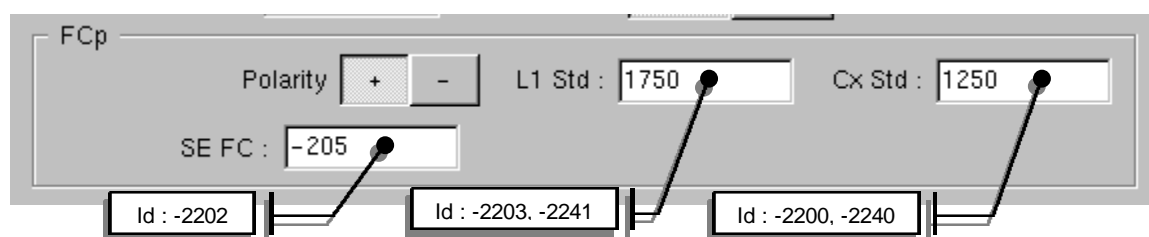


Id	Format	Comment	Min	Max	Unit
-2201	int	E0W Std	1	65535	DAC
-2214	int	Sample voltage propagation	0	1	
-2215	int	E0W voltage propagation	0	1	

### 4.2 Primary faraday cup

This group is used to define the parameters values to set for activate primary FC :

- L1, Cx and SE FC



Id	Format	Comment	Min	Max	Unit
-2200	int	Cx std in positive polarity	-2048	2047	DAC
-2202	int	SE Fc std	-2048	2047	DAC
-2203	int	L1 std in positive polarity	0	4095	DAC
-2240	int	Cx std in negative polarity	-2048	2047	DAC
-2241	int	L1 std in negative polarity	0	4095	DAC

### 4.3 Raster

This group is used to define the parameters values for the Raster:

- B1, B2 and B3 relative value of the scanning plates.
- Relation between the field of view in microns and in bits.

Id	Format	Comment	Min	Max	Unit
-2204	int	B1	0	4095	DAC
-2205	int	B2X	0	4095	DAC
-2206	int	B2Y	0	4095	DAC
-2207	int	B3	0	4095	DAC
-2208	double	Raster size	0.0	10000.0	µm
-2209	int	Raster DAC	1	2047	DAC
-2210	double	Raster x10 coefficient	0.0	100.0	

### 4.4 LF4 dependency

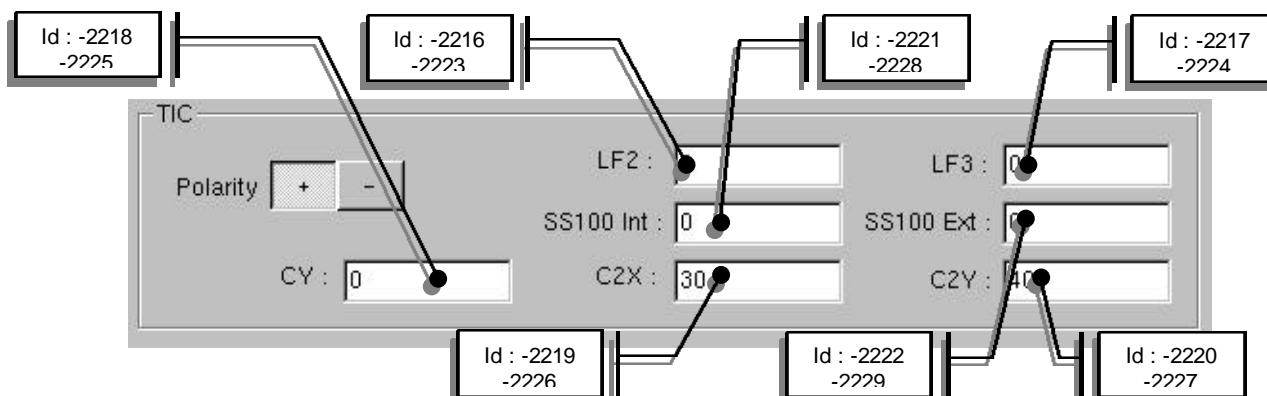
This group is used to define LF4 dependency relationship parameters:

Id	Format	Comment	Min	Max	Unit
-2211	int	LF4 dependency	0	1	
-2212	double	LF4 slope	-50.0	-5.0	
-2213	double	LF4 offset	0.0	50000.0	

## 4.5 Total Ion Current

This group is used to define the parameters values to set for activate TIC:

- LF2, LF3, SS100, Cy, C2x and C2y

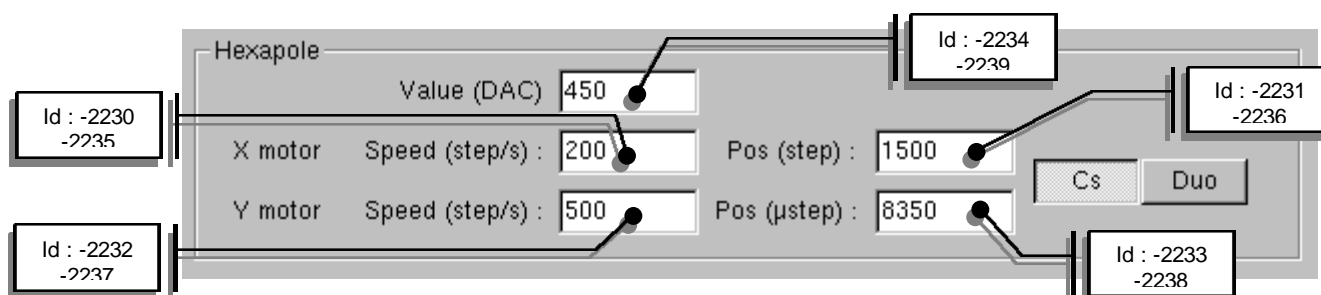


Id	Format	Comment	Min	Max	Unit
-2216	int	LF2 for TIC in positive polarity	0	4095	DAC
-2217	int	LF3 for TIC in positive polarity	0	4095	DAC
-2218	int	Cy for TIC in positive polarity	-2048	2047	DAC
-2219	int	C2x for TIC in positive polarity	-2048	2047	DAC
-2220	int	C2y for TIC in positive polarity	-2048	2047	DAC
-2221	int	SS100int for TIC in positive polarity	0	65535	DAC
-2222	int	SS100ext for TIC in positive polarity	0	65535	DAC
-2223	int	LF2 for TIC in negative polarity	0	4095	DAC
-2224	int	LF3 for TIC in negative polarity	0	4095	DAC
-2225	int	Cy for TIC in negative polarity	-2048	2047	DAC
-2226	int	C2x for TIC in negative polarity	-2048	2047	DAC
-2227	int	C2y for TIC in negative polarity	-2048	2047	DAC
-2228	int	SS100int for TIC in negative polarity	0	65535	DAC
-2229	int	SS100ext for TIC in negative polarity	0	65535	DAC

## 4.6 Hexapole

This group is used to define the Hexapole motorization parameters values:

- Hex value
- X and Y motor speed depending to the source
- X and Y motor position depending to the source



Id	Format	Comment	Min	Max	Unit
-2230	int	Hexapole X motor speed in Cs	80	2000	Step/s
-2231	int	Hexapole X motor position in Cs	-5000	5000	Step
-2232	int	Hexapole Y motor speed in Cs	80	2000	Step/s
-2233	int	Hexapole Y motor position in Cs	-5000	5000	Step
-2234	int	Hexapole value in Cs	-2048	2047	DAC
-2235	int	Hexapole X motor speed in Duo	80	2000	Step/s
-2236	int	Hexapole X motor position in Duo	-5000	5000	Step
-2237	int	Hexapole Y motor speed in Duo	80	2000	Step/s
-2238	int	Hexapole Y motor position in Duo	-5000	5000	Step

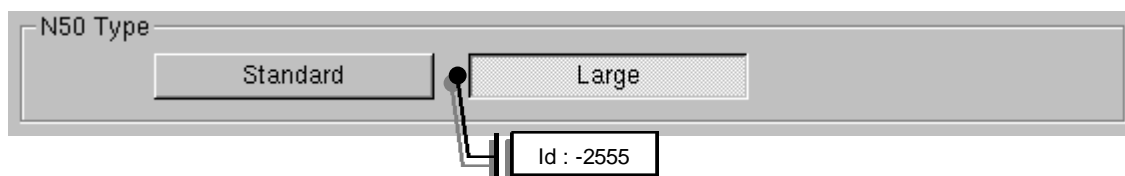
-2239	int	Hexapole value in Duo	-2048	2047	DAC
-------	-----	-----------------------	-------	------	-----

## 5. Hardware

This page allows you to define the Hardware functionalities.

### 5.1 N50 type

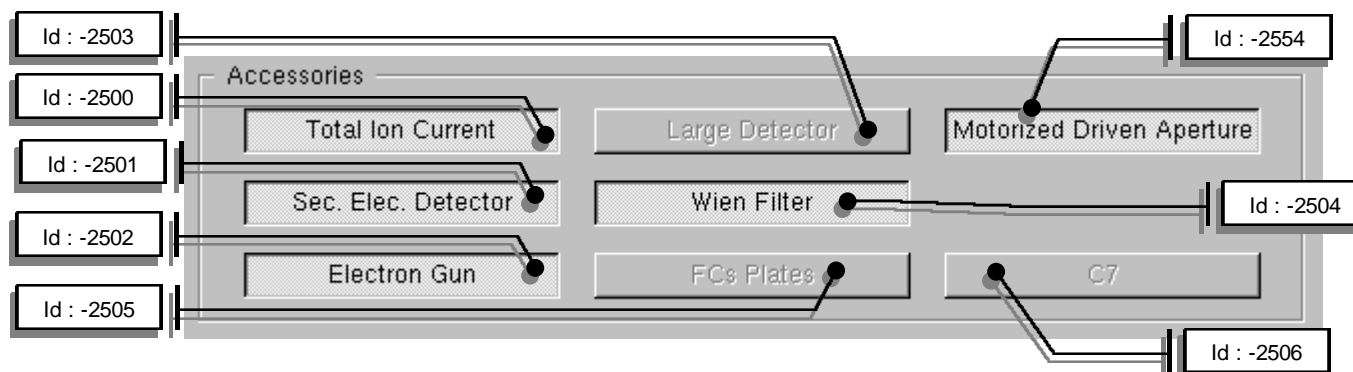
This group is used to select the NANOSims type:



Id	Format	Comment	Min	Max	Unit
-2555	int	N50 Type ( 0 = Standard / 1 = Large)	0	1	

### 5.2 Accessories

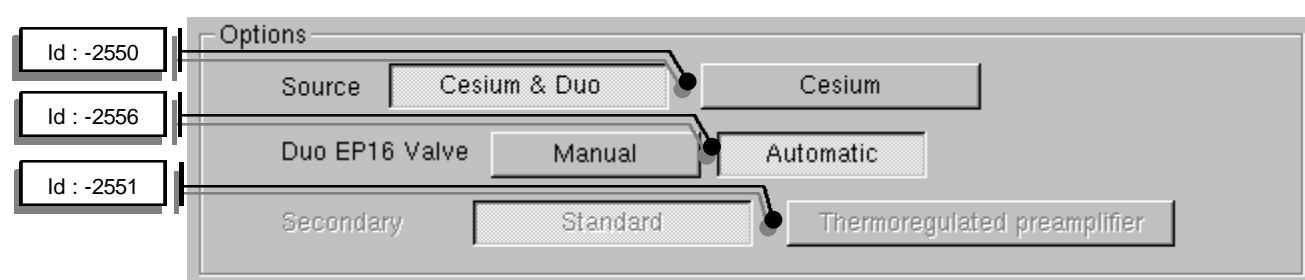
This group is used to define the available accessories on the instrument :



Id	Format	Comment	Min	Max	Unit
-2500	int	Total ion current accessory	0	1	
-2501	int	Secondary electron detector accessory	0	1	
-2502	int	Electron gun accessory	0	1	
-2503	int	Large detector accessory	0	1	
-2504	int	Wien filter accessory	0	1	
-2505	int	Secondary faraday cup accessory	0	1	
-2506	int	C7 accessory	0	1	
-2554	int	Motorization driven aperture (0=Manual / 1=Motor)	0	1	

### 5.3 Options

This group is used to define the available options on the instrument :



Id	Format	Comment	Min	Max	Unit
----	--------	---------	-----	-----	------

-2550	int	Cs/Duo accessory ( 0 = Cs / 1 = Cs/Duo )	0	1	
-2551	int	Secondary faraday cup accessory ( 0 = standard / 1 = High resolution )	0	1	
-2556	int	EP16 valve control ( 0=manual / 1=automatic )	0	1	

## 5.4 Motorizations

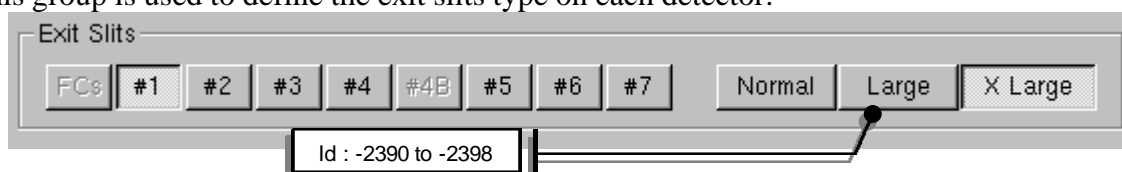
This group is used to define the available motorizations on the instrument :



Id	Format	Comment	Min	Max	Unit
-2520	int	Motorization mask	0	255	

## 5.5 Exit Slits

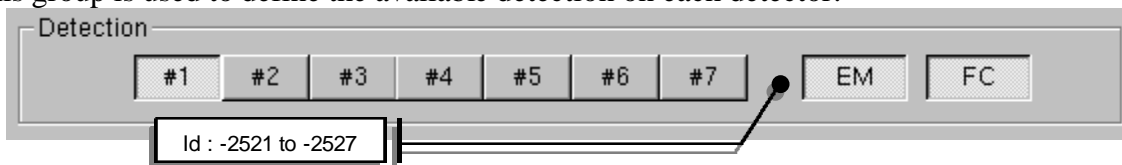
This group is used to define the exit slits type on each detector:



Id	Format	Comment	Min	Max	Unit
-2390	int	Trolley #1 exit slit type ( 0=Normal / 1=Large / 2=Extra Large)	0	2	
-2391	int	Trolley #2 exit slit type ( 0=Normal / 1=Large / 2=Extra Large)	0	2	
-2392	int	Trolley #3 exit slit type ( 0=Normal / 1=Large / 2=Extra Large)	0	2	
-2393	int	Trolley #4 exit slit type ( 0=Normal / 1=Large / 2=Extra Large)	0	2	
-2394	int	5 <sup>th</sup> detector exit slit type ( 0=Normal / 1=Large / 2=Extra Large)	0	2	
-2395	int	Secondary faraday cup exit slit type ( 0=Normal / 1=Large / 2=Extra Large)	0	2	
-2396	int	Det4B exit slit type ( 0=Normal / 1=Large / 2=Extra Large)	0	2	
-2397	int	Trolley #6 exit slit type ( 0=Normal / 1=Large / 2=Extra Large)	0	2	
-2398	int	Detector #7 exit slit type ( 0=Normal / 1=Large / 2=Extra Large)	0	2	

## 5.6 Detection

This group is used to define the available detection on each detector:



Id	Format	Comment	Min	Max	Unit
-2521	int	Available detection for Det#1 ( 1=EM / 2=FC / 3=EM & FC)	0	3	
-2522	int	Available detection for Det#2 ( 1=EM / 2=FC / 3=EM & FC)	0	3	
-2523	int	Available detection for Det#3	0	3	

		( 1=EM / 2=FC / 3=EM & FC)			
-2524	int	Available detection for Det#4 ( 1=EM / 2=FC / 3=EM & FC)	0	3	
-2525	int	Available detection for Det#5 ( 1=EM / 2=FC / 3=EM & FC)	0	3	
-2526	int	Available detection for Det#6 ( 1=EM / 2=FC / 3=EM & FC)	0	3	
-2527	int	Available detection for Det#7 ( 1=EM / 2=FC / 3=EM & FC)	0	3	

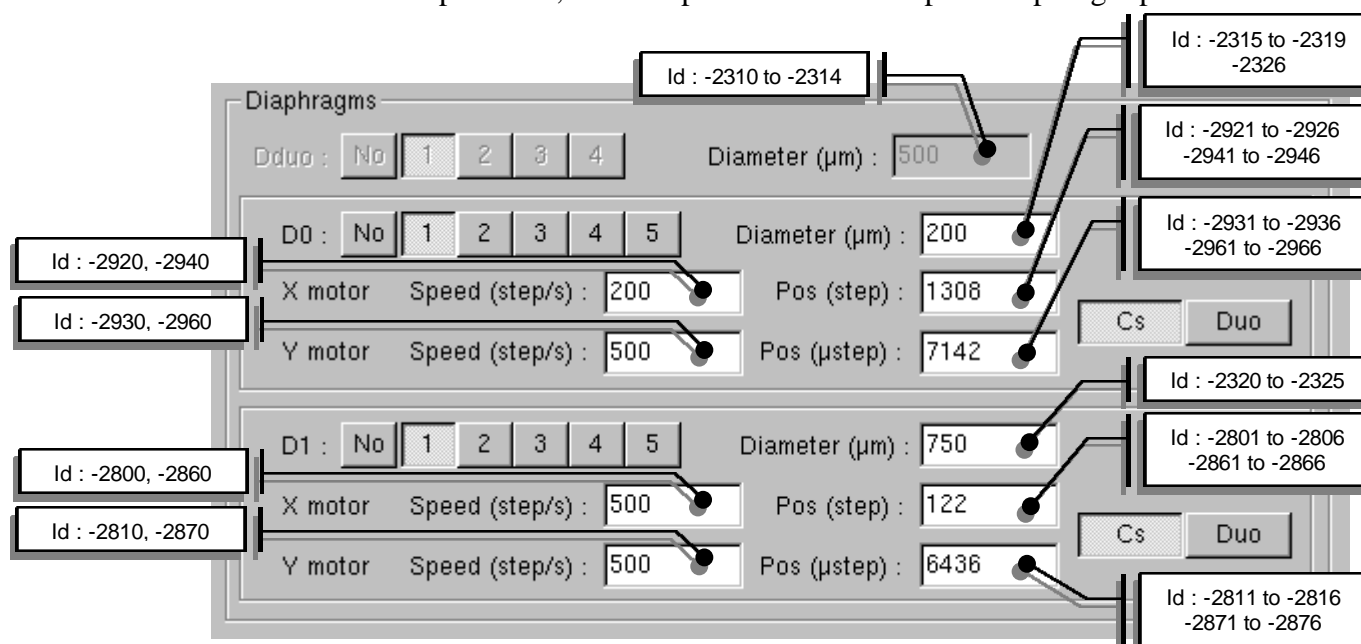
## 6. Slits & Diaphragms

This page allow you to define the Slits and Diaphragms parameters.

### 6.1 Diaphragms

This group is used to define the parameters values for the different diaphragms:

- Dduo diameter for each diaphragm position
- D0 diameter positions, motors speed and motor step for diaphragm positions
- D1 diameter positions, motors speed and motor step for diaphragm positions



Id	Format	Comment	Min	Max	Unit
-2310	double	Position 1 Duo diaphragm diameter	0.0	1000.0	µm
-2311	double	Position 2 Duo diaphragm diameter	0.0	1000.0	µm
-2312	double	Position 3 Duo diaphragm diameter	0.0	1000.0	µm
-2313	double	Position 4 Duo diaphragm diameter	0.0	1000.0	µm
-2314	double	No Duo diaphragm diameter	0.0	1000.0	µm
-2315	double	Position 1 D0 diaphragm diameter	0.0	1000.0	µm
-2316	double	Position 2 D0 diaphragm diameter	0.0	1000.0	µm
-2317	double	Position 3 D0 diaphragm diameter	0.0	1000.0	µm
-2318	double	Position 4 D0 diaphragm diameter	0.0	1000.0	µm
-2326	double	Position 5 D0 diaphragm diameter	0.0	1000.0	µm
-2319	double	No D0 diaphragm diameter	0.0	1000.0	µm
-2320	double	Position 1 D1 diaphragm diameter	0.0	1000.0	µm
-2321	double	Position 2 D1 diaphragm diameter	0.0	1000.0	µm
-2322	double	Position 3 D1 diaphragm diameter	0.0	1000.0	µm
-2323	double	Position 4 D1 diaphragm diameter	0.0	1000.0	µm
-2324	double	Position 5 D1 diaphragm diameter	0.0	1000.0	µm
-2325	double	No D1 diaphragm diameter	0.0	1000.0	µm
-2800	int	D1 X motor speed in Cs	80	2000	Step/s
-2801	int	D1 X motor step for Position 1 in Cs	-3000	3000	Step

-2802	int	D1 X motor step for Position 2 in Cs	-3000	3000	Step
-2803	int	D1 X motor step for Position 3 in Cs	-3000	3000	Step
-2804	int	D1 X motor step for Position 4 in Cs	-3000	3000	Step
-2805	int	D1 X motor step for Position 5 in Cs	-3000	3000	Step
-2806	int	D1 X motor step for No D1 in Cs	-3000	3000	Step
-2810	int	D1 Y motor speed in Cs	80	2000	Step/s
-2811	int	D1 Y motor step for Position 1 in Cs	0	25000	Step
-2812	int	D1 Y motor step for Position 2 in Cs	0	25000	Step
-2813	int	D1 Y motor step for Position 3 in Cs	0	25000	Step
-2814	int	D1 Y motor step for Position 4 in Cs	0	25000	Step
-2815	int	D1 Y motor step for Position 5 in Cs	0	25000	Step
-2816	int	D1 Y motor step for No D0 in Cs	0	25000	Step
-2860	int	D1 X motor speed in Duo	80	2000	Step/s
-2861	int	D1 X motor step for Position 1 in Duo	-3000	3000	Step
-2862	int	D1 X motor step for Position 2 in Duo	-3000	3000	Step
-2863	int	D1 X motor step for Position 3 in Duo	-3000	3000	Step
-2864	int	D1 X motor step for Position 4 in Duo	-3000	3000	Step
-2865	int	D1 X motor step for Position 5 in Duo	-3000	3000	Step
-2866	int	D1 X motor step for No D1 in Duo	-3000	3000	Step
-2870	int	D1 Y motor speed in Duo	80	2000	Step/s
-2871	int	D1 Y motor step for Position 1 in Duo	0	25000	Step
-2872	int	D1 Y motor step for Position 2 in Duo	0	25000	Step
-2873	int	D1 Y motor step for Position 3 in Duo	0	25000	Step
-2874	int	D1 Y motor step for Position 4 in Duo	0	25000	Step
-2875	int	D1 Y motor step for Position 5 in Duo	0	25000	Step
-2876	int	D1 Y motor step for No D0 in Duo	0	25000	Step
-2920	int	D0 X motor speed in Cs	80	2000	Step/s
-2921	int	D0 X motor step for Position 1 in Cs	-3000	3000	Step
-2922	int	D0 X motor step for Position 2 in Cs	-3000	3000	Step
-2923	int	D0 X motor step for Position 3 in Cs	-3000	3000	Step
-2924	int	D0 X motor step for Position 4 in Cs	-3000	3000	Step
-2925	int	D0 X motor step for No D0 in Cs	-3000	3000	Step
-2926	int	D0 X motor step for Position 5 in Cs	-3000	3000	Step
-2930	int	D0 Y motor speed in Cs	80	2000	Step/s
-2931	int	D0 Y motor step for Position 1 in Cs	0	25000	Step
-2932	int	D0 Y motor step for Position 2 in Cs	0	25000	Step
-2933	int	D0 Y motor step for Position 3 in Cs	0	25000	Step
-2934	int	D0 Y motor step for Position 4 in Cs	0	25000	Step
-2935	int	D0 Y motor step for No D0 in Cs	0	25000	Step
-2936	int	D0 Y motor step for Position 5 in Cs	0	25000	Step
-2940	int	D0 X motor speed in Duo	80	2000	Step/s
-2941	int	D0 X motor step for Position 1 in Duo	-3000	3000	Step
-2942	int	D0 X motor step for Position 2 in Duo	-3000	3000	Step
-2943	int	D0 X motor step for Position 3 in Duo	-3000	3000	Step
-2944	int	D0 X motor step for Position 4 in Duo	-3000	3000	Step
-2945	int	D0 X motor step for No D0 in Duo	-3000	3000	Step
-2946	int	D0 X motor step for Position 5 in Duo	-3000	3000	Step
-2960	int	D0 Y motor speed in Duo	80	2000	Step/s
-2961	int	D0 Y motor step for Position 1 in Duo	0	25000	Step
-2962	int	D0 Y motor step for Position 2 in Duo	0	25000	Step
-2963	int	D0 Y motor step for Position 3 in Duo	0	25000	Step
-2964	int	D0 Y motor step for Position 4 in Duo	0	25000	Step
-2965	int	D0 Y motor step for No D0 in Duo	0	25000	Step
-2966	int	D0 Y motor step for Position 5 in Duo	0	25000	Step

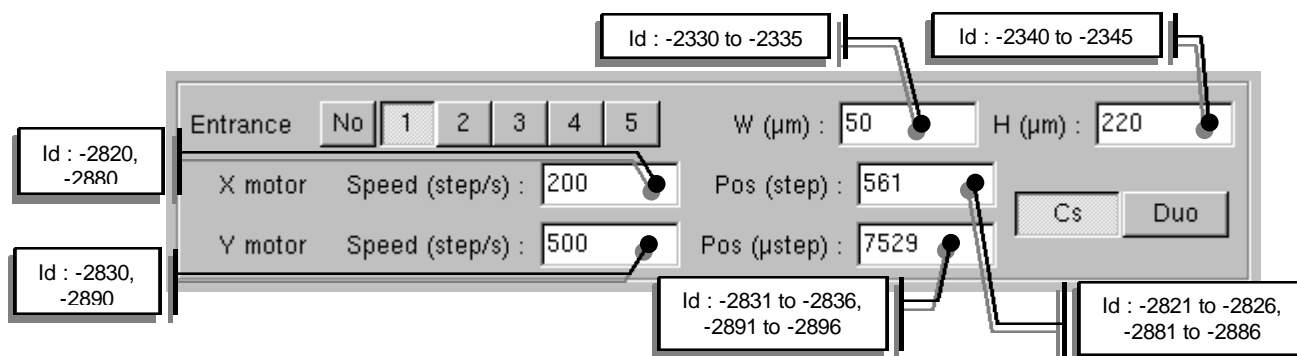
## 6.2 Slits

This group is used to define the parameters values for the different slits.

### 6.2.1 Entrance Slit

This group is used to define the parameters values for the Entrance slit:

- width and height for each slit position
- motors speed
- motor position for each slit position



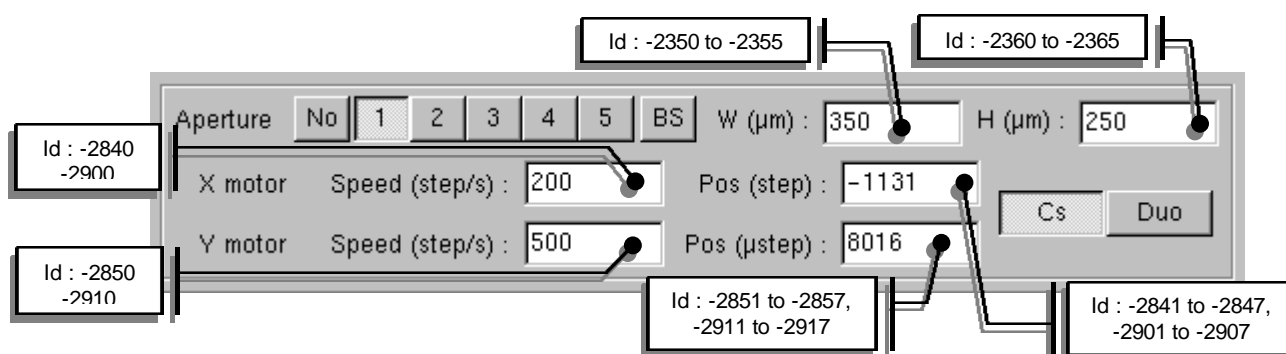
Id	Format	Comment	Min	Max	Unit
-2330	double	Position 1 Entrance slit width	0.0	500.0	µm
-2331	double	Position 2 Entrance slit width	0.0	500.0	µm
-2332	double	Position 3 Entrance slit width	0.0	500.0	µm
-2333	double	Position 4 Entrance slit width	0.0	500.0	µm
-2334	double	Position 5 Entrance slit width	0.0	500.0	µm
-2335	double	No Entrance slit width	0.0	500.0	µm
-2340	double	Position 1 Entrance slit height	0.0	500.0	µm
-2341	double	Position 2 Entrance slit height	0.0	500.0	µm
-2342	double	Position 3 Entrance slit height	0.0	500.0	µm
-2343	double	Position 4 Entrance slit height	0.0	500.0	µm
-2344	double	Position 5 Entrance slit height	0.0	500.0	µm
-2345	double	No Entrance slit height	0.0	500.0	µm
-2820	int	Entrance slit X motor speed in Cs	80	2000	Step/s
-2821	int	Entrance slit X motor step for Position 1 in Cs	-3000	3000	Step
-2822	int	Entrance slit X motor step for Position 2 in Cs	-3000	3000	Step
-2823	int	Entrance slit X motor step for Position 3 in Cs	-3000	3000	Step
-2824	int	Entrance slit X motor step for Position 4 in Cs	-3000	3000	Step
-2825	int	Entrance slit X motor step for Position 5 in Cs	-3000	3000	Step
-2826	int	Entrance slit X motor step for No slit in Cs	-3000	3000	Step
-2830	int	Entrance slit Y motor speed in Cs	80	2000	Step/s
-2831	int	Entrance slit Y motor step for Position 1 in Cs	0	25000	Step
-2832	int	Entrance slit Y motor step for Position 2 in Cs	0	25000	Step
-2833	int	Entrance slit Y motor step for Position 3 in Cs	0	25000	Step
-2834	int	Entrance slit Y motor step for Position 4 in Cs	0	25000	Step
-2835	int	Entrance slit Y motor step for Position 5 in Cs	0	25000	Step
-2836	int	Entrance slit Y motor step for No slit in Cs	0	25000	Step
-2880	int	Entrance slit X motor speed in Duo	80	2000	Step/s
-2881	int	Entrance slit X motor step for Position 1 in Duo	-3000	3000	Step
-2882	int	Entrance slit X motor step for Position 2 in Duo	-3000	3000	Step
-2883	int	Entrance slit X motor step for Position 3 in Duo	-3000	3000	Step
-2884	int	Entrance slit X motor step for Position 4 in Duo	-3000	3000	Step
-2885	int	Entrance slit X motor step for Position 5 in Duo	-3000	3000	Step
-2886	int	Entrance slit X motor step for No slit in Duo	-3000	3000	Step

-2890	int	Entrance slit Y motor speed in Duo	80	2000	Step/s
-2891	int	Entrance slit Y motor step for Position 1 in Duo	0	25000	Step
-2892	int	Entrance slit Y motor step for Position 2 in Duo	0	25000	Step
-2893	int	Entrance slit Y motor step for Position 3 in Duo	0	25000	Step
-2894	int	Entrance slit Y motor step for Position 4 in Duo	0	25000	Step
-2895	int	Entrance slit Y motor step for Position 5 in Duo	0	25000	Step
-2896	int	Entrance slit Y motor step for No slit in Duo	0	25000	Step

## 6.2.2 Aperture Slit

This group is used to define the parameters values for the Aperture slit:

- width and height for each slit position
- motors speed
- motor position for each slit position



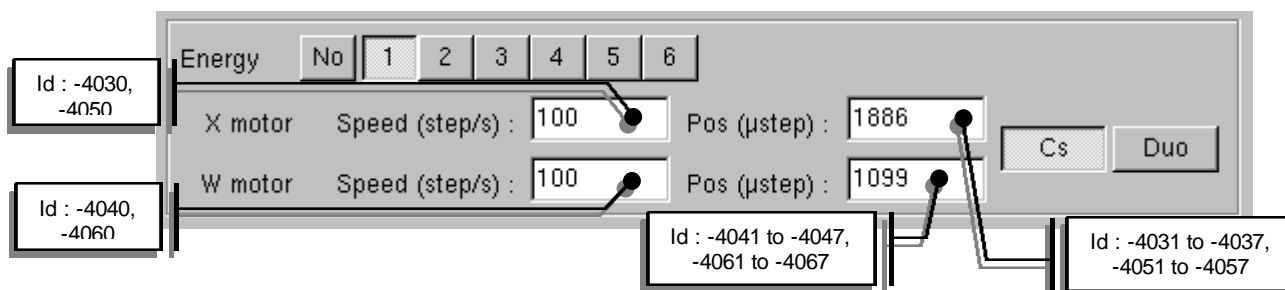
Id	Format	Comment	Min	Max	Unit
-2350	double	Position 1 Aperture slit width	0.0	500.0	µm
-2351	double	Position 2 Aperture slit width	0.0	500.0	µm
-2352	double	Position 3 Aperture slit width	0.0	500.0	µm
-2353	double	Position 4 Aperture slit width	0.0	500.0	µm
-2354	double	Position 5 Aperture slit width	0.0	500.0	µm
-2355	double	No Aperture slit width	0.0	500.0	µm
-2360	double	Position 1 Aperture slit height	0.0	500.0	µm
-2361	double	Position 2 Aperture slit height	0.0	500.0	µm
-2362	double	Position 3 Aperture slit height	0.0	500.0	µm
-2363	double	Position 4 Aperture slit height	0.0	500.0	µm
-2364	double	Position 5 Aperture slit height	0.0	500.0	µm
-2365	double	No Aperture slit height	0.0	500.0	µm
-2840	int	Aperture slit X motor speed in Cs	80	2000	Step/s
-2841	int	Aperture slit X motor step for Position 1 in Cs	-3000	3000	Step
-2842	int	Aperture slit X motor step for Position 2 in Cs	-3000	3000	Step
-2843	int	Aperture slit X motor step for Position 3 in Cs	-3000	3000	Step
-2844	int	Aperture slit X motor step for Position 4 in Cs	-3000	3000	Step
-2845	int	Aperture slit X motor step for Position 5 in Cs	-3000	3000	Step
-2846	int	Aperture slit X motor step for No slit in Cs	-3000	3000	Step
-2847	int	Aperture slit X motor step for BeamStop in Cs	-3000	3000	Step
-2850	int	Aperture slit Y motor speed in Cs	80	2000	Step/s
-2851	int	Aperture slit Y motor step for Position 1 in Cs	0	25000	Step
-2852	int	Aperture slit Y motor step for Position 2 in Cs	0	25000	Step
-2853	int	Aperture slit Y motor step for Position 3 in Cs	0	25000	Step
-2854	int	Aperture slit Y motor step for Position 4 in Cs	0	25000	Step
-2855	int	Aperture slit Y motor step for Position 5 in Cs	0	25000	Step
-2856	int	Aperture slit Y motor step for No slit in Cs	0	25000	Step
-2857	int	Aperture slit Y motor step for BeamStop in Cs	0	25000	Step
-2900	int	Aperture slit X motor speed in Duo	80	2000	Step/s
-2901	int	Aperture slit X motor step for Position 1 in	-3000	3000	Step

		Duo			
-2902	int	Aperture slit X motor step for Position 2 in Duo	-3000	3000	Step
-2903	int	Aperture slit X motor step for Position 3 in Duo	-3000	3000	Step
-2904	int	Aperture slit X motor step for Position 4 in Duo	-3000	3000	Step
-2905	int	Aperture slit X motor step for Position 5 in Duo	-3000	3000	Step
-2906	int	Aperture slit X motor step for No slit in Duo	-3000	3000	Step
-2907	int	Aperture slit X motor step for BeamStop in Duo	-3000	3000	Step
-2910	int	Aperture slit Y motor speed in Duo	80	2000	Step/s
-2911	int	Aperture slit Y motor step for Position 1 in Duo	0	25000	Step
-2912	int	Aperture slit Y motor step for Position 2 in Duo	0	25000	Step
-2913	int	Aperture slit Y motor step for Position 3 in Duo	0	25000	Step
-2914	int	Aperture slit Y motor step for Position 4 in Duo	0	25000	Step
-2915	int	Aperture slit Y motor step for Position 5 in Duo	0	25000	Step
-2916	int	Aperture slit Y motor step for No slit in Duo	0	25000	Step
-2917	int	Aperture slit Y motor step for BeamStop in Duo	0	25000	Step

### 6.2.3 Energy Slit

This group is used to define the parameters values for the Energy slit:

- motors speed
- motor position for each slit position



Id	Format	Comment	Min	Max	Unit
-4030	int	Energy slit X motor speed in Cs	80	2000	Step/s
-4031	int	Energy slit X motor step for Position 1 in Cs	-11000	11000	Step
-4032	int	Energy slit X motor step for Position 2 in Cs	-11000	11000	Step
-4033	int	Energy slit X motor step for Position 3 in Cs	-11000	11000	Step
-4034	int	Energy slit X motor step for Position 4 in Cs	-11000	11000	Step
-4035	int	Energy slit X motor step for Position 5 in Cs	-11000	11000	Step
-4036	int	Energy slit X motor step for Position 6 in Cs	-11000	11000	Step
-4037	int	Energy slit X motor step for No slit in Cs	-11000	11000	Step
-4040	int	Energy slit W motor speed in Cs	80	2000	Step/s
-4041	int	Energy slit W motor step for Position 1 in Cs	-11000	11000	Step
-4042	int	Energy slit W motor step for Position 2 in Cs	-11000	11000	Step
-4043	int	Energy slit W motor step for Position 3 in Cs	-11000	11000	Step
-4044	int	Energy slit W motor step for Position 4 in Cs	-11000	11000	Step
-4045	int	Energy slit W motor step for Position 5 in Cs	-11000	11000	Step
-4046	int	Energy slit W motor step for Position 6 in Cs	-11000	11000	Step
-4047	int	Energy slit W motor step for No slit in Cs	-11000	11000	Step
-4050	int	Energy slit X motor speed in Duo	80	2000	Step/s
-4051	int	Energy slit X motor step for Position 1 in Duo	-11000	11000	Step
-4052	int	Energy slit X motor step for Position 2 in Duo	-11000	11000	Step

-4053	int	Energy slit X motor step for Position 3 in Duo	-11000	11000	Step
-4054	int	Energy slit X motor step for Position 4 in Duo	-11000	11000	Step
-4055	int	Energy slit X motor step for Position 5 in Duo	-11000	11000	Step
-4056	int	Energy slit X motor step for Position 6 in Duo	-11000	11000	Step
-4057	int	Energy slit X motor step for No slit in Duo	-11000	11000	Step
-4060	int	Energy slit Y motor speed in Duo	80	2000	Step/s
-4061	int	Energy slit Y motor step for Position 1 in Duo	-11000	11000	Step
-4062	int	Energy slit Y motor step for Position 2 in Duo	-11000	11000	Step
-4063	int	Energy slit Y motor step for Position 3 in Duo	-11000	11000	Step
-4064	int	Energy slit Y motor step for Position 4 in Duo	-11000	11000	Step
-4065	int	Energy slit Y motor step for Position 5 in Duo	-11000	11000	Step
-4066	int	Energy slit Y motor step for Position 6 in Duo	-11000	11000	Step
-4067	int	Energy slit Y motor step for No slit in Duo	-11000	11000	Step

## 6.2.4 Exit Slit

This group is used to define the parameters values for the Aperture slit:

- width and height for each slit position and type
- motors speed
- motor position for each slit position

### 6.2.4.1 Detector #1

Id	Format	Comment	Min	Max	Unit
-2370	double	Det #1 Position 1 Exit slit normal width	0.0	500.0	μm
-2371	double	Det #1 Position 1 Exit slit normal height	0.0	2000.0	μm
-2372	double	Det #1 Position 1 Exit slit large width	0.0	500.0	μm
-2373	double	Det #1 Position 1 Exit slit large height	0.0	2000.0	μm
-2374	double	Det #1 Position 2 Exit slit normal width	0.0	500.0	μm
-2375	double	Det #1 Position 2 Exit slit normal height	0.0	2000.0	μm
-2376	double	Det #1 Position 2 Exit slit large width	0.0	500.0	μm
-2377	double	Det #1 Position 2 Exit slit large height	0.0	2000.0	μm
-2378	double	Det #1 Position 3 Exit slit normal width	0.0	500.0	μm
-2379	double	Det #1 Position 3 Exit slit normal height	0.0	2000.0	μm
-2380	double	Det #1 Position 3 Exit slit large width	0.0	500.0	μm
-2381	double	Det #1 Position 3 Exit slit large height	0.0	2000.0	μm
-2390	int	Det #1 Exit slit type ( 0=Normal / 1=Large / 2=XLarge )	0	2	
-2474	double	Det #1 Position 1 Exit slit command	0.0	500.0	μm
-2475	double	Det #1 Position 2 Exit slit command	0.0	500.0	μm
-2476	double	Det #1 Position 3 Exit slit command	0.0	500.0	μm
-2720	double	Det #1 Position 1 Exit slit XLarge width	0.0	500.0	μm
-2721	double	Det #1 Position 1 Exit slit XLarge height	0.0	2000.0	μm
-2722	double	Det #1 Position 2 Exit slit XLarge width	0.0	500.0	μm
-2723	double	Det #1 Position 2 Exit slit XLarge height	0.0	2000.0	μm
-2724	double	Det #1 Position 3 Exit slit XLarge width	0.0	500.0	μm
-2725	double	Det #1 Position 3 Exit slit XLarge height	0.0	2000.0	μm
-4000	int	Det #1 Exit slit motor speed	80	2000	Step/s
-4001	int	Det #1 Exit slit motor step for Position 1	0	10000	Step
-4002	int	Det #1 Exit slit motor step for Position 2	0	10000	Step
-4003	int	Det #1 Exit slit motor step for Position 3	0	10000	Step

### 6.2.4.2 Detector #2

Id	Format	Comment	Min	Max	Unit
-2402	double	Det #2 Position 1 Exit slit normal width	0.0	500.0	μm
-2403	double	Det #2 Position 1 Exit slit normal height	0.0	2000.0	μm
-2404	double	Det #2 Position 1 Exit slit large width	0.0	500.0	μm
-2405	double	Det #2 Position 1 Exit slit large height	0.0	2000.0	μm
-2406	double	Det #2 Position 2 Exit slit normal width	0.0	500.0	μm
-2407	double	Det #2 Position 2 Exit slit normal height	0.0	2000.0	μm
-2408	double	Det #2 Position 2 Exit slit large width	0.0	500.0	μm
-2409	double	Det #2 Position 2 Exit slit large height	0.0	2000.0	μm
-2410	double	Det #2 Position 3 Exit slit normal width	0.0	500.0	μm
-2411	double	Det #2 Position 3 Exit slit normal height	0.0	2000.0	μm
-2412	double	Det #2 Position 3 Exit slit large width	0.0	500.0	μm
-2413	double	Det #2 Position 3 Exit slit large height	0.0	2000.0	μm
-2391	int	Det #2 Exit slit type	0	2	

		( 0=Normal / 1=Large / 2=XLarge )			
-2477	double	Det #2 Position 1 Exit slit command	0.0	500.0	µm
-2478	double	Det #2 Position 2 Exit slit command	0.0	500.0	µm
-2479	double	Det #2 Position 3 Exit slit command	0.0	500.0	µm
-2726	double	Det #2 Position 1 Exit slit Xlarge width	0.0	500.0	µm
-2727	double	Det #2 Position 1 Exit slit Xlarge height	0.0	2000.0	µm
-2728	double	Det #2 Position 2 Exit slit Xlarge width	0.0	500.0	µm
-2729	double	Det #2 Position 2 Exit slit Xlarge height	0.0	2000.0	µm
-2730	double	Det #2 Position 3 Exit slit Xlarge width	0.0	500.0	µm
-2731	double	Det #2 Position 3 Exit slit Xlarge height	0.0	2000.0	µm
-4004	int	Det #2 Exit slit motor speed	80	2000	Step/s
-4005	int	Det #2 Exit slit motor step for Position 1	0	10000	Step
-4006	int	Det #2 Exit slit motor step for Position 2	0	10000	Step
-4007	int	Det #2 Exit slit motor step for Position 3	0	10000	Step

#### 6.2.4.3 Detector #3

Id	Format	Comment	Min	Max	Unit
-2414	double	Det #3 Position 1 Exit slit normal width	0.0	500.0	µm
-2415	double	Det #3 Position 1 Exit slit normal height	0.0	2000.0	µm
-2416	double	Det #3 Position 1 Exit slit large width	0.0	500.0	µm
-2417	double	Det #3 Position 1 Exit slit large height	0.0	2000.0	µm
-2418	double	Det #3 Position 2 Exit slit normal width	0.0	500.0	µm
-2419	double	Det #3 Position 2 Exit slit normal height	0.0	2000.0	µm
-2420	double	Det #3 Position 2 Exit slit large width	0.0	500.0	µm
-2421	double	Det #3 Position 2 Exit slit large height	0.0	2000.0	µm
-2422	double	Det #3 Position 3 Exit slit normal width	0.0	500.0	µm
-2423	double	Det #3 Position 3 Exit slit normal height	0.0	2000.0	µm
-2424	double	Det #3 Position 3 Exit slit large width	0.0	500.0	µm
-2425	double	Det #3 Position 3 Exit slit large height	0.0	2000.0	µm
-2392	int	Det #3 Exit slit type ( 0=Normal / 1=Large / 2=XLarge )	0	2	
-2480	double	Det #3 Position 1 Exit slit command	0.0	500.0	µm
-2481	double	Det #3 Position 2 Exit slit command	0.0	500.0	µm
-2482	double	Det #3 Position 3 Exit slit command	0.0	500.0	µm
-2732	double	Det #3 Position 1 Exit slit Xlarge width	0.0	500.0	µm
-2733	double	Det #3 Position 1 Exit slit Xlarge height	0.0	2000.0	µm
-2734	double	Det #3 Position 2 Exit slit Xlarge width	0.0	500.0	µm
-2735	double	Det #3 Position 2 Exit slit Xlarge height	0.0	2000.0	µm
-2736	double	Det #3 Position 3 Exit slit Xlarge width	0.0	500.0	µm
-2737	double	Det #3 Position 3 Exit slit Xlarge height	0.0	2000.0	µm
-4008	int	Det #3 Exit slit motor speed	80	2000	Step/s
-4009	int	Det #3 Exit slit motor step for Position 1	0	10000	Step
-4010	int	Det #3 Exit slit motor step for Position 2	0	10000	Step
-4011	int	Det #3 Exit slit motor step for Position 3	0	10000	Step

#### 6.2.4.4 Detector #4

Id	Format	Comment	Min	Max	Unit
-2426	double	Det #4 Position 1 Exit slit normal width	0.0	500.0	µm
-2427	double	Det #4 Position 1 Exit slit normal height	0.0	2000.0	µm
-2428	double	Det #4 Position 1 Exit slit large width	0.0	500.0	µm
-2429	double	Det #4 Position 1 Exit slit large height	0.0	2000.0	µm
-2430	double	Det #4 Position 2 Exit slit normal width	0.0	500.0	µm
-2431	double	Det #4 Position 2 Exit slit normal height	0.0	2000.0	µm
-2432	double	Det #4 Position 2 Exit slit large width	0.0	500.0	µm
-2433	double	Det #4 Position 2 Exit slit large height	0.0	2000.0	µm
-2434	double	Det #4 Position 3 Exit slit normal width	0.0	500.0	µm
-2435	double	Det #4 Position 3 Exit slit normal height	0.0	2000.0	µm
-2436	double	Det #4 Position 3 Exit slit large width	0.0	500.0	µm
-2437	double	Det #4 Position 3 Exit slit large height	0.0	2000.0	µm
-2393	int	Det #4 Exit slit type ( 0=Normal / 1=Large / 2=XLarge )	0	2	
-2483	double	Det #4 Position 1 Exit slit command	0.0	500.0	µm
-2484	double	Det #4 Position 2 Exit slit command	0.0	500.0	µm

-2485	double	Det #4 Position 3 Exit slit command	0.0	500.0	μm
-2738	double	Det #4 Position 1 Exit slit Xlarge width	0.0	500.0	μm
-2739	double	Det #4 Position 1 Exit slit Xlarge height	0.0	2000.0	μm
-2740	double	Det #4 Position 2 Exit slit Xlarge width	0.0	500.0	μm
-2741	double	Det #4 Position 2 Exit slit Xlarge height	0.0	2000.0	μm
-2742	double	Det #4 Position 3 Exit slit Xlarge width	0.0	500.0	μm
-2743	double	Det #4 Position 3 Exit slit Xlarge height	0.0	2000.0	μm
-4012	int	Det #4 Exit slit motor speed	80	2000	Step/s
-4013	int	Det #4 Exit slit motor step for Position 1	0	10000	Step
-4014	int	Det #4 Exit slit motor step for Position 2	0	10000	Step
-4015	int	Det #4 Exit slit motor step for Position 3	0	10000	Step

### 6.2.4.5 Detector #5

Id	Format	Comment	Min	Max	Unit
-2438	double	Det #5 Position 1 Exit slit normal width	0.0	500.0	µm
-2439	double	Det #5 Position 1 Exit slit normal height	0.0	2000.0	µm
-2440	double	Det #5 Position 1 Exit slit large width	0.0	500.0	µm
-2441	double	Det #5 Position 1 Exit slit large height	0.0	2000.0	µm
-2442	double	Det #5 Position 2 Exit slit normal width	0.0	500.0	µm
-2443	double	Det #5 Position 2 Exit slit normal height	0.0	2000.0	µm
-2444	double	Det #5 Position 2 Exit slit large width	0.0	500.0	µm
-2445	double	Det #5 Position 2 Exit slit large height	0.0	2000.0	µm
-2446	double	Det #5 Position 3 Exit slit normal width	0.0	500.0	µm
-2447	double	Det #5 Position 3 Exit slit normal height	0.0	2000.0	µm
-2448	double	Det #5 Position 3 Exit slit large width	0.0	500.0	µm
-2449	double	Det #5 Position 3 Exit slit large height	0.0	2000.0	µm
-2394	int	Det #5 Exit slit type ( 0=Normal / 1=Large / 2=XLarge )	0	2	
-2489	double	Det #5 Position 1 Exit slit command	0.0	500.0	µm
-2490	double	Det #5 Position 2 Exit slit command	0.0	500.0	µm
-2491	double	Det #5 Position 3 Exit slit command	0.0	500.0	µm
-2744	double	Det #5 Position 1 Exit slit Xlarge width	0.0	500.0	µm
-2745	double	Det #5 Position 1 Exit slit Xlarge height	0.0	2000.0	µm
-2746	double	Det #5 Position 2 Exit slit Xlarge width	0.0	500.0	µm
-2747	double	Det #5 Position 2 Exit slit Xlarge height	0.0	2000.0	µm
-2748	double	Det #5 Position 3 Exit slit Xlarge width	0.0	500.0	µm
-2749	double	Det #5 Position 3 Exit slit Xlarge height	0.0	2000.0	µm
-4016	int	Det #5 Exit slit motor speed	80	2000	Step/s
-4017	int	Det #5 Exit slit motor step for Position 1	0	10000	Step
-4018	int	Det #5 Exit slit motor step for Position 2	0	10000	Step
-4019	int	Det #5 Exit slit motor step for Position 3	0	10000	Step

### 6.2.4.6 Fc Detector

Id	Format	Comment	Min	Max	Unit
-2450	double	Secondary Fc Position 1 Exit slit normal width	0.0	500.0	µm
-2451	double	Secondary Fc Position 1 Exit slit normal height	0.0	2000.0	µm
-2452	double	Secondary Fc Position 1 Exit slit large width	0.0	500.0	µm
-2453	double	Secondary Fc Position 1 Exit slit large height	0.0	2000.0	µm
-2454	double	Secondary Fc Position 2 Exit slit normal width	0.0	500.0	µm
-2455	double	Secondary Fc Position 2 Exit slit normal height	0.0	2000.0	µm
-2456	double	Secondary Fc Position 2 Exit slit large width	0.0	500.0	µm
-2457	double	Secondary Fc Position 2 Exit slit large height	0.0	2000.0	µm
-2458	double	Secondary Fc Position 3 Exit slit normal width	0.0	500.0	µm
-2459	double	Secondary Fc Position 3 Exit slit normal height	0.0	2000.0	µm
-2460	double	Secondary Fc Position 3 Exit slit large width	0.0	500.0	µm
-2461	double	Secondary Fc Position 3 Exit slit large height	0.0	2000.0	µm
-2395	int	Sec Fc Exit slit type ( 0=Normal / 1=Large / 2=XLarge )	0	2	

### 6.2.4.7 Detector #4B

Id	Format	Comment	Min	Max	Unit
-2462	double	Det #4B Position 1 Exit slit normal width	0.0	500.0	µm
-2463	double	Det #4B Position 1 Exit slit normal height	0.0	2000.0	µm
-2464	double	Det #4B Position 1 Exit slit large width	0.0	500.0	µm
-2465	double	Det #4B Position 1 Exit slit large height	0.0	2000.0	µm
-2466	double	Det #4B Position 2 Exit slit normal width	0.0	500.0	µm
-2467	double	Det #4B Position 2 Exit slit normal height	0.0	2000.0	µm
-2468	double	Det #4B Position 2 Exit slit large width	0.0	500.0	µm
-2469	double	Det #4B Position 2 Exit slit large height	0.0	2000.0	µm
-2470	double	Det #4B Position 3 Exit slit normal width	0.0	500.0	µm

-2471	double	Det #4B Position 3 Exit slit normal height	0.0	2000.0	µm
-2472	double	Det #4B Position 3 Exit slit large width	0.0	500.0	µm
-2473	double	Det #4B Position 3 Exit slit large height	0.0	2000.0	µm
-2396	int	Det #4B Exit slit type ( 0=Normal / 1=Large / 2=XLarge )	0	2	
-2486	double	Det #4B Position 1 Exit slit command	0.0	500.0	µm
-2487	double	Det #4B Position 2 Exit slit command	0.0	500.0	µm
-2488	double	Det #4B Position 3 Exit slit command	0.0	500.0	µm

#### 6.2.4.8 Detector #6

Id	Format	Comment	Min	Max	Unit
-2397	int	Det #6 Exit slit type ( 0=Normal / 1=Large / 2=XLarge )	0	2	
-2492	double	Det #6 Position 1 Exit slit command	0.0	500.0	µm
-2493	double	Det #6 Position 2 Exit slit command	0.0	500.0	µm
-2494	double	Det #6 Position 3 Exit slit command	0.0	500.0	µm
-2750	double	Det #6 Position 1 Exit slit normal width	0.0	500.0	µm
-2751	double	Det #6 Position 1 Exit slit normal height	0.0	2000.0	µm
-2752	double	Det #6 Position 1 Exit slit large width	0.0	500.0	µm
-2753	double	Det #6 Position 1 Exit slit large height	0.0	2000.0	µm
-2754	double	Det #6 Position 1 Exit slit XLarge width	0.0	500.0	µm
-2755	double	Det #6 Position 1 Exit slit XLarge height	0.0	2000.0	µm
-2756	double	Det #6 Position 2 Exit slit normal width	0.0	500.0	µm
-2757	double	Det #6 Position 2 Exit slit normal height	0.0	2000.0	µm
-2758	double	Det #6 Position 2 Exit slit large width	0.0	500.0	µm
-2759	double	Det #6 Position 2 Exit slit large height	0.0	2000.0	µm
-2760	double	Det #6 Position 2 Exit slit XLarge width	0.0	500.0	µm
-2761	double	Det #6 Position 2 Exit slit XLarge height	0.0	2000.0	µm
-2762	double	Det #6 Position 3 Exit slit normal width	0.0	500.0	µm
-2763	double	Det #6 Position 3 Exit slit normal height	0.0	2000.0	µm
-2764	double	Det #6 Position 3 Exit slit large width	0.0	500.0	µm
-2765	double	Det #6 Position 3 Exit slit large height	0.0	2000.0	µm
-2766	double	Det #6 Position 3 Exit slit XLarge width	0.0	500.0	µm
-2767	double	Det #6 Position 3 Exit slit XLarge height	0.0	2000.0	µm
-4020	int	Det #6 Exit slit motor speed	80	2000	Step/s
-4021	int	Det #6 Exit slit motor step for Position 1	0	10000	Step
-4022	int	Det #6 Exit slit motor step for Position 2	0	10000	Step
-4023	int	Det #6 Exit slit motor step for Position 3	0	10000	Step

#### 6.2.4.9 Detector #7

Id	Format	Comment	Min	Max	Unit
-2398	int	Det #7 Exit slit type ( 0=Normal / 1=Large / 2=XLarge )	0	2	
-2768	double	Det #7 Position 1 Exit slit normal width	0.0	500.0	µm
-2769	double	Det #7 Position 1 Exit slit normal height	0.0	2000.0	µm
-2770	double	Det #7 Position 1 Exit slit large width	0.0	500.0	µm
-2771	double	Det #7 Position 1 Exit slit large height	0.0	2000.0	µm
-2772	double	Det #7 Position 1 Exit slit XLarge width	0.0	500.0	µm
-2773	double	Det #7 Position 1 Exit slit XLarge height	0.0	2000.0	µm
-2774	double	Det #7 Position 2 Exit slit normal width	0.0	500.0	µm
-2775	double	Det #7 Position 2 Exit slit normal height	0.0	2000.0	µm
-2776	double	Det #7 Position 2 Exit slit large width	0.0	500.0	µm
-2777	double	Det #7 Position 2 Exit slit large height	0.0	2000.0	µm
-2778	double	Det #7 Position 2 Exit slit XLarge width	0.0	500.0	µm
-2779	double	Det #7 Position 2 Exit slit XLarge height	0.0	2000.0	µm
-2780	double	Det #7 Position 3 Exit slit normal width	0.0	500.0	µm
-2781	double	Det #7 Position 3 Exit slit normal height	0.0	2000.0	µm
-2782	double	Det #7 Position 3 Exit slit large width	0.0	500.0	µm
-2783	double	Det #7 Position 3 Exit slit large height	0.0	2000.0	µm
-2784	double	Det #7 Position 3 Exit slit XLarge width	0.0	500.0	µm
-2785	double	Det #7 Position 3 Exit slit XLarge height	0.0	2000.0	µm
-4024	int	Det #7 Exit slit motor speed	80	2000	Step/s
-4025	int	Det #7 Exit slit motor step for Position 1	0	10000	Step

-4026	int	Det #7 Exit slit motor step for Position 2	0	10000	Step
-4027	int	Det #7 Exit slit motor step for Position 3	0	10000	Step

#### 6.2.4.10 Large Detector

Large Detector Slit width (μm)  (μm/mm) \* Slit cmd (mm) +  (μm)

Id : -2400  Id : -2401

Id	Format	Comment	Min	Max	Unit
-2400	double	Large detector slit width slope	30.0	60.0	μm/mm
-2401	double	Large detector slit width offset	-1000.0	1000.0	mm

## 7. Detectors

This page is used to define the parameters settings for the different detector.

### 7.1 Electron multiplier

This group is used to define the parameters values for the detectors:

- Security, dead time, yield and background for EM
- Background for FC

Detector

Detector

Electron Multiplier

Security (c/s) :  Dead Time (ns) :  Yield (%) :

Background (c/s) :

Faraday Cup

Background (c/s) :

Id : -2640 to -2648, -2677, -2678

Id : -2610 to -2619

Id : -2660 to -2666, -2670 to -2676

Id : -2620 to -2629

Id : -2600 to -2609

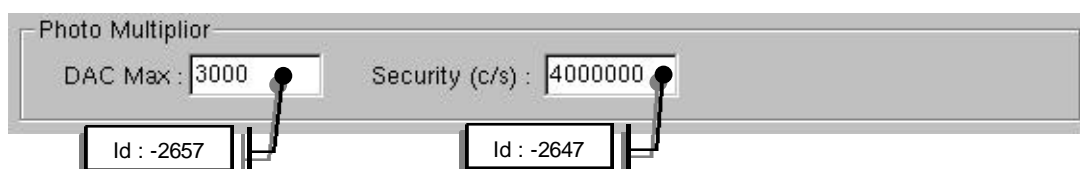
Id	Format	Comment	Min	Max	Unit
-2600	double	Det #1 yield	0.0	100.0	%
-2601	double	Det #2 yield	0.0	100.0	%
-2602	double	Det #3 yield	0.0	100.0	%
-2603	double	Det #4 yield	0.0	100.0	%
-2604	double	5 <sup>th</sup> detector yield	0.0	100.0	%
-2605	double	Large detector yield	0.0	100.0	%
-2606	double	Tic detector yield	0.0	100.0	%
-2607	double	Det #4B yield	0.0	100.0	%
-2608	double	Det #6 yield	0.0	100.0	%
-2609	double	Det #7 yield	0.0	100.0	%
-2610	int	Det #1 background	0	5000	cps
-2611	int	Det #2 background	0	5000	cps
-2612	int	Det #3 background	0	5000	cps
-2613	int	Det #4 background	0	5000	cps
-2614	int	5 <sup>th</sup> detector background	0	5000	cps
-2615	int	Large detector background	0	5000	cps
-2616	int	Tic detector background	0	5000	cps
-2617	int	Det #4B background	0	5000	cps
-2618	int	Det #6 background	0	5000	cps
-2619	int	Det #7 background	0	5000	cps
-2620	int	Det #1 dead time	15	100	ns
-2621	int	Det #2 dead time	15	100	ns
-2622	int	Det #3 dead time	15	100	ns

-2623	int	Det #4 dead time	15	100	ns
-2624	int	5 <sup>th</sup> detector dead time	15	100	ns
-2625	int	Large detector dead time	15	100	ns
-2626	int	Tic detector dead time	15	100	ns
-2627	int	Det #4B dead time	15	100	ns
-2628	int	Det #6 dead time	15	100	ns
-2629	int	Det #7 dead time	15	100	ns
-2640	int	Det #1 security	1000000	10000000	cps
-2641	int	Det #2 security	1000000	10000000	cps
-2642	int	Det #3 security	1000000	10000000	cps
-2643	int	Det #4 security	1000000	10000000	cps
-2644	int	5 <sup>th</sup> detector security	1000000	10000000	cps
-2645	int	Large detector security	1000000	10000000	cps
-2646	int	Tic detector security	1000000	10000000	cps
-2648	int	Det #4B security	1000000	10000000	cps
-2677	int	Det #6 security	1000000	10000000	cps
-2678	int	Det #7 security	1000000	10000000	cps
-2660	int	Det #1 FC background for pos polarity	0	5000	cps
-2661	int	Det #2 FC background for pos polarity	0	5000	cps
-2662	int	Det #3 FC background for pos polarity	0	5000	cps
-2663	int	Det #4 FC background for pos polarity	0	5000	cps
-2664	int	Det #5 FC background for pos polarity	0	5000	cps
-2665	int	Det #6 FC background for pos polarity	0	5000	cps
-2666	int	Det #7 FC background for pos polarity	0	5000	cps
-2670	int	Det #1 FC background for neg polarity	0	5000	cps
-2671	int	Det #2 FC background for neg polarity	0	5000	cps
-2672	int	Det #3 FC background for neg polarity	0	5000	cps
-2673	int	Det #4 FC background for neg polarity	0	5000	cps
-2674	int	Det #5 FC background for neg polarity	0	5000	cps
-2675	int	Det #6 FC background for neg polarity	0	5000	cps
-2676	int	Det #7 FC background for neg polarity	0	5000	cps

## 7.2 Photo multiplier

This group is used to define the parameters values for the photo multiplier:

- Security and max DAC

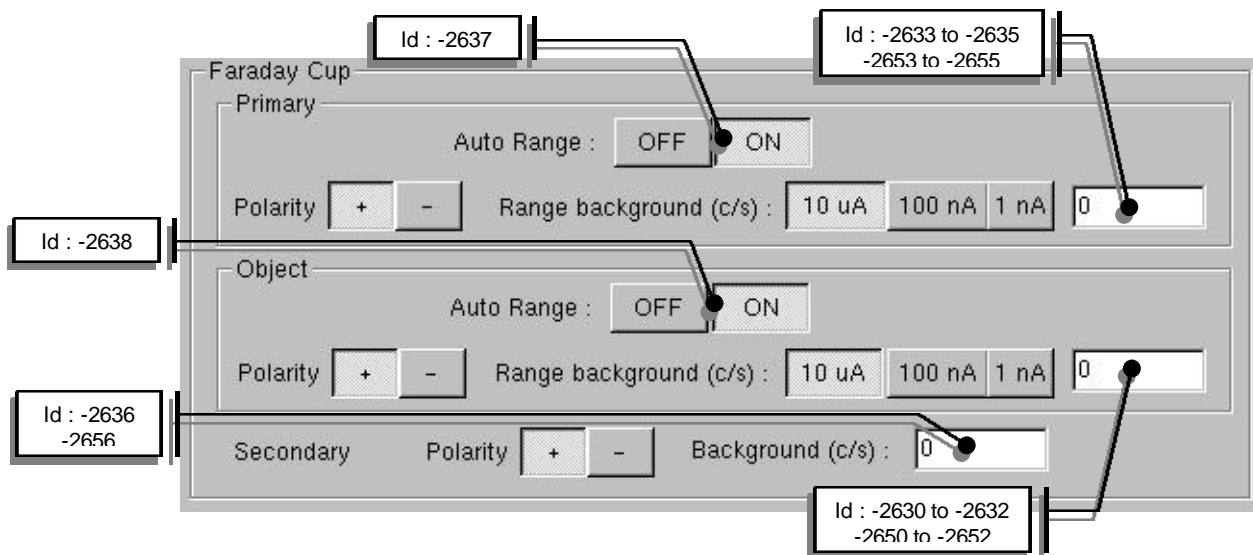


Id	Format	Comment	Min	Max	Unit
-2647	int	Photo multiplier security	1000000	10000000	cps
-2657	int	Photo multiplier Dac max	1	4095	DAC

## 7.3 Faraday cup

This group is used to define the parameters values for the FC:

- Autorange, background values for each range for FCp
- Autorange, background values for each range for FCo
- Background values for FCs



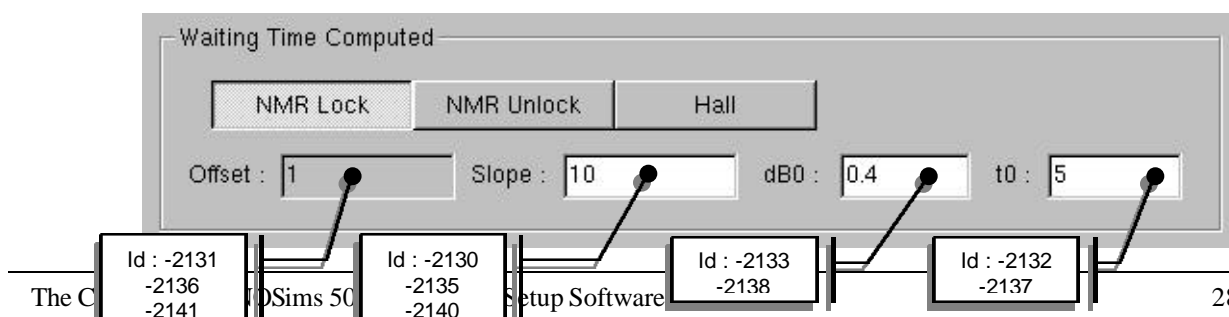
Id	Format	Comment	Min	Max	Unit
-2630	int	Object faraday cup range (10 $\mu$ A) background for positive polarity	0	5000	cps
-2631	int	Object faraday cup range (100 nA) background for positive polarity	0	5000	cps
-2632	int	Object faraday cup range (1 nA) background for positive polarity	0	5000	cps
-2633	int	Primary faraday cup range (10 $\mu$ A) background for positive polarity	0	5000	cps
-2634	int	Primary faraday cup range (100 nA) background for positive polarity	0	5000	cps
-2635	int	Primary faraday cup range (1 nA) background for positive polarity	0	5000	cps
-2636	int	Secondary faraday cup background for positive polarity	0	5000	cps
-2637	int	Primary faraday cup auto range	0	1	
-2638	int	Object faraday cup auto range	0	1	
-2650	int	Object faraday cup range (10 $\mu$ A) background for negative polarity	0	5000	cps
-2651	int	Object faraday cup range (100 nA) background for negative polarity	0	5000	cps
-2652	int	Object faraday cup range (1 nA) background for negative polarity	0	5000	cps
-2653	int	Primary faraday cup range (10 $\mu$ A) background for negative polarity	0	5000	cps
-2654	int	Primary faraday cup range (100 nA) background for negative polarity	0	5000	cps
-2655	int	Primary faraday cup range (1 nA) background for negative polarity	0	5000	cps
-2656	int	Secondary faraday cup background for negative polarity	0	5000	cps

## 8. B Field

This page is used to define the parameters settings for the magnetic field.

### 8.1 Waiting time computed

This group is used to define the waiting time computed parameters for B field mode :



<b>Id</b>	<b>Format</b>	<b>Comment</b>	<b>Min</b>	<b>Max</b>	<b>Unit</b>
-2130	double	NMR Unlock slope waiting time	0.0	100.0	
-2131	double	NMR Unlock offset waiting time			
-2132	double	NMR Unlock zero waiting time	0.0	10.0	s
-2133	double	NMR Unlock delta B limit waiting time	0.0	5.0	
-2135	double	NMR Lock slope waiting time	0.0	100.0	
-2136	double	NMR Lock offset waiting time			
-2137	double	NMR Lock zero waiting time	0.0	10.0	s
-2138	double	NMR Lock delta B limit waiting time	0.0	5.0	
-2140	double	Hall slope waiting time	0.0	100.0	
-2141	double	Hall offset waiting time	0.0	100.0	

## 9. Directories

This page is used to define the data directories.

User directory :	<input type="text" value="/space/ims/data"/>	<input type="button" value="Browse"/>
PHD directory	<input type="text" value="/space/ims/data"/>	<input type="button" value="Browse"/>

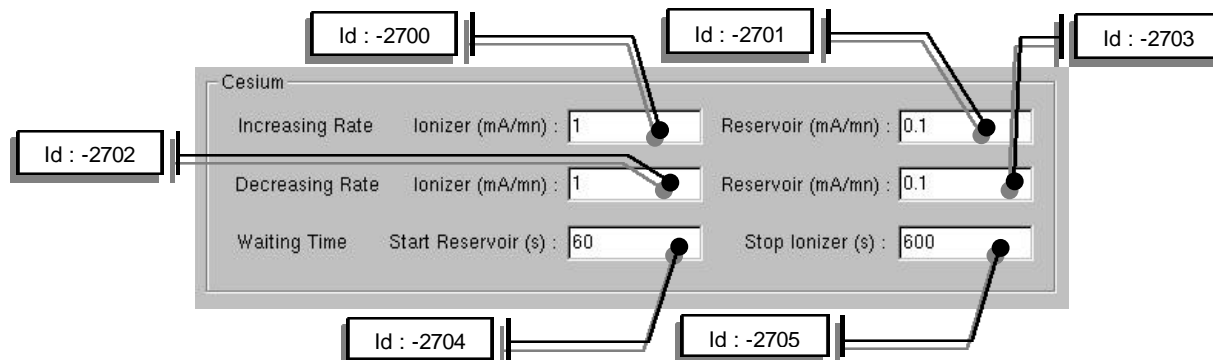
## 10. Sources

This page is used to define the parameters settings for the sources.

### 10.1 Cesium

This group is used to define the parameters the Cesium source start and stop:

- Increasing rate for ionizer and reservoir
- Decreasing rate for ionizer and reservoir
- Waiting time for start reservoir and stop ionizer



Id	Format	Comment	Min	Max	Unit
-2700	double	Cs ionizer increasing rate	0.015	2.0	mA/mn
-2701	double	Cs reservoir increasing rate	0.015	2.0	mA/mn
-2702	double	Cs ionizer decreasing rate	0.015	2.0	mA/mn
-2703	double	Cs reservoir decreasing rate	0.015	2.0	mA/mn
-2504	int	Cs reservoir increasing waiting time	30	3600	s
-2505	int	Cs ionizer decreasing waiting time	30	3600	s



**The CAMECA NANOSIMS 50 L**  
**Sources Software user's guide**

# Contents


<b>1.</b>	<b>INTRODUCTION .....</b>	<b>3</b>
1.1	THE SOURCE FILE (SRC) .....	3
1.2	ENTER/EXIT PROGRAM .....	3
<b>2.</b>	<b>THE SOURCES PANELS DESCRIPTION.....</b>	<b>3</b>
2.1	THE MAIN DIALOG BOX .....	3
2.1.1	<i>The Cesium Source</i> .....	3
2.1.2	<i>The Duoplasmatron Source</i> .....	4
2.2	LOADING A SRC FILE.....	4
2.3	SAVING AN SRC FILE IN ANOTHER NAME.....	5
2.4	CREATE A NEW SRC FILE .....	5
<b>3.</b>	<b>CESIUM SOURCE CONTROL .....</b>	<b>6</b>
3.1	OVERVIEW .....	6
3.2	PARAMETERS.....	6
3.3	AUTOMATIC STARTING .....	6
3.4	AUTOMATIC COOLING.....	8
3.5	AUTOMATIC OUTGAZING.....	9
<b>4.</b>	<b>DUOPLASMATRON SOURCE MANAGEMENT .....</b>	<b>10</b>
4.1	PARAMETERS.....	10
4.2	AUTOMATIC STARTING .....	10
4.3	AUTOMATIC COOLING.....	10
<b>5.</b>	<b>ELECTRON GUN SOURCE MANAGEMENT.....</b>	<b>11</b>
5.1	OVERVIEW .....	11
5.2	PARAMETERS.....	11
5.3	AUTOMATIC STARTING .....	11
5.4	AUTOMATIC COOLING.....	12
5.5	AUTOMATIC OUTGAZING.....	13
<b>6.</b>	<b>REAL MEASURE .....</b>	<b>13</b>


# 1. Introduction


## 1.1 The Source File (SRC)

An *Source File* (SRC) contains the sources parameters settings corresponding to a required physical configuration. With the *Sources* interface, the sources (Cs, Duo and Neg) can be started or stopped automatically.

## 1.2 Enter/Exit Program

- In order to enter the *sources* program click the *sources* icon  in the main icon board.

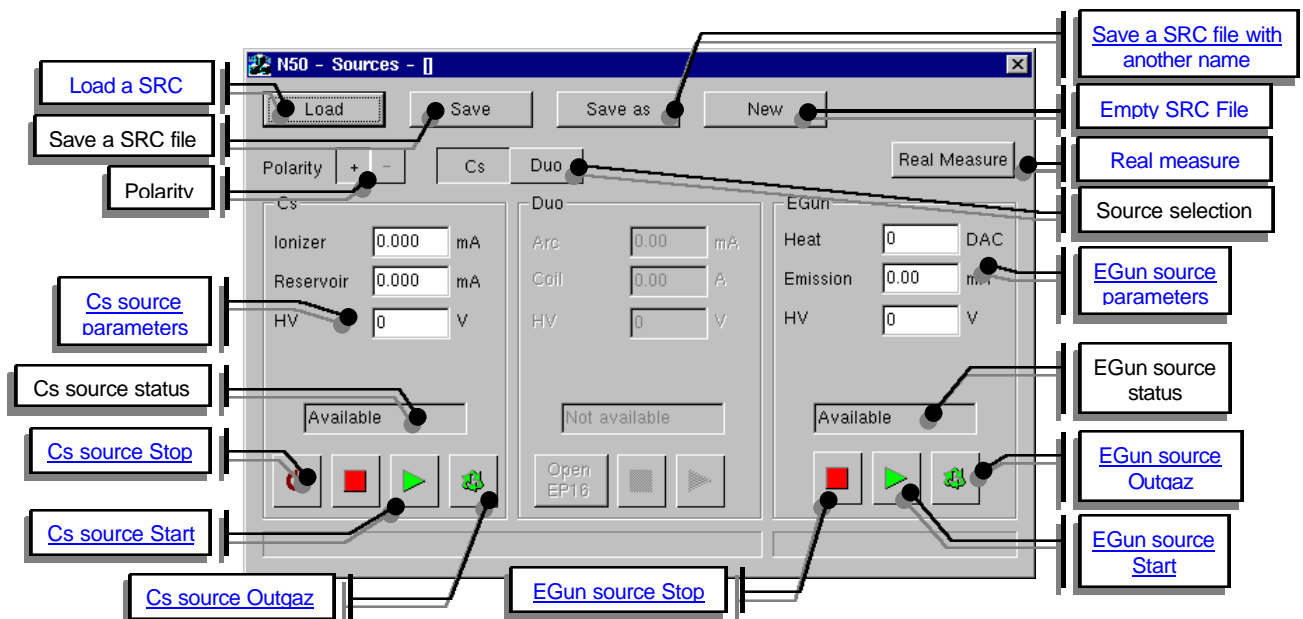
The icon must be red .

- In order to iconize the program click *sources* icon in the main icon board.
- In order to quit the program, click the  symbol in the header of the *Sources N50* dialog box. The dialog box is erased and the *sSrcN50Lources*- icon in the main icon board returns to the blue colour.

# 2. The Sources Panels Description

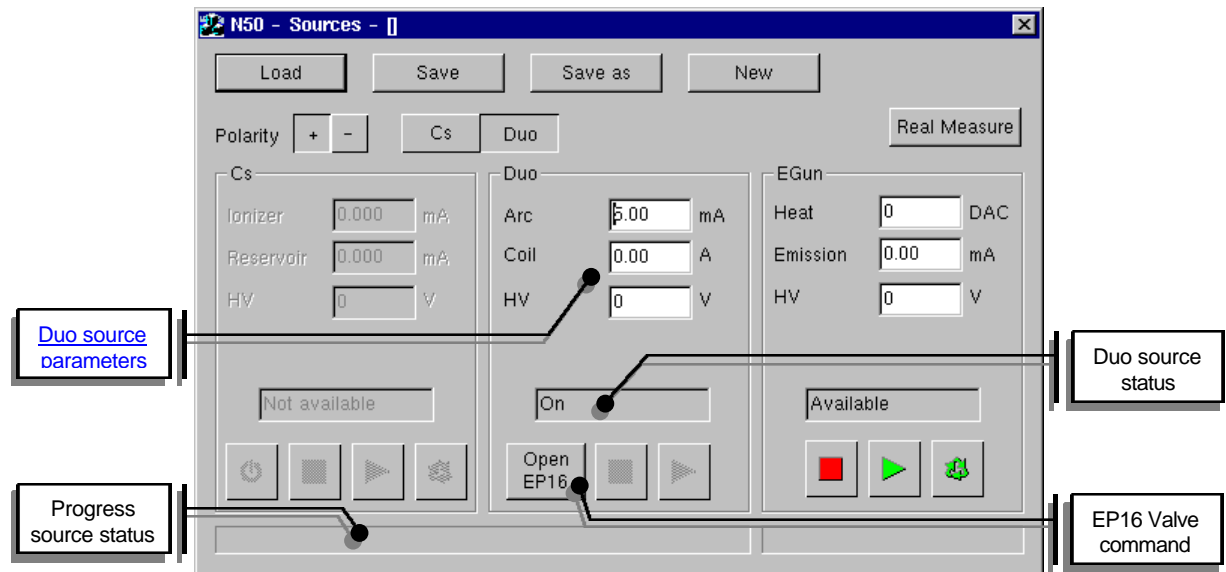
## 2.1 The main dialog box

### 2.1.1 The Cesium Source




The [Cs source management](#) is described below.

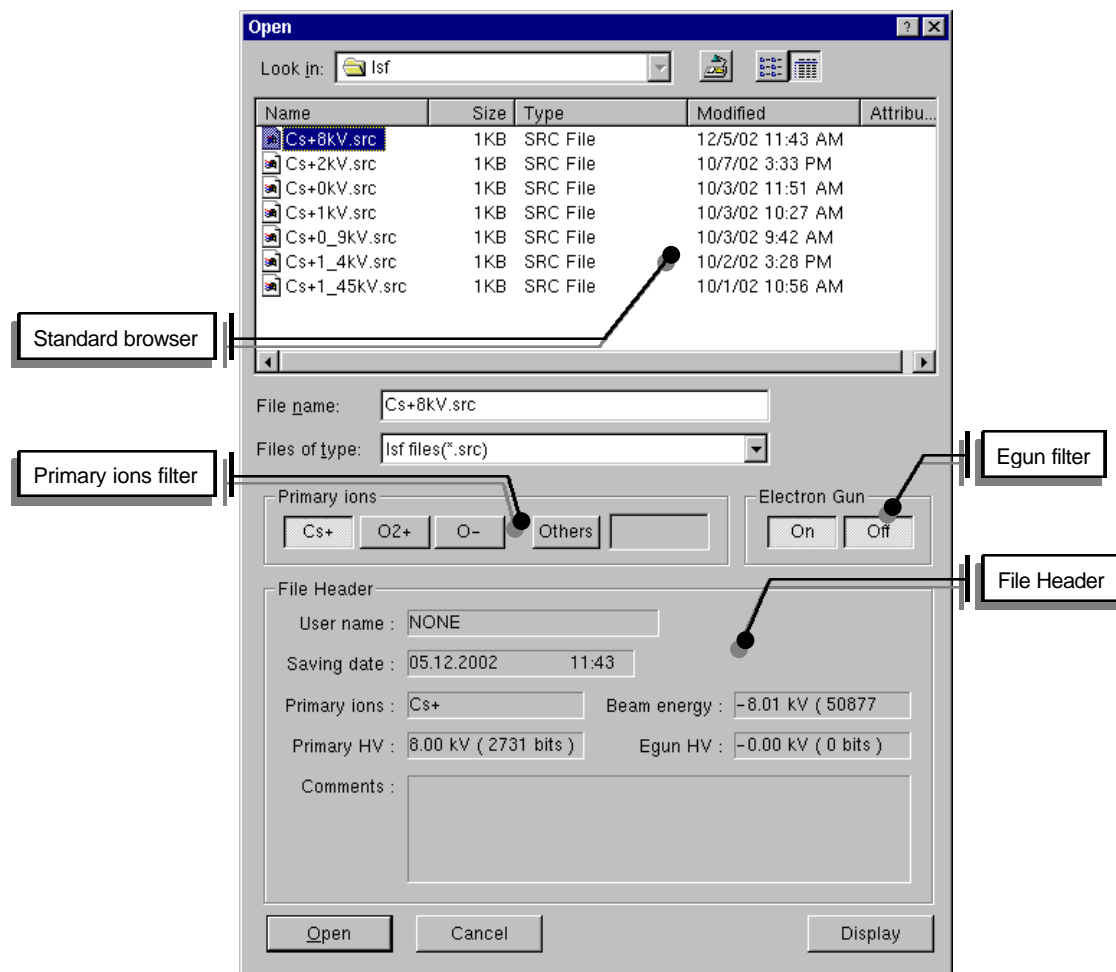
## 2.1.2 The Duoplasmatron Source



The [Duo source management](#) is described below.

## 2.2 Loading a Src File

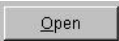

Select  button to Load an SRC file, and open the SRC loading dialog box.




The standard browser allows to sort the SRC files by name, by size or by date.

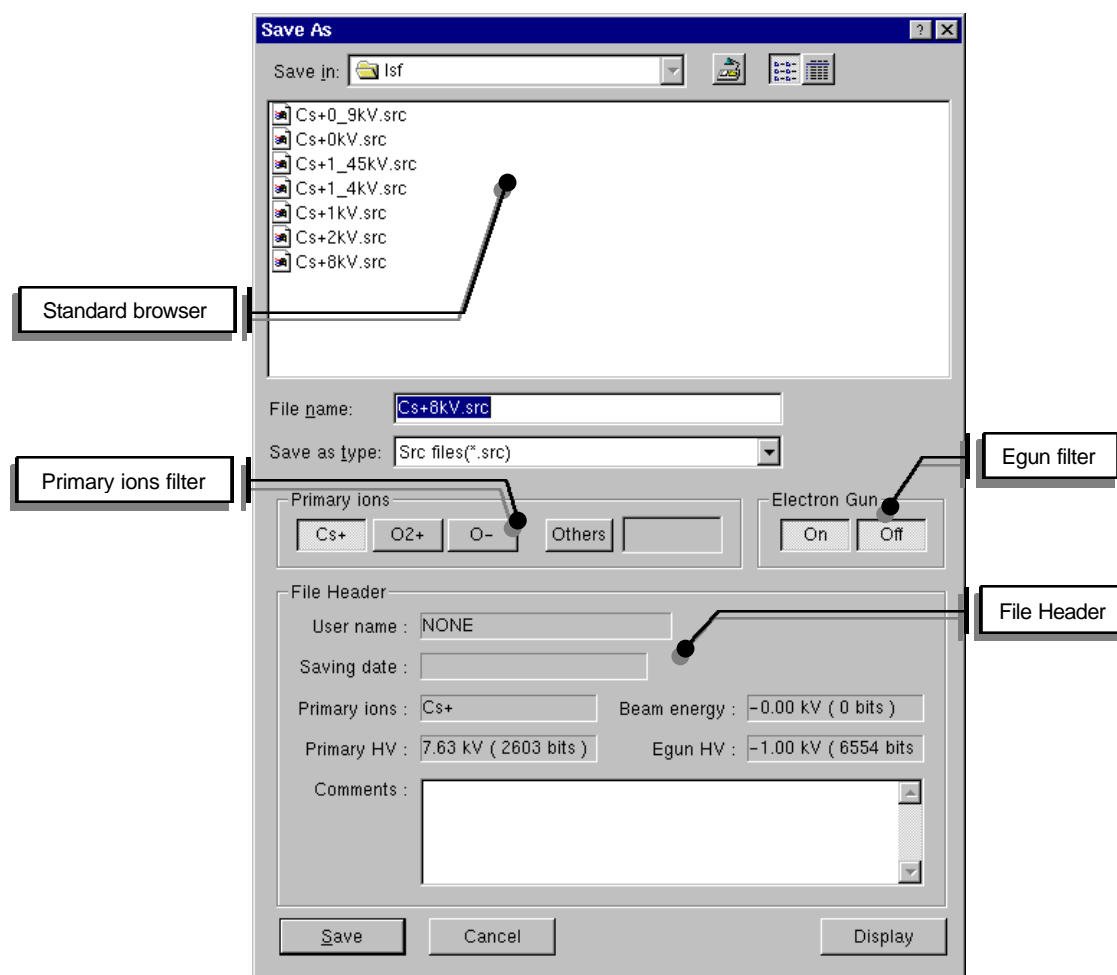
Additionally, the field *Primary ions* allows to filter the SRC files according to their primary ions (Cs, O<sub>2</sub><sup>+</sup>, O<sup>-</sup>, Other ions) and the field *Electron gun* filters according to the Egun status.

Select an SRC file shows the file header content (User name, Saving date, Primary ions, Beam energy, Primary HV, Egun HV and Comments).

Select  button to load the selected file or the  button to return to the [main dialog box](#) without loading

## 2.3 Saving an SRC File in another name

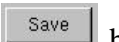
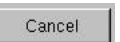
Select  button to Save an SRC file in another name, and open the SRC saving dialog box.




The standard browser allows to sort the SRC files by name, by size or by date.

Additionally, the field *Primary ions* allows to filter the SRC files according to their primary ions (Cs, O<sub>2</sub><sup>+</sup>, O<sup>-</sup>, Other ions) and the field *Electron gun* filters according to the Egun status.

The file header content (User name, Primary ions, Beam energy, Primary HV, Egun HV and Comments) show the header values to be saved. The comment editable box allow to add a comment in the file.




Select  button to save the selected file or the  button to return to the [main dialog box](#) without saving

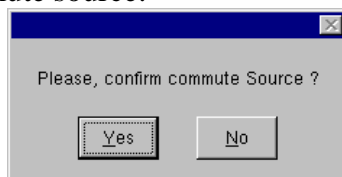
## 2.4 Create a new SRC File

Select  button to create an empty SRC file.

### 3. Cesium Source control

#### 3.1 Overview

Select   button to activate the Cesium source panel, the following message box appears and select  to commute source:



The sources main dialog is modified as described before in [The Cesium Source](#) paragraph.

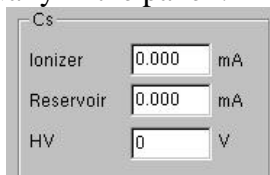
The Cs Source control panels allow the operator to set the Cs Source **High Voltage, ionizer current** and **reservoir current**. The Cs Source High Voltage (or Accel HV) is chosen by the user according to analytical requirements. Both the ionizer and the reservoir currents are depending on the kind of Source (Refer to [The CAMECA ion source user's guide](#)). The total Cs Source current (ionizer + reservoir + leakage currents) is readable from this interface (see the section [Real Measure](#)). The level of this leakage current gives an idea of the source aging.

In the *Ion source user's guide*, it is explained that for a given source accel HV, the reservoir current must be increased along the source life for keeping the same spot density. This increase is not achieved automatically. Practically, it the user is advised to increase the reservoir current manually.

Starting the Cs source, stopping it or switching the accelerating voltage involve automatic process under computer control. This is documented in the section § [Automatic stating](#).

#### 3.2 Parameters

The Cs parameters can be set manually in the panel :




#### 3.3 Automatic Starting


Any Cs source *Start Process* can be defined by the set of 3 initial parameters and 3 final parameters

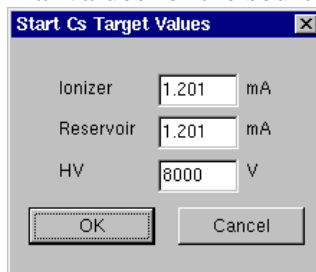
Initial Cs HV	Final Cs HV
Initial Cs ionizer current	Final Cs ionizer current
Initial Cs reservoir current	Final Cs reservoir current

The initial parameters are the instrument current parameters.

The final values are get from the SRC file and can be seen by move the mouse on the  button :



Select the  button and fill the final values for the sources parameters :

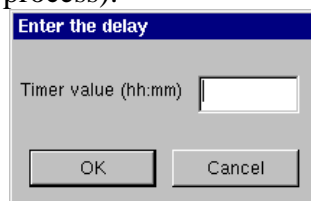


Start Cs Target Values

Ionizer	1.201	mA
Reservoir	1.201	mA
HV	8000	V

OK Cancel

Following, enter the delay for the beginning of starting in the dialog box (select button with no value for immediate process):

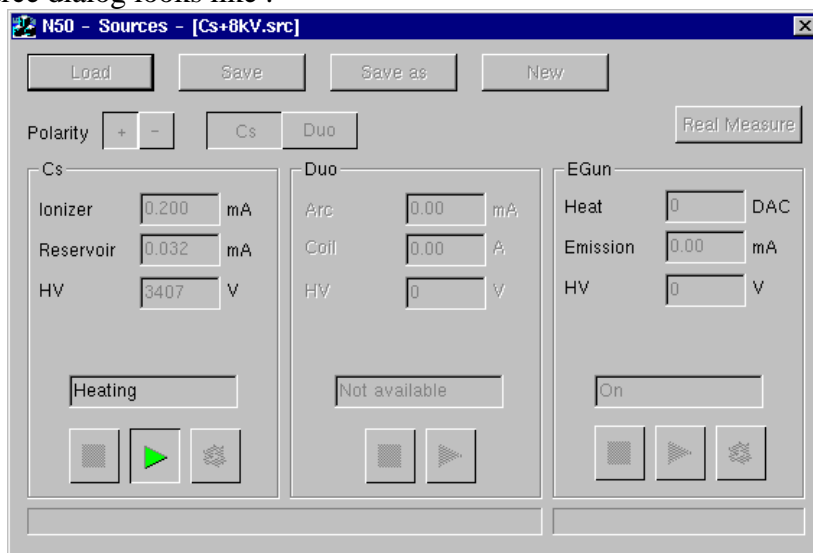


Enter the delay

Timer value (hh:mm)

OK Cancel

The main source dialog looks like :






N50 - Sources - [Cs+8kV.src]

Load Save Save as New

Polarity + - Cs Duo Real Measure

Cs		Duo		EGun	
Ionizer	0.200 mA	Arc	0.00 mA	Heat	0 DAC
Reservoir	0.032 mA	Coil	0.00 A	Emission	0.00 mA
HV	3407 V	HV	0 V	HV	0 V

Heating Not available On

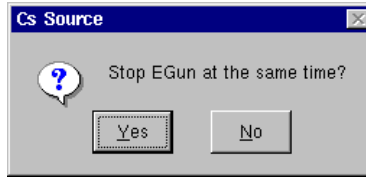
Select the  button will abort the process immediately.


### The Cs source Start Process

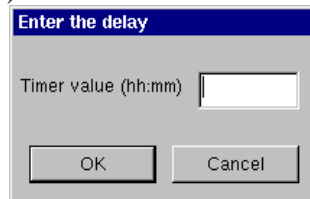
- Step 1: The HV is continuously increased from its initial value (typ 0) to its final value by step of 468.75V (160 DAC).
- Step 2: The Ionizer Current is continuously increased from its initial value (typ 0) to its final value. This heating ramp duration can be edited in the [Setup Sources parameter panel](#) (Ionizer increasing rate).
- Step 3: Waiting time which can be edited in the [Setup Sources parameter panel](#) (Start Reservoir Waiting time)
- Step 4: The Reservoir Current is continuously increased from its initial value (typ 0) to its final value. This heating ramp duration can be edited in the [Setup Sources parameter panel](#) (Reservoir increasing rate).

### 3.4 Automatic Cooling

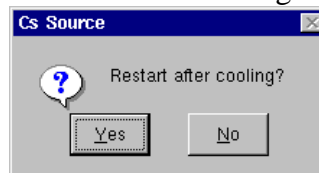
Select the  to execute the automatic cooling. If the Egun is also started, the following message box is displayed :




The delay dialog box for the beginning of cooling process appears (select  button with no value for immediate process):

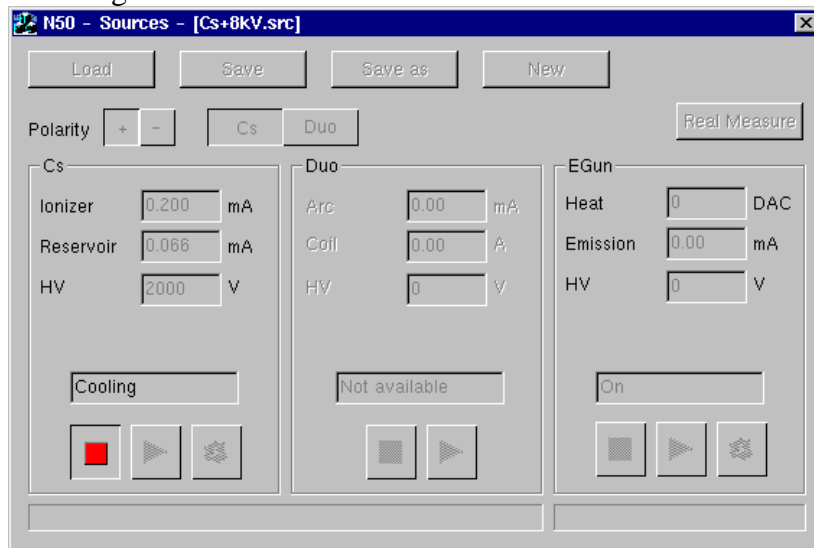



In this process, the source can be restarted after cooling:



Select  button if the restart is wanted. Then, like the [starting process](#), the target values and the delay dialog boxes are displayed.

The main source dialog looks like :




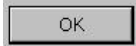
Select the  button will abort the process immediately.

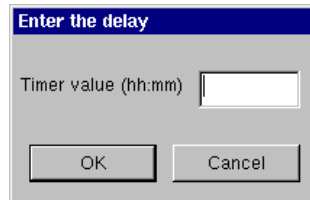
#### The Cs source Stop Process

- Step 1: The Reservoir Current is continuously decreased from the current value to zero. This cooling ramp duration can be edited in the [Setup Sources parameter panel](#) (Reservoir decreasing rate).
- Step 2: Waiting time which can be edited in the [Setup Sources parameter panel](#) (Stop Ionizer Waiting time)

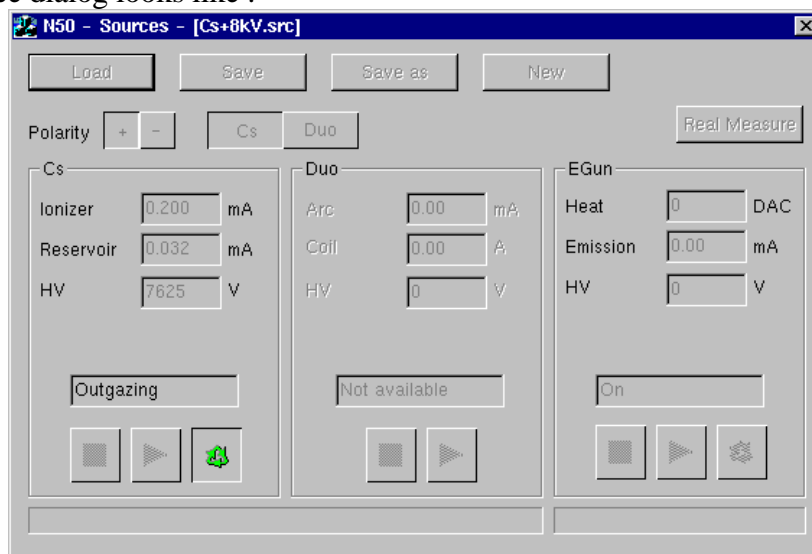
- Step 3: The Ionizer Current is continuously decreased from the current value to zero. This cooling ramp duration can be edited in the [Setup Sources parameter panel](#) (Ionizer decreasing rate).
- Step 4: The HV is continuously decreased from the current value to zero by step of 12000V (4096 DAC).

### 3.5 Automatic Outgazing

Select the  to execute the automatic outgazing. The delay dialog box for the beginning of process appears (select  button with no value for immediate process):



The main source dialog looks like :






Select the  button will abort the process immediately.

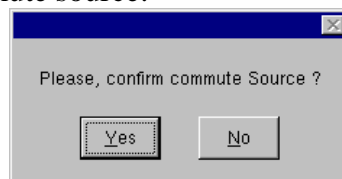
#### The Cs source Outgaz Process





- Step 1: Test if the Vacuum HV Security is ON otherwise the process is aborted.
- Step 2: The HV is continuously increased from the current value to 2000V by step of 468.75V (160 DAC).
- Step 3: The Ionizer Current is continuously increased from the current value to 0.3mA by step of 0.044mA(22 DAC).
- Step 4: Waiting time of 15 minutes.
- Step 5: The Reservoir Current is continuously increased from the current value to 0.3mA by step of 0.008mA (4 DAC).
- Step 6: Do the following process while the Ionizer Current is less than 1mA:
  - ◆ Step 6.1: Waiting time of 5 minutes.
  - ◆ Step 6.2: If the Cs pressure is less than 1.0E-5T increase the Ionizer Current of 0.1mA by step of 0.044mA(22 DAC).
  - ◆ Step 6.3: Measure the Ionizer Current.
- Step 7: Do the following process while the Reservoir Current is less than 0.3mA:
  - ◆ Step 7.1: Waiting time of 5 minutes.
  - ◆ Step 7.2: If the Cs pressure is less than 1.0E-5T increase the Reservoir Current of 0.1mA by step of 0.008mA (4 DAC).

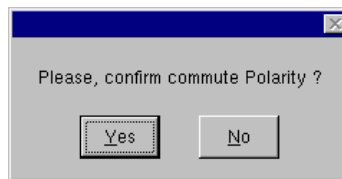
- ◆ Step 7.3: Measure the Reservoir Current.
- Step 8: Do the following process while the HV is less than 8000V:
  - ◆ Step 8.1: Waiting time of 5 minutes.
  - ◆ Step 8.2: If the Cs pressure is less than  $1.0E-5T$  increase the HV of 1000V by step of 468.75V (160 DAC).
  - ◆ Step 8.3: Measure the HV.
- Step 9: Do the following process while the Reservoir Current is less than 0.3mA:
  - ◆ Step 9.1: Waiting time of 5 minutes.
  - ◆ Step 9.2: If the Cs pressure is less than  $1.0E-5T$  increase the Reservoir Current of 0.1mA by step of 0.008mA (4 DAC).
  - ◆ Step 9.3: Measure the Reservoir Current.

## 4. Duoplasmatron Source management

Select   button to activate the Duo source panel, the following message box appears and select  to commute source:



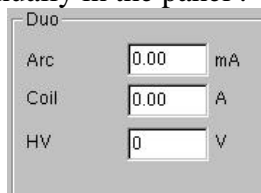
Select    button to set the polarity, the following message box appears and select  to commute polarity:



The sources main dialog is modified as described before in [the duoplasmatron source](#) paragraph.

### 4.1 Parameters

The Duo parameters can be set manually in the panel :



### 4.2 Automatic Starting

Not yet available

### 4.3 Automatic Cooling

Not yet available

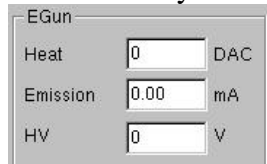
## 5. Electron Gun Source management

### 5.1 Overview

Refer to the [Normal Electron Gun \(NEG\) user's guide](#)

### 5.2 Parameters


The Electron Gun parameters can be set manually in the panel :

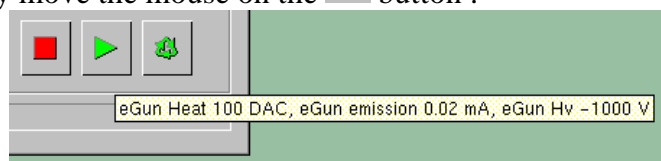



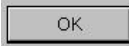
EGun

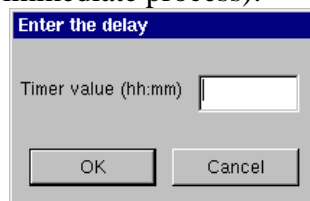
Heat	<input type="text" value="0"/>	DAC
Emission	<input type="text" value="0.00"/>	mA
HV	<input type="text" value="0"/>	V

### 5.3 Automatic Starting

The Electron Gun Source can be start automatically. The target values are get from the SRC file and can be seen by move the mouse on the  button :



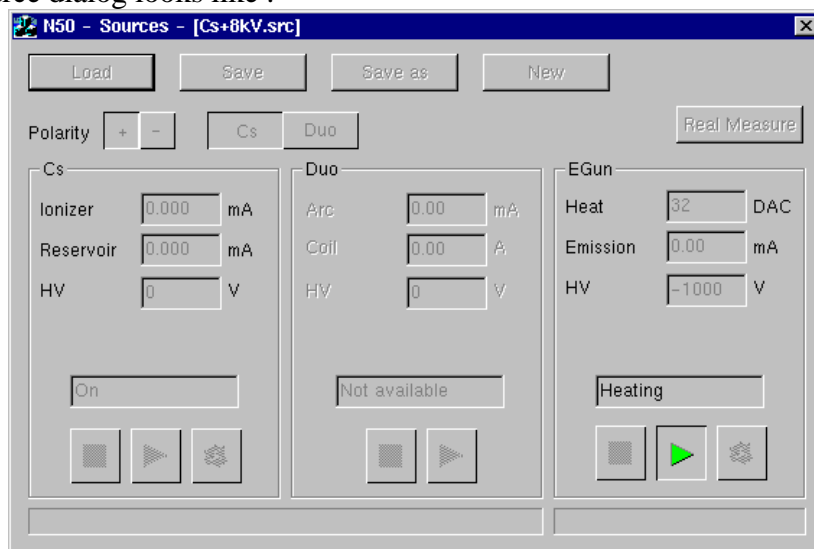
Select the  button and enter the delay for the beginning of starting in the dialog box (select  button with no value for immediate process):



Enter the delay

Timer value (hh:mm)

The main source dialog looks like :




N50 - Sources - [Cs+8kV.src]

Buttons: Load, Save, Save as, New

Polarity: +, -, Cs, Duo

Real Measure



<b>Cs</b>	<b>Duo</b>	<b>EGun</b>
Ionizer <input type="text" value="0.000"/> mA	Arc <input type="text" value="0.00"/> mA	Heat <input type="text" value="32"/> DAC
Reservoir <input type="text" value="0.000"/> mA	Coil <input type="text" value="0.00"/> A	Emission <input type="text" value="0.00"/> mA
HV <input type="text" value="0"/> V	HV <input type="text" value="0"/> V	HV <input type="text" value="-1000"/> V
<input type="button" value="On"/>	<input type="button" value="Not available"/>	<input type="button" value="Heating"/>

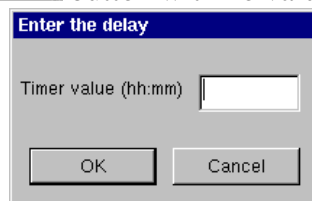
Select the  button will abort the process immediately.

### The EGun source *Start Process*

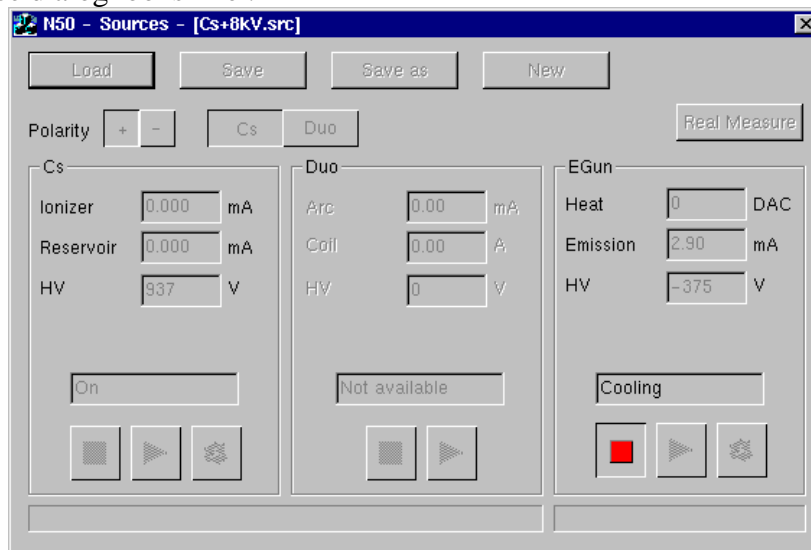
- Step 1: Test if the Vacuum Egun HV Security is ON otherwise the process is aborted.
- Step 2: The HV is continuously increased from its initial value (typ 0) to its final value by step of  $-312.48\text{V}$  (2048 DAC).
- Step 3: Set the Emission at maxi (2.9mA).
- Step 4: The Heat is continuously increased from its initial value (typ 0) to its final value by step of 16 DAC.
- Step 5: Get the heating current
  - ♦ If the measured heating current is zero display message "Filament broken" and abort the Process
- Step 6: Set the Emission at its final value.

## 5.4 Automatic Cooling

Select the  to execute the automatic cooling. The delay dialog box for the beginning of cooling process appears (select  button with no value for immediate process):



The main source dialog looks like :





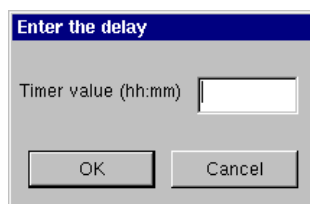
Select the  button will abort the process immediately.

### The EGun source *Stop Process*

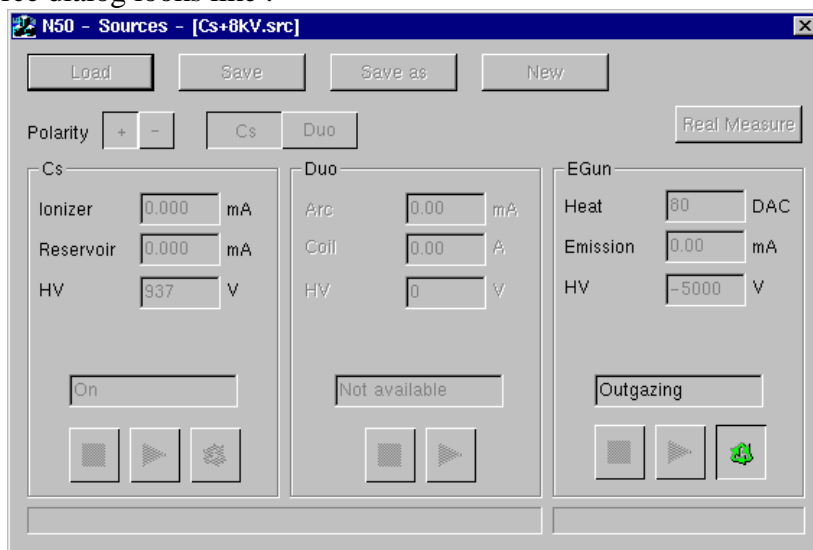
- Step 1: The Heat is continuously decreased from its current value to zero in 1 minute by step of 128 DAC.
- Step 2: Set the Emission at maxi (2.9mA).
- Step 4: The HV is continuously decreased from its current value to zero value by step of  $-625\text{V}$  (4096 DAC).
- Step 5: Set the Emission to 0mA.


## 5.5 Automatic Outgazing

Select the  to execute the automatic outgazing (Heat = 1000DAC, Emission = 2mA, HV = -5000V). The delay dialog box for the beginning of process appears (select  button with no value for immediate process):




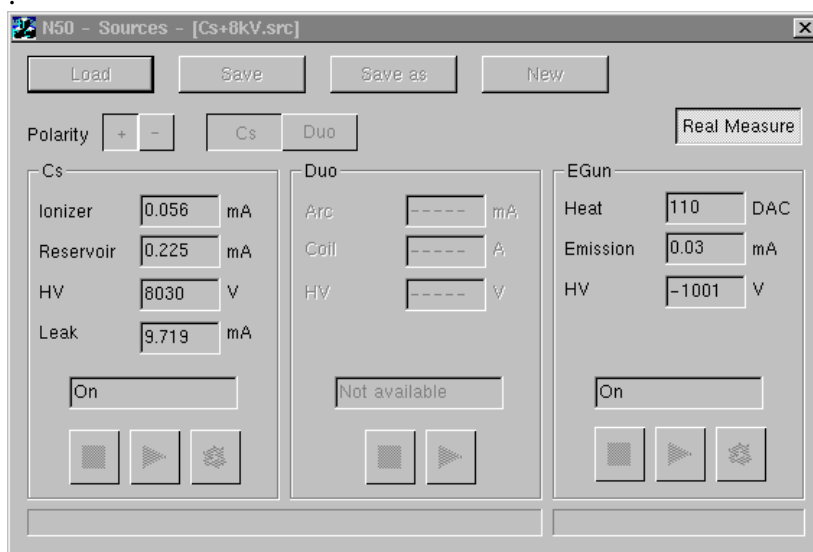
The main source dialog looks like :

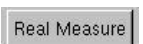


Select the  button will abort the process immediately.

## 6. Real measure

Select the  to do cyclically measure for all the sources parameters, the main source dialog looks like :



Select the  button will abort the process immediately.



# The CAMECA NANOSIMS 50 L

## KEYBOARD user's guide

### CONTENT

<b>1</b>	<b>KEYBOARD</b>	<b>3</b>
1.1	THUMBWHEELS	3
1.2	LCD DISPLAY	4
1.3	BUTTON ARRAY	5
1.3.1	<i>Control Buttons</i>	6
1.3.2	<i>Lock/Fast Buttons</i>	7
1.3.3	<i>Tuning Buttons</i>	8
FIGURE 1: THE THUMBWHEELS X, Y AND Z		3
FIGURE 2: THE LCD DISPLAY		4
FIGURE 3 KEYBOARD		5

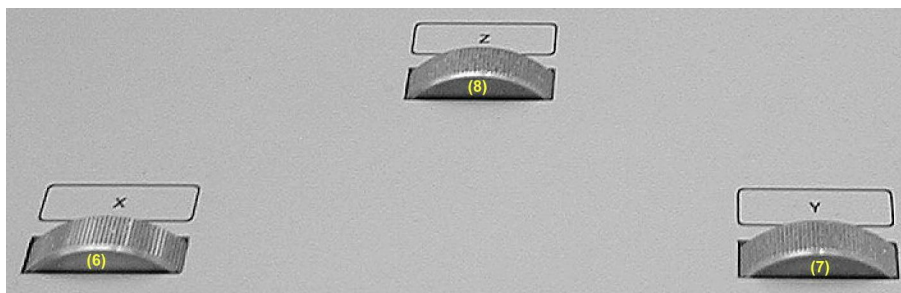
[Content](#)

# 1 KEYBOARD

The ‘dedicated keyboard’ (CAMECA nomenclature) of the NanoSIMS gives direct access to voltages, deflectors, lenses, etc. It consists of three main components: a two-line LCD display, an array of 138 buttons and three thumbwheels. The functions of the thumbwheels change depending on what options are selected with the dedicated keyboard buttons. The LCD display shows the names of the currently selected functions as well as their current values.

## 1.1 THUMBWHEELS

The instrument has three ‘thumbwheels’ which are denoted x, y and z (Numbers 6, 7 and 8 in Figure 1). These wheels are used to manually change the settings of various instrument parameters. The rotation is translated into a change of parameter bit values. Be sure to verify the wheels’ current definitions before using them.



*Figure 1: The thumbwheels X, Y and Z*

*The yellow numbers are the same as in Figure 3.*

Usually, there is a constant translation between the wheels’ rotation and the actual bit change applied. It is possible to change this ‘wheel speed’ with two buttons on the dedicated keyboard.(x3 and x10)

To temporarily disable the thumbwheels, press button ‘Lock’ (see Figure 3). While the lock is enabled, turning the wheels does not change any parameter settings. It is, however, still possible to review current parameter values in the locked mode. This locked mode secures the thumbwheels from unintended changes.It should be the preferred setting whenever possible.

The thumbwheels act much like mechanical controls, except that they can be turned infinitely in either direction. Once the minimum or maximum bit value is reached, further movement in the same direction does not lead to any further changes.

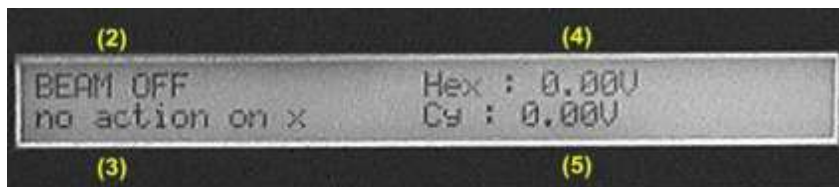
[Content](#)

## 1.2 LCD DISPLAY

The current definition of the thumbwheels is shown in the LCD display. The four corners of the display show the settings always in the same manner:

- top-left corner (number 2 in Figure 2):  
General information (in some cases) or empty. No special meaning
- bottom-left corner (number 3 in Figure 2):  
Current definition of thumbwheel 'X' and its current setting.
- top-right corner (number 4 in Figure 2):  
Current definition of thumbwheel 'Z' and its current setting.
- bottom-right corner (number 5 in Figure 2):  
Current definition of thumbwheel 'Y' and its current setting.

If one of the wheels does not currently have any function, this is shown *e.g.* as 'no action on x' in the display (see Figure 2). Rotating wheel 'X' at this time does not change any settings.



*Figure 2: The LCD display*

*The LCD display of the dedicated keyboard. The yellow numbers are the same as in the other Figures.*

The current settings can be displayed either as bit (*i.e.* digital) values or as physical (*e.g.* voltage, ampere, amu, micrometer, etc.) values. Press button:



(see Figure 3) to change from one display mode to the other. Note that the physical values are not in all cases very accurate. The internal translation from bits to physical values is based on a set of correlation factors which are not always precisely known. In other words, these physical values do not represent actual readings and should only be used as a rough guideline until each parameter is well calibrated. The bit values on the other hand are always as precise as the instrument can handle it. Of course, there are only 'integer' bit values.

[Content](#)

### 1.3 BUTTON ARRAY



Figure 3 keyboard

These buttons define the functions of the thumbwheels at any given time. Once a button is pressed, the thumbwheels are immediately associated with a new optical element.

A large number of these 138 buttons are currently unused. The labeled buttons make up three groups: 'Controls' on the left, 'Tuning' in the center and the Lock/Fast buttons on the lower right (see Figure 3). Each button has a green LED light in its upper left corner (some have a second LED, see below). The green light indicates whether this button is currently 'pressed', i.e. selected. The functions of all active buttons are discussed below:






All components of the dedicated keyboard. The yellow numbers are for identification only.

[Content](#)

### 1.3.1 CONTROL BUTTONS





There are 5 labeled buttons in this group

	<p><b>HV</b> This button always has to be on (i.e. green LED lit) during normal operation. Turning this button off, results in all high voltages being turned off and all parameters being set to zero. All previous tune-up information is immediately lost and does not come back by turning the 'HV' button back on. Exception: the source high voltages are not affected by this button.</p>
	<p><b>CFp</b> The name stands for primary Faraday cup ('Coupe Faraday primaire' in French). This is the main button for turning the primary ion beam on or off. When the green LED on this button is lit, the primary Faraday cup is engaged ('beam off') and when the LED is off, the beam is hitting the sample ('beam on').</p>
	<p>This button increases the 'speed' of the thumbwheels by a factor of 10. Can also be used in connection with the 'X3' button .</p>
	<p><b>V/D</b> Switches the display between physical units (like <u>V</u>olts) and bits (i.e. <u>D</u>igital) as described above.</p>
	<p>Pressing this button sets all currently selected parameters (i.e. those that are shown in the LCD display) to zero. This can be useful to quickly reset a lens or deflector to its 'neutral' position</p>

[Content](#)

### 1.3.2 LOCK/FAST BUTTONS

These two buttons are on the lower right side of the dedicated keyboard.

	<b>Lock</b> Temporarily disables the thumbwheels, but not the LCD display. Used as a 'safe' setting to avoid unintended parameter changes.
	<b>Fast</b> This button increases the 'speed' of the thumbwheels by a factor of 3. Can also be used in connection with the 'X10' button .

[Content](#)

### 1.3.3 TUNING BUTTONS

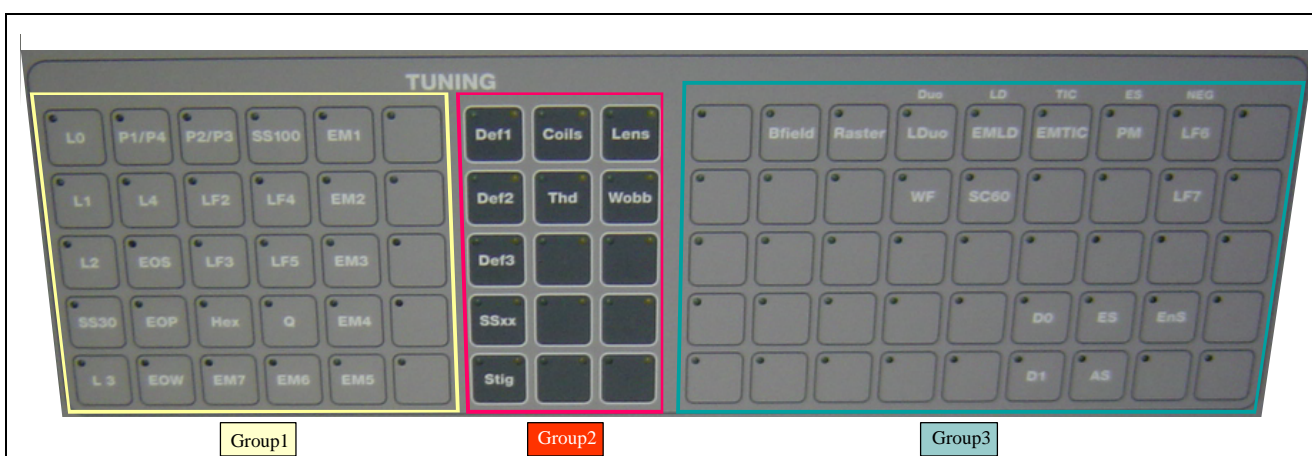
The tuning buttons are again subdivided into three different groups

**Group 1** 6 columns of light-colored buttons on the left

**Group 2**: 3 columns of darker buttons in the center

**Group 3**: 9 columns of light-colored buttons on the right.

The buttons of group 1 and 3 are used in conjunction with the buttons from group 2 in the following way: The buttons from group 1 and 3 represent the major optical elements of the NanoSIMS (detectors, lenses, electrostatic sectors). Once one of them is selected, the yellow LED lights in the top-right corner of the group 2 buttons indicate which of them are available as sub-options for this optical element. Example: When 'L1' is selected, yellow LED lights indicate that 'Def1', 'Def2', 'Lens' and 'Wobb' are available as sub-options for 'L1'. Of these possible sub-options from group 2, only those are currently selected whose green LED light in the top-left corner is lit.







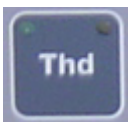
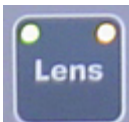
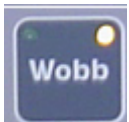


The two buttons 'Lens' and 'Wobb' affect only the optical element (selected from the group 1 buttons) itself which is always represented by the 'Z' thumbwheel. The definition of the 'X' and 'Y' thumbwheels depend on what is selected from the other group 2 buttons ('Def1', 'Def2', etc). Many of these functions (like deflectors) have two 'directions', x acts in the vertical direction, and y acts in the horizontal direction, which are then represented by the respective thumbwheels.

[Content](#)

## Group 2

Here is a list of all group 2 buttons and what their names stand for:







	Def1	A first set of (x and y) deflectors that is somehow associated with the optical element that is selected from the group 1 buttons.
	Def2	A second set of (x and y) deflectors that is somehow associated with the optical element that is selected from the group 1 buttons.
	Def3	A third set of (x and y) deflectors that is somehow associated with the optical element that is selected from the group 1 buttons.
	SS <sub>xx</sub>	An electrostatic sector for a 'xx' degree turn. Thumbwheels 'X' and 'Y' represent the potential of the inner and outer electrode.
	Stig	A stigmator (x and y) that is associated with the optical element that is selected from the group 1 buttons
	Coils	Coils acting either on primary electrons or on ions
	Thd	The threshold voltage for the selected electron multiplier (EM).
	Lens	The voltage of the optical element selected from group 1, controlled by the 'Z' thumbwheel.
	Wobb	With this button selected, the 'Z' thumbwheel controls the amplitude of the 'wobble effect' that is being applied to the 'Lens' voltage. Mainly used for centering the beam in the optical axis.

[Content](#)


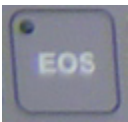





The exact name of the optical element that is currently controlled by the thumbwheels is always shown in the LCD display. Below is a list of all group 1 and 3 buttons and the available sub-options. The asterisks indicate the group 2 buttons that are pre-selected once the respective group 1 or 3 button is pressed; these are the default options.

[Content](#)






### Group 1

	Group 1 or 3 Button	Group 2 Button	'X' Wheel	'Y' Wheel	'Z' Wheel
	L0 : Lens L0	Def1*	C0x	C0y	
		Lens*			L0
		Wobb			L0 Wobb
	L1 : Lens L1	Def1*	C0x	C0y	
		Def2	C1x	C1y	
		Lens*			L1
		Wobb			L1 Wobb
	L2 : Lens L2	Def1*	C0x	C0y	
		Def2	C1x	C1y	
		Def3	Cx	SE FC	
		Lens*			L2
		Wobb			L2 Wobb
	SS30 : ES Sector 30°	Def1	C0x	C0y	
		Def2	C1x	C1y	
		Def3	Cx	SE FC	
		SSxx*	SS30 int.	SS30 ext.	
	L3 : Lens L3	Def1	C0x	C0y	
		Def2	C1x	C1y	
		Def3	Cx	SE FC	
		SSxx*	SS30 int.	SS30 ext.	
		Lens*			L3
		Wobb			L3 Wobb
	P1/P4	Def1*	P1b	P1h	
		Def2	P4b	P4h	







[Content](#)

	Group 1 or 3 Button	Group 2 Button	'X' Wheel	'Y' Wheel	'Z' Wheel
	L4	Def1	P1b	P1h	
		Def2	P4b	P4h	
		Def3*		Cy	
		Lens*			L4
		Wobb			L4 Wobb
	EOS	Def3*		Cy	
		Lens*			EOS
					EOS
		Wobb			Wobb
	EOP	Def1	C0x	C0y	
		Def2	C1x	C1y	
		Stig*	Oct-90	Oct-45	
		Lens*			EOP
		Wobb			EOP Wobb
	EOW	Def1*	EOW t	Offset	Cy
		Lens*			EOW Ref
	P2/P3 (*)	Def1*	P2b	P2h	
		Def2	P3b	P3h	
	LF2	Def1*		Cy	
		Def2	C2X	C2Y	
		Lens*			LF2
	LF3	Def1*		Cy	
		Def2	C2X	C2Y	
		Lens*			LF3


[Content](#)

	Group 1 or 3 Button	Group 2 Button	'X' Wheel	'Y' Wheel	'Z' Wheel
	Hex	Def1*		Cy	
		Def2	C2x	C2y	
		Lens*			Hex
	SS100	Def1		Cy	
		Def2	C2x	C2y	
		SSxx*	SS100 int.	SS100 ext.	
	LF4	Def1*	C4x	C4y	
		Def2	C2x	C2y	
		Def3	C3x	C3y	
		SSxx	SS100 int.	SS100 ext.	
		Lens*			LF4
	LF5	Def1*	C4x	C4y	
		Def2	C2x	C2y	
		Def3	C3x	C3y	
		SSxx	SS100 int.	SS100 ext.	
		Lens*			LF5
	Q	Def1	C2x	C2y	
		Def2	C3x	C3y	
		Def3*	C4x	C4y	
		SSxx	SS100 int.	SS100 ext.	
		Lens*			Q

[Content](#)

	Group 1 or 3 Button	Group 2 Button	'X' Wheel	'Y' Wheel	'Z' Wheel
	EM1	Def1	C4x	C4y	
		Def2	Def-1	Focus - 1	
		Def3	Def-FC	Focus-FC	
		Thd*	Thd1		
		Lens*			EM1
	EM2	Def1	C4x	C4y	
		Def2	Def-2	Focus - 2	
		Thd*	Thd2		
		Lens*			EM2
	EM3	Def1	C4x	C4y	
		Def2	Def-3	Focus - 3	
		Thd*	Thd3		
		Lens*			EM3
	EM4	Def1	C4x	C4y	
		Def2	Def-4	Focus - 4	
		Thd*	Thd4		
		Lens*			EM4
	EM5	Def1	C4x	C4y	
		Def2	Def-5	Focus - 5	
		Thd*	Thd5		
		Lens*			EM5
	EM6	Def1	C4x	C4y	
		Def2	Def-6	Focus - 6	
		Thd*	Thd6		
		Lens*			EM6

[Content](#)



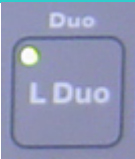


	EM7 (#708)	Def1	C4x	C4y	
		Def2	Def-7	Focus - 7	
		Thd*	Thd7		
		Lens*			EM7




(\*) Variation of the ratio  $P2/P3$  according to Setup/Tuning/part parameters  $\Delta P3/\Delta P2$

The combinations of these buttons gives access to virtually all parameters of the NanoSIMS. Entire sets of parameter settings can be saved as setup files from the SUN.








[Content](#)

### Group 3

	B-field	Def1*			
		Def2	C4x	C4y	
		Lens*			B field
	Raster	Def1*	Xlow RTI	Ylow RTI	
		Lens*			Raster
	L Duo	Def1*	CDuoX	CDuoY	
		Lens*			LDuo
		Wobb			LDuo Wobb
	WF	Def1*	CWF	WF Coil	
		Def2	CDuoX	CDuoY	
	EMLD	Def1	C4x	C4y	
		Def2*	C7x	C7y	
		Thd	Thd EM		
		Lens*			EM LD

	SC60	Def1	C7x	C7y	
		SSxx*	SC60 int.	SC60 ext.	
	EMTIC	Def1		Cy	
		Def2*	C2x	C2y	
		Thd	Thd TIC		
		Lens*			EM TIC
	PM	Def1*	PM Offset		
		Coils	eGun Be		
		Def2	Bhor	Bvert	
		Lens			PM

[Content](#)

	LF6	Def1*	C5x	C5y	LF6
		Coils	eGun Be		LF6
		Lens*			LF6
	LF7	Def1	C5x	C5y	LF7
		Def2*	C6x	C6y	LF7
		Coils	eGun Be		LF7
		Lens*			LF7
	D0		D0 X	D0 Y	No action
	ES		ES X	ES Y	No action
	EnS		Ens X	EnS W	No Action
	D1		D1 X	D1 Y	No Action
	As		As X	As Y	No action

[Content](#)

Special thanks to Franck J Statdermann (\*) for providing a preliminary version of this manual

(\*) © FRANK J STADERMANN  
[fjs@wuphys.wustl.edu](mailto:fjs@wuphys.wustl.edu)

Laboratory for Space Sciences  
Physics Department, CB 1105  
Washington University  
1 Brookings Drive  
St. Louis, MO 63130, USA

[Content](#)



# **The CAMECA NANOSIMS 50 L**

## **NMR FIELD REGULATION user's guide**

## Contents

1	INTRODUCTION	3
2	SOFTWARE INTERFACE OPERATION.	3
2.1	RECORDING FIELD VALUES WITH THE TESLAMETER	6
2.2	HARDWARE SETUP PANEL	8
2.3	FIELD DAC/NMR CALIBRATION PANEL.	10

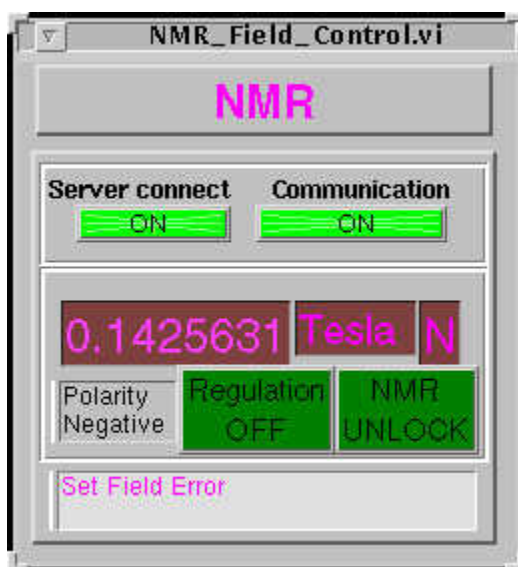
## 1 Introduction

This software is mainly used when the NMR regulation mode is selected. The regulation mode can only be chosen in the tuning window. This manual describes the main windows and capabilities of this software.

## 2 Software Interface Operation.

### Reduced Panel Display.

A click on the “NMR” button opens more Controls



#### Server connect

Status of the interface connection with the server. This status has to be green in order to send field commands or to read the Bfield value.

#### Communication

Status of the Communication line (RS232) controlling the NMR Teslameter.

#### 0.1425631 Tesla N

NMR Field Reading in Tesla or Gauss N: Status of the Teslameter N= not Locked, S = NMR Signal, W = Wrong reading, L = Locked (Reading OK).

#### Polarity Negative

Displays the Instrument Polarity

#### Regulation OFF

Status of the Regulation Process, if Regulation = OFF the field is under the hall probe control only.

#### NMR UNLOCK

Status of the Teslameter for a New field value, is Blinking during the field setup, then LOCK = reading OK ; UNLOCK = reading not OK.

### “Set Field Error”

Message from the NMR Interface.

### Main Control Panel.



### Enable Controls

Enables Access to the Interface Configuration and other Controls

The password “**ims**” must be Entered for ims1270/80, “**nano50**” for nanosims.

**Field DAC/NMR Field Table**

This Table Records the Nmr Measurement corresponding to the Fields to be Regulated.

**CLEAR TABLE**

Clears the **Field DAC/NMR Field Table**

**VALID TABLE**

Locks the table so The NMR values are no longer updated

**CORRECTION**

Starts a software Field Regulation (for test only).

**REGULATION**

Starts the NMR Regulation process.

**CYCLING**

Starts a local Cycling process , Fiels in the “**Field DAC/NMR Field Table**”Will cycle periodically.

**Parameters**

Opens the Hadware configuration Panel.

**GRAPH**

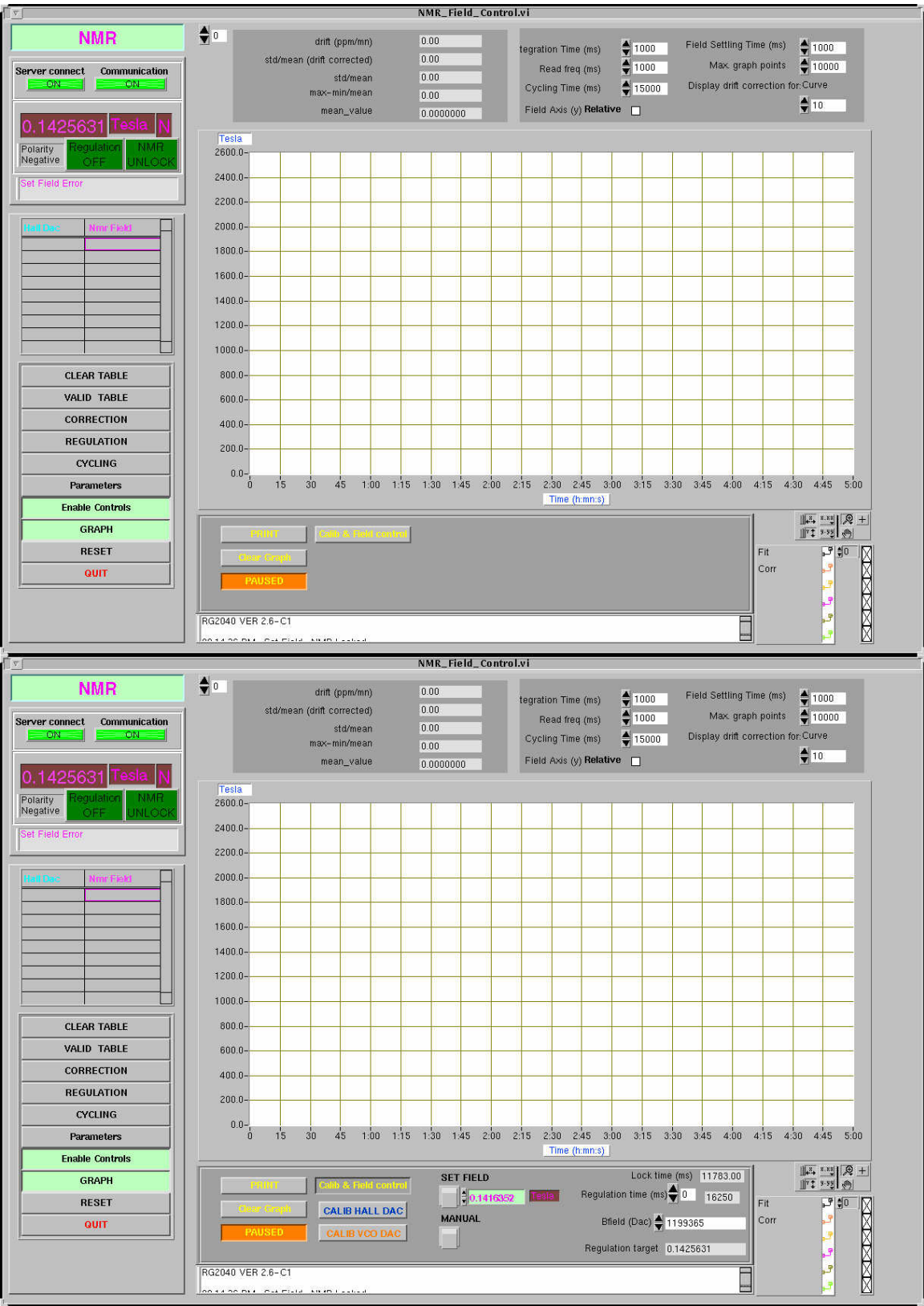
Opens A Graph that displays Field Measurements and Statistics Computation.

Enables also access to Calibration Functions.

**RESET**

Reinitialise the Interface

2.1Recording Field values with the Teslameter



Recording Field values with the Teslameter :

- ☐ Select :GRAPH, Release the PAUSE button, the field value is now recorded and statistics are computed for all data displayed in the graph.

Starting Regulating the Field with the NMR:

- ☐ Press '**Enable Controls**', enter the password (ims or nano50)
- ☐ Press '**REGULATION**'

The Regulation process starts by setting the Teslameter in order to take an accurate measurement of the field, then starts the actual regulation process.

This process will take 30 seconds on the first time the regulation starts upon a reset, or Interface open. The next regulation process will take maximum 12seconds.

If the 'VALID TABLE' button is pressed the Regulation will be performed on the NMR value stored in the 'Hall\_Dac/NMR\_Field' Table, If no NMR Field value corresponding to the current Hall DAC is stored in the Table, a new reading is taken.

To stop the NMR Regulation: Release the 'REGULATION' Button.

## 2.2 Hardware setup Panel

**Set\_nmr\_parameters.vi**

**Communication**

Serial port: 3      GPIB address: 2  
Baud rate: 9600      Comm\_mode: SERIAL  
☒ HW Handshake      Instrument: 1270

**RMN Data Directory**

File path: /home/ims/nmr\_data  
☐ auto start  
☐ auto load

**Probes Config**

Low Probe: 1      High Probe: 3

**Regulation parameters**

**PID loop**

Cumulative correction gain adjust: 80  
Proportionnal Correction gain adjust: 0  
Regulation Window (10e-7T): 3200  
Init Regulation Window on reset: ☐

**Display**

Rea: slow(1s)      0:tesla 1:Gauss  
Select Unit: 0

**Set Field parameters**

Enable fast read for search: ☐  
Trigger Delay(x0,1s): 0  
Max wait time vs field (ms): 4000

**Digital Filter**

Digital Filter: ☐      Buffer Length: 0  
Slide Average: ☐      Threshold: 0  
average\_n: 0

OK      Cancel      Save

### Serial Port

Port number used for communication with the Teslameter

The number corresponds to the index of the RS232 device defined in  
~/ims/.labviewrc

### Baud Rate

Default = 9600

**HW\_Andshake**

Optional hardware dataflow control ,if selected the jumpers J6,J7 in the  
Teslameter chassis must be set to the appropriate position.

Default = no HW Hanshake

**GPIO Address**

GPIO Address of the Teslameter when the optional GPIO communication mode  
is selected.

**Com\_mode**

Default = SERIAL

**Instrument**

Cameca Instrument Type where the Interface is used

**Auto\_start , Auto\_load**

If not checked The operator will be prompted to enter the configuration files  
path.

Normaly always checked.

**Probes Config**

Defines the NMR probes Configuration:

NANOSIMS: Low range probe =2, High range probe =3 (2 probes)

IMS1270/80: Low range probe =1, High range probe = 3 (3 probes)

The numbers correspond to the probes number as displayed in the teslameter  
front panel.

**RMN Data Directory**

Path where the NMR Interface configuration files will be placed.

This directory is automatically created if it doesn't exist.

Default = `~/ims/nmr_data`

Refer to the Metrolab RG2050 and RG2040 Documentation for a full  
description of the other parameters.

**OK**

Apply the changes temporarily

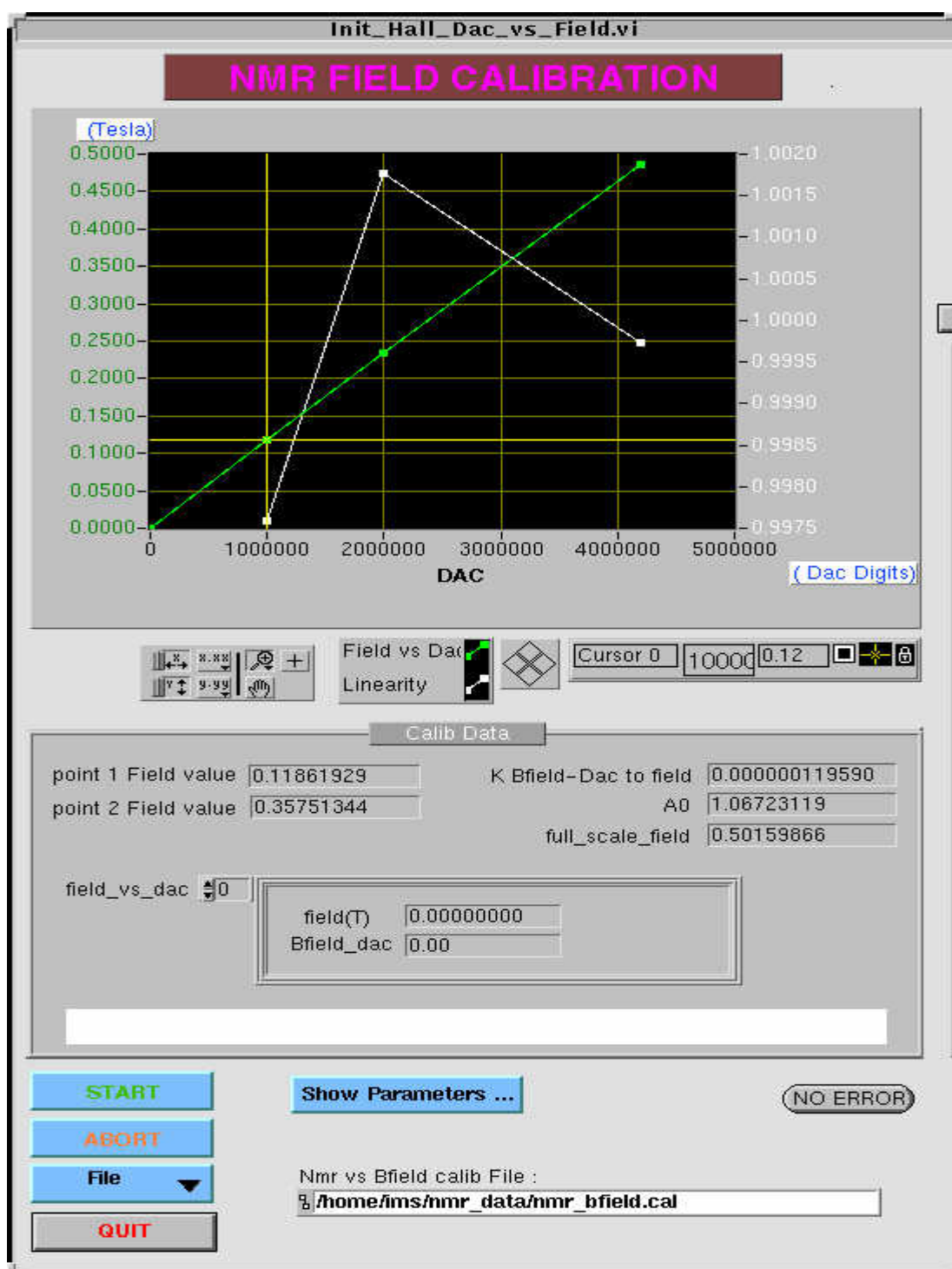
**Cancel**

Changes are not applied

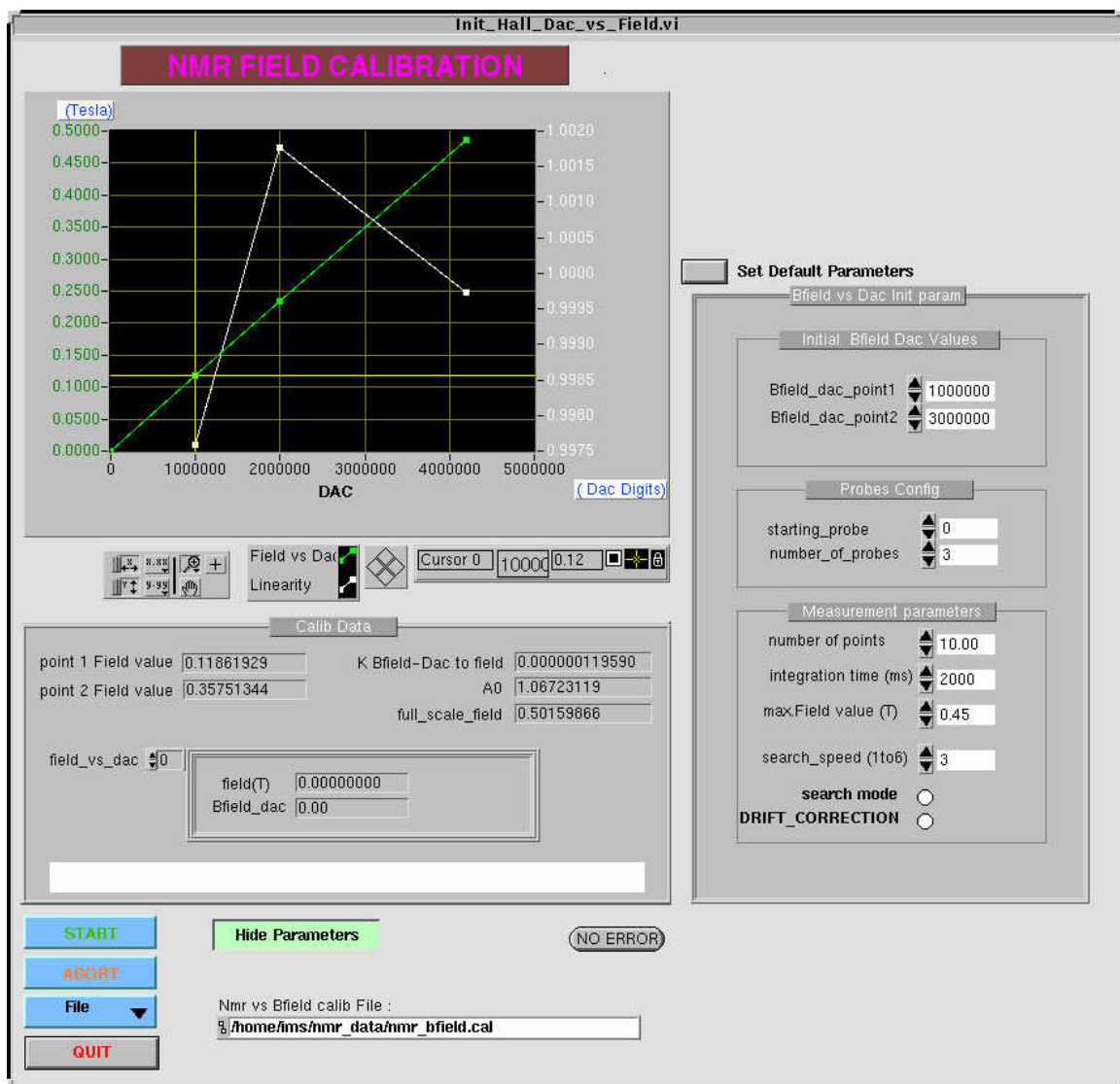
**Save**

Changes are applied and saved to the file `~/ims/nmr_data/setup.nmr` .

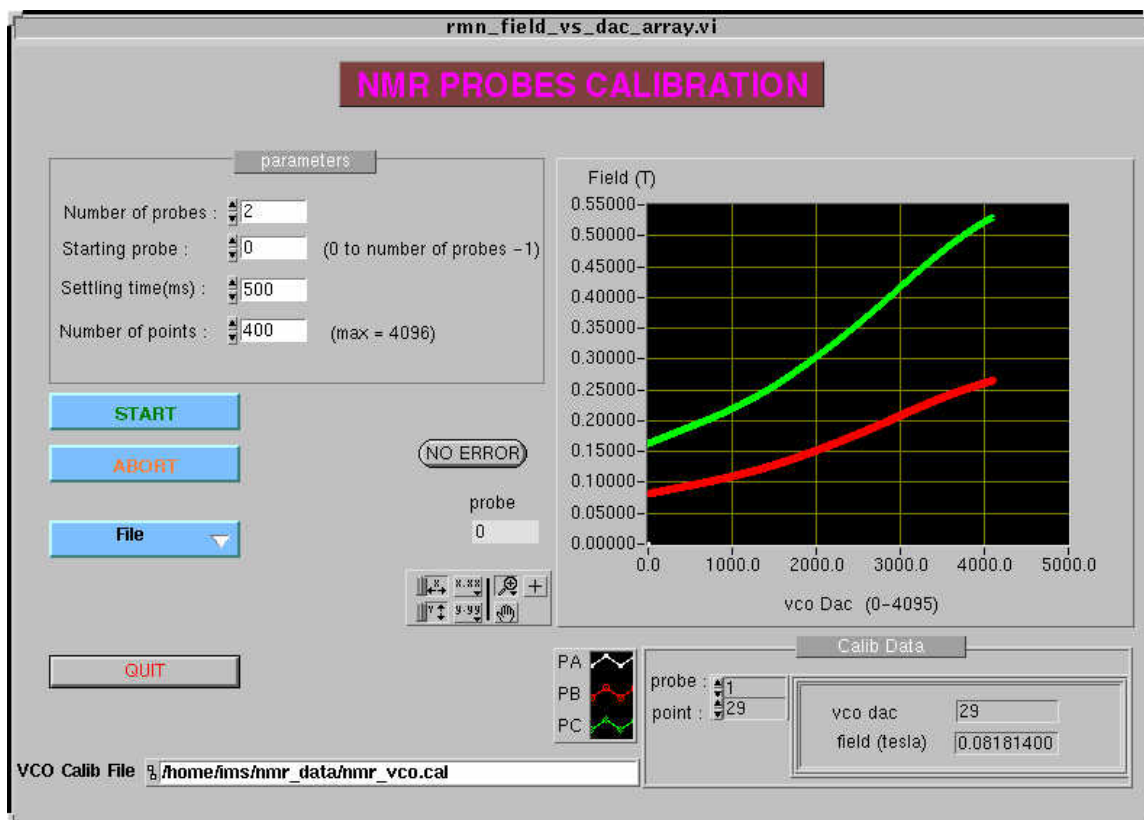
## 2.3 Field DAC/NMR Calibration panel.



NMR FIELD CALIBRATION: This program will perform the NMR Field calibration versus the Magnet power supply Control DAC.  
 It will fill a table of couple of NMR/DAC values.  
 This calibration must be done for positive and negative instrument polarity.  
 The data is saved to `~ims/nmr_data/nmr_bfield.cal`



## Probes / Teslameter VCO calibration Panel.



This program will perform the NMR Probes Calibration versus the Teslameter Internal VCO DAC.

Default parameters : Settling Time between measurements 500ms, Number of points 400

The data will be saved to **~/ims/nmr\_data/nmr\_vco.cal**



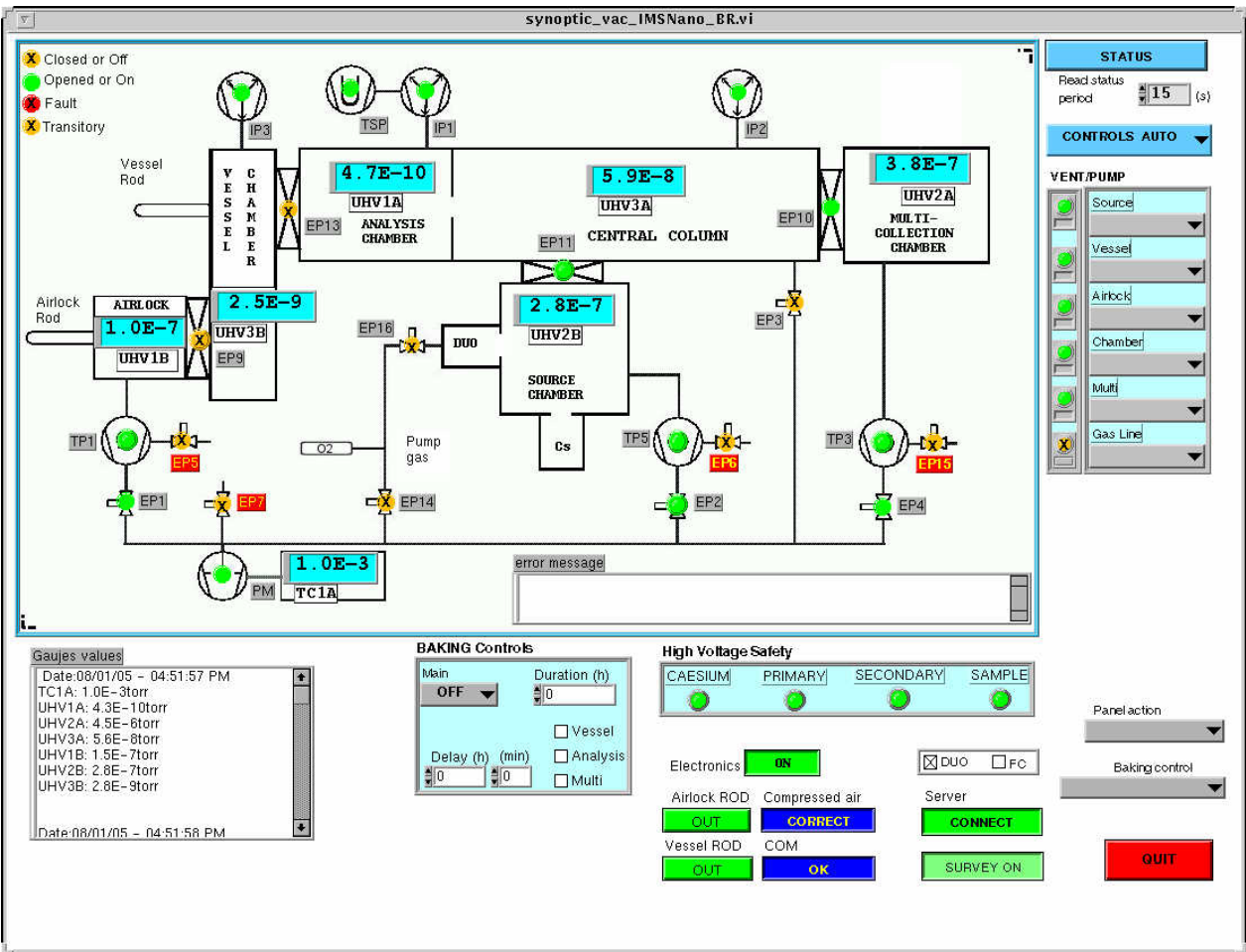
# The CAMECA NANOSIMS 50 L

## Vaccum Survey Automate user's guide

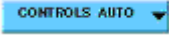

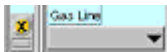

<b>1</b>	<b>SYNOPTICS</b>	<b>2</b>
1.1	SYNOPTIC IN MODE "AUTO"	2
1.2	SYNOPTIC IN MODE "MANUAL"	6
1.3	PRESSURE RECORDER	8
<b>2</b>	<b>AUTOMATED VACUUM SYSTEM</b>	<b>9</b>
2.1	CONFIGURATION	9
2.2	THE AIRLOCK CONTROL PANEL	10
2.3	VACUUM AND SURVEY CONTROLS	11
2.4	OPENING/CLOSING ISOLATION VALVES	14
2.4.1	ISOLATION VALVE <i>Airlock / Vessel or Analysis chamber</i>	14
2.4.2	ISOLATION VALVE <i>VESSEL / ANALYSIS CHAMBER</i>	14
2.5	VACUUM CONTROL BY THE SUN	15
<b>3</b>	<b>VACCUM WINDOW MENU</b>	<b>16</b>

# 1 SYNOPTICS










## 1.1 SYNOPTIC IN MODE “AUTO”



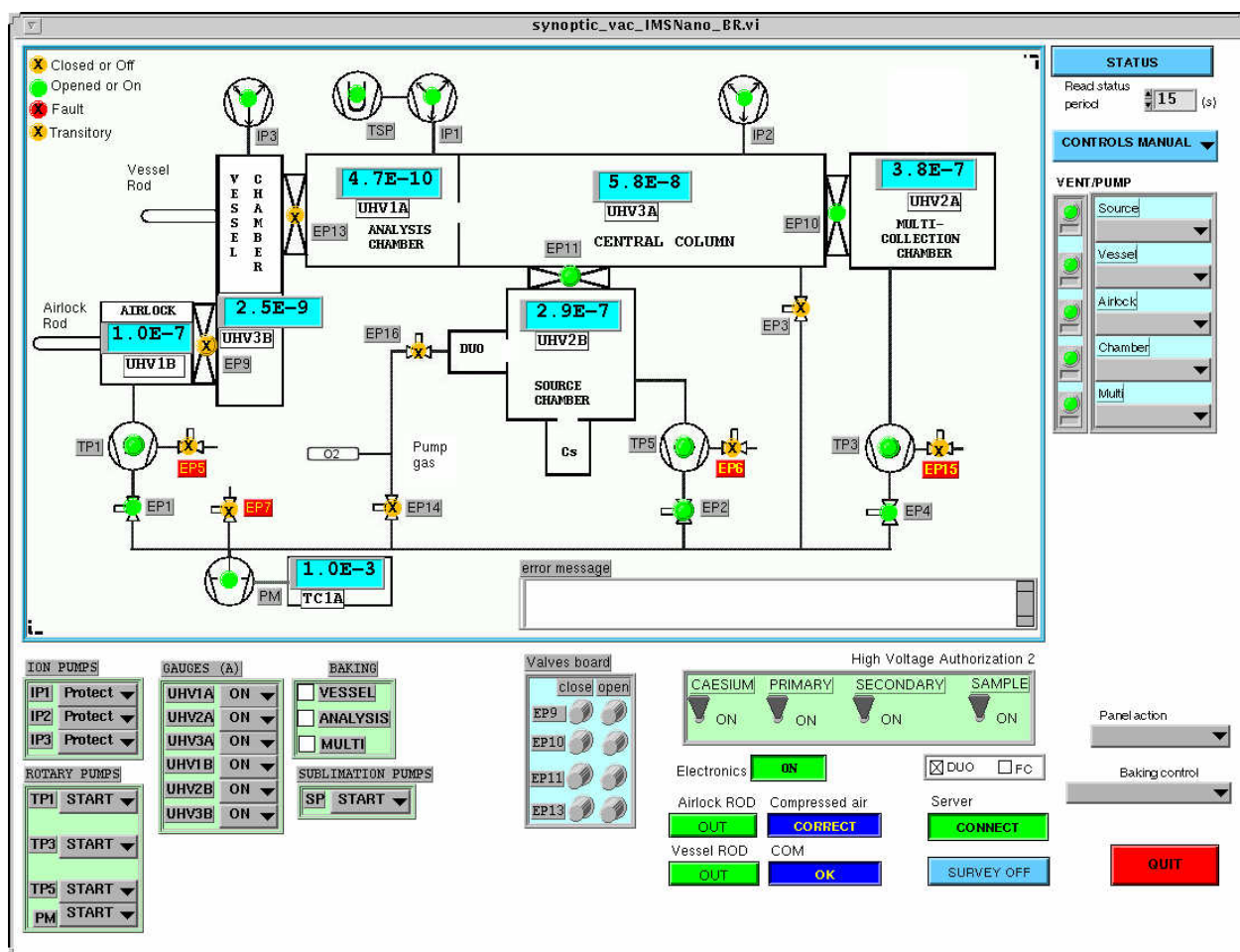
	<p><b>Blue color : “Status”</b> you have the possibility to choice the read status period . the minimum value is 15sec.</p> <p><b>Green color : “reading”</b> The computer reads the state of the nanosims (vaccum, valves, pumps, HV..)</p> <p>The vacuum synoptic is refreshed every Read status period</p>

	<p>3 options are available</p> <ul style="list-style-type: none"> <li>• Manual</li> <li>• Auto</li> <li>• Recorder</li> </ul> <p>By clicking on this button, select the mode.</p> <p><b>Mode Auto</b> The automate survey is ON</p> <p><b>Mode manual</b> Every vaccum part can be changed by clicking with the mouse on the synoptic</p> <p><b>Recorder Mode</b> The vaccum evolution is recorded (see the synoptic “Pressure recorder”)</p>
	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p><b>Vent</b></p> <p><b>Pump</b></p> <p>Change status</p> </div> <div> <p>Each combo (except “Gas Line”) clicking gives access to a menu with 3 possibilities</p> <ul style="list-style-type: none"> <li>• Vent</li> <li>• Pump</li> <li>• Change status (Only available in manual mode)</li> </ul> <p><b>Green Led</b> The pumping is done</p> <p><b>Red lighting Led</b> The pumping or the venting is running (the vaccum is not right)</p> <p><b>Orange Led</b> The venting is done</p> <p><b>Change status (only available in manual mode)</b> Change the color All vaccum states are recoreded in a NVRAM</p> <p><b>Note :</b> For each action, a confirmation message (OK - Cancel) is displayed.</p> <p><b>WARNING :</b> You can start an action if and only if <b>any other action is running</b></p> </div> </div>
	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p><b>START</b></p> <p><b>STOP</b></p> </div> <div> <p>To clean the O2 pipe</p> <p><b>Start (*)</b> Start the pipes cleanup</p> <p><b>Stop</b> Abort the cleanup sequence</p> <p>Only 2 states are available :</p> <p>Red lighting Led: sequence running</p> <p>Orange Ligthing Led : the clanup is done</p> </div> </div>
	<p>The last error message is displayed in this panel. This panel is always displayed</p>





<div>Panel action</div> <div></div>	<ul style="list-style-type: none"><li>Hide all message</li><li>Show all messages</li><li>Delete all messages</li></ul>	<p>Flip/flop message panel can be displayed or hided: All error messages between the vaccum and the sun are displayed on this panel.</p> <p>3 actions are available :</p> <p><b>Hide all messages</b> Hide the error message panel</p> <p><b>Show all messages</b> Display of the error messages panel</p> <p><b>Delete all massages</b> Delete all messages in the error message panel</p>	
	<ul style="list-style-type: none"><li>Save gauges values</li><li>Delete gauges values</li><li>Show gauges values</li><li>Hide gauges values</li></ul>	<p>All gauges values are refrehed ans displayed in the following panel</p> <div><div>Gauges values</div><div>Date:08/01/05 - 04:51:57 PM TC1A: 1.0E-3torr UHV1A: 4.3E-10torr UHV2A: 4.5E-8torr UHV3A: 5.6E-8torr UHV1B: 1.5E-7torr UHV2B: 2.8E-7torr UHV3B: 2.8E-9torr Date:08/01/05 - 04:51:58 PM</div></div> <p>4 actions are available</p> <p><b>Save</b> (all gauges values are saved in a file)</p> <p><b>Delete</b> (all gauges values are erased)</p> <p><b>Show</b> ( the gauges values panel is displayed)</p> <p>Hide this panel ( the gauges values panel is hided)</p>	
<div>Baking control</div> <div></div>	<div>ON</div> <div>OFF</div>	<div>BAKING Controls</div> <div><div>Main</div><div>Duration (h)</div><div>OFF</div><div>0</div><div><input type="checkbox"/> Vessel</div><div>Delay (h) (min)</div><div>0</div><div>0</div><div><input type="checkbox"/> Analysis</div><div><input type="checkbox"/> Multi</div></div>	<p><b>Duration</b> : time of baking in hours</p> <p><b>Delay</b> : recorded moments before (in h and mn)</p> <p><input type="checkbox"/> <b>Vessel</b> (vessel chamber)</p> <p><input type="checkbox"/> <b>Analysis</b> (analysis chamber)</p> <p><input type="checkbox"/> <b>Multi</b> (multi chamber)</p> <p>All checked chambers will be baked</p>
<div>High Voltage Safety</div> <div><div>CAESIUM</div><div>PRIMARY</div><div>SECONDARY</div><div>SAMPLE</div><div></div><div></div><div></div><div></div></div>	<p>Status of Caesium, Primary, Secondary and Sample high voltage.</p> <p>Green : High voltage is permitted</p> <p>Red : High voltage is Not permitted (Hard)</p>		
<div>Electronics</div> <div>ON</div>	<p>Electronic On or Off</p>		
<div>Airlock ROD</div> <div>OUT</div> <div>Vessel ROD</div> <div>OUT</div>	<p>Grenn</p> <p>The airlock (or vessel) rod valve can be closed</p> <p>Red</p> <p>The airlock (or vessel) rod valve can not be closed ( airlock (vessel) rod load or airlock(or vessel) rod unload under way</p>		

Compressed air 	The compressed air is > 4 bar
COM 	The communication is operational
	Options display (in this case, the nanosims is equipped with the Duoplasmatron)
Server 	The server is connected
	The survey is operational
	Quit this application, the synoptic display is
	Electrovalves for pump the Nitrogen flow
	Electrovalves to pump or vent the several parts of the machine
	Linear gate valve

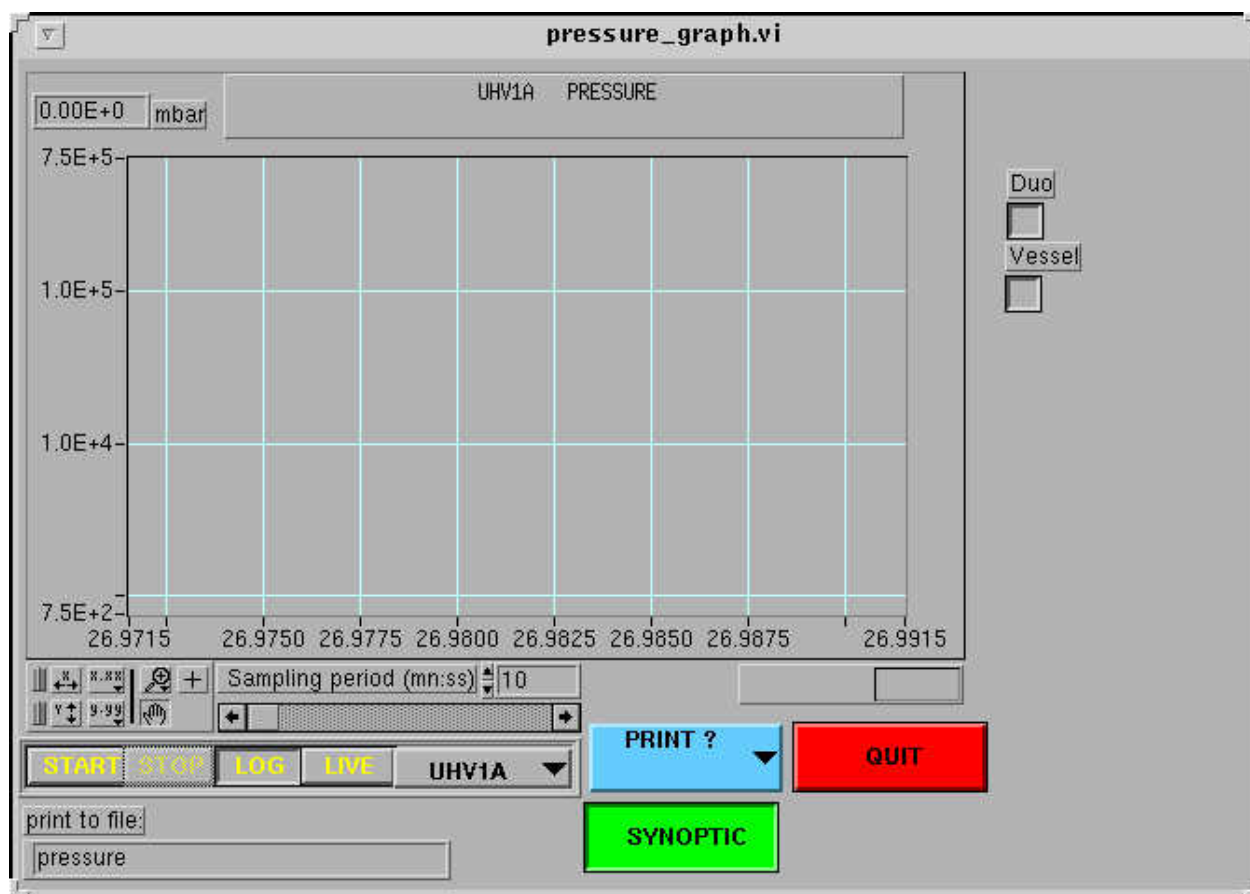
## 1.2 SYNOPTIC IN MODE “MANUAL”



<p>CONTROLS MANUAL</p>	<p>Manual control selected</p>
<p>ION PUMPS</p> <p>IP1 Protect</p> <p>IP2 Protect</p> <p>IP3 Protect</p>	<p><b>ON</b> : start of the ion pump</p> <p><b>OFF</b>: Stop the io pump</p> <p><b>Protect</b>: If the vaccum threshold is to bad, the hight voltage of the ion pump is stopped automatically</p>
<p>ROTARY PUMPS</p> <p>TP1 START</p> <p>TP3 START</p> <p>TP5 START</p> <p>PM START</p>	<p><b>ON</b> : start the turbomolecular pump</p> <p><b>OFF</b> : stop the turbomolecular pump</p>
<p>GAUGES (A)</p> <p>UHV1A ON</p> <p>UHV2A ON</p> <p>UHV3A ON</p> <p>UHV1B ON</p> <p>UHV2B ON</p> <p>UHV3B ON</p>	<p><b>ON</b> : start the gauge</p> <p><b>OFF</b>: stop the gauge</p>

	All checked chambers will be baked
	Start or stop the sublimation pump Note : The intensity, the period and the working time are set directly on the sublimation box
	Close ou open the Linear gate valve
	Entitle or not the High voltage on Caesium, primary, secondary or sample part

## 1.3 PRESSURE RECORDER



## 2 Automated vacuum system

### 2.1 CONFIGURATION

#### ☐ Pumps :

Vacuum Synoptic	Type	Controleurs
Primary Pump	Alcatel Drytel 31 rotary pump (15 m3/h)	-
TP1-TP5	Varian V70 turbomolecular pump	Varian
TSP	Varian Ion pump + Titanium Sublimator	Varian
IP4	Varian Ion pump (150 l / sec)	Varian
IP1-IP2	Varian Ion pump (300 l / sec)	Varian
TP3	Varian V300 turbomolecular pump	Varian

#### ☐ Vacuum gauges:

Vacuum Synoptic	Type	Controleurs
TC1A	Varian 531 thermocouple	Varian (A)
UHV1A	Varian UHV24 High pressure ( $10^{-11}$ Torr )	Varian (A)
UHV2A	“	Varian (A)
UHV3A	“	Varian (A)
UHV1B	“	Varian (B)
UHV2B	“	Varian (B)
UHV3B	“	Varian (B)

#### ☐ Valves :

Vacuum Synoptic	Type	Electrovalve
EP1, EP2, EP5 a EP7 EP14, EP15 à EP17.	pneumatic gate valve (VAT 26324-KA11)	Simple effect
EP9 & EP13	pneumatic gate valve (VAT 10836-CE24)	Bistable
EP10	pneumatic gate valve (Caburn ZE-GV-625M)	Double effect
EP11	pneumatic valve (Cameca 0045621000)	Double effect
EP16	Vanne auto Duo	Double effect

EP3 & EP4	pneumatic gate valve (VAT 28332-GE11)	Simple effect
-----------	--	---------------

## 2.2 THE AIRLOCK CONTROL PANEL

The airlock control panel is used for the introduction of the sample in the airlock chamber and during the transfer of the sample to the analysis chamber.

### PUMP VENT AIRLOCK

Press on Pump to pump the airlock  
Press Vent to vent the airlock  
Green LED lighting : The airlock is pumped.  
Red LED lighting : The airlock is vented.

### AIRLOCK VALVE $\frac{3}{4}$ EP9

Press on OPEN to open the pneumatic valve  
Press on CLOSE to close the pneumatic valve  
Green LED lighting : The airlock valve is close  
Red LED lighting : The airlock valve is open.

### VESSEL VALVE $\frac{3}{4}$ EP13

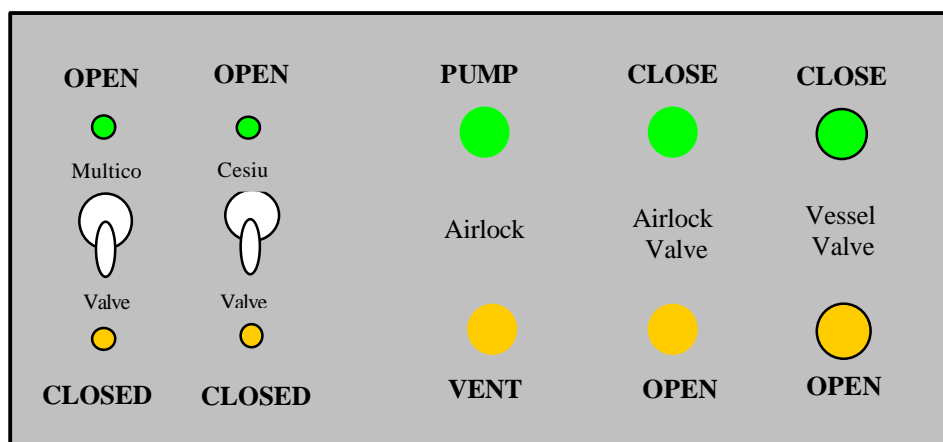
Press on OPEN to open the pneumatic valve  
Press on CLOSE to close the pneumatic valve  
Green LED lighting : The vessel valve is closed.  
Red LED lighting: The vessel valve is open

### SOURCE VALVE $\frac{3}{4}$ EP11

One switch opens or closes the pneumatic valve if the survey system of the automation allows it  
Green LED lighting : The Source valve is open  
Red LED lighting: The source valve is closed

### MULTICOL VALVE $\frac{3}{4}$ EP10

The opening or the closing of the pneumatic valve can be performed by using the switch. Theses actions will be done only if the survey automate allows it  
Green LED lighting : The multicollection valve is open  
Red LED lighting: The multicollection valve is closed



*Airlock control panel*

## 2.3 VACUUM AND SURVEY CONTROLS

To stop the running procedure, switch to the opposite function (VENT or PUMP). You have a period of time between 30 sec and 1 minute to do it.

Warning : For the airlock chamber, the procedure is done immediately.

Only one operation will be take into account. The other one will be ignored.

### ❑ TO INTERRUPT A PROCEDURE, ERROR MESSAGES

At evry time, you have the possibility to interrupt the current procedure sending the complementary procedure.

The initial configuration of the machine will be done as sone as possible (It's depending of the cycle in which the automate is runing ).

Before to activate one procedure, the vaccum automate checks if the compressed air for the pneumatical valves is actively involved.

The pressure-cell, on the electrovalve, must be able to check a pressure value lower than 4 bars. In this case, an error is displayd.

For each procedure, the survey automate checks permanently if each step of the procedure is going as expected

If one of these conditions is not going as expected, the vacuum automate will interrupt the running procedure. A error message will be sendd to the SUN computer to inform the customer and the initial state will be applied

### ❑ POWER CUT :

After a power cut, if the jumper 'restart' is on "Y", the automate will try to restore the state of the machine to set it in the last state.

During this procedure, the survey automate is "busy" that's mean that any command will not take into account.

During the restore procedure to comme back to the original state, if a problem is detected in a part of the Nanosims, the status of this part will be stayed to indicate that the state is right.

Also, all the parts of thie section will be stoped (valves, pumpes, gauges).

## ❑ SURVEY :

The survey task tests at every time the state of the machine. This system checks permanently all the parts of the machine ( pumps, gauges)

If one error is detected, a message is immediately displayed

If a vacuum level is right, then the automate will activate the necessary surveys to run the high voltages and the opening of Source et Multicollection valves.

- There are the vacuum thresholds to allow to set the high voltages on the several parts pf the Nanosims.

### ■ PRIMARY AND SECONDARY HIGH VOLTAGE :

- Source Vacuum ( UHV2B )  $< 10^{-5}$  torr ou  $5.10^{-5}$  torr if DUO is actively involved.

Chamber analysis Vacuum( UHV1A )  $< 10^{-6}$  torr.

Central Column Vacuum ( UHV3A )  $< 10^{-6}$  torr.

Multicollection Vacuum ( UHV2A )  $< 10^{-6}$  torr.

### ■ SAMPLE HIGH VOLTAGE

- The primary and secondary high voltages must be ON.
- Chamber analysis/Vessel isolation valve closed (EP13) or Chamber analysis/Airlock isolation valve closed (EP9) if the vessel is absent.

### ■ CESIUM GUN HIGH VOLTAGE :

- Source vacuum ( UHV2B )  $< 10^{-5}$  torr.
- Watter présent.

- There are the vacuum thresholds to allow the authorization to open the Source and multicollection valves

Note : The toggle switches of the airlock box open really the valves.

### ■ SOURCE ISOLATION VALVE EP11 :

- If Source and Analysis chamber/Central column ventilated and all pumping parts OFF, then OPEN authorization.
- If the source vaccum UHV2B  $< 10^{-5}$  torr or  $5.10^{-5}$  torr if DUO is present and central column vaccum ( UHV3A )  $< 10^{-6}$  torr and pumping parts runing, then Open authorization

### ■ MULTICOLLECTION ISOLATION VALVE EP10 :

- If Multicollection et Analysis chamber/ Central column ventilated and all pumping parts OFF, then OPEN authorization.

- If Multicollection vacuum UHV2A <  $10^{-6}$  torr and Central Column vacuum UHV3A <  $10^{-6}$  torr and pumping parts running, then OPEN authorization.

## 2.4 OPENING/CLOSING ISOLATION VALVES

### 2.4.1 ISOLATION VALVE Airlock / Vessel or Analysis chamber

- Preliminary conditions :**
1. Any other procedure is activated.
  2. Compressed air pressure > 4 bars.
  3. Airlock chamber Rod in their guides.
  4. Airlock chamber and vessel chamber or analysis chamber pumped or ventilated.

☞ — Start the function **"Open"** from the airlock box.

■ **Case 1 : Several parts are ventilated**

**If the vessel chamber is actively involved**

If the vessel chamber valve is closed ( **EP13** ) and all pumping parts are stopped, Ouverture.  
**else** if all pumping parts are stopped then Opening

■ **Case 2 : Several parts are pumped**

**If the vessel chamber is actively involved**

If vessel chamber valve is closed ( **EP13** )

If airlock vacuum UHV1B <  $5 \cdot 10^{-6}$  torr and vessel chamber vacuum UHV3B <  $10^{-6}$  torr then Opening.

**else**

If airlock vacuum UHV1B <  $8 \cdot 10^{-7}$  torr and Chamber vacuum UHV1A <  $10^{-8}$  torr

Opening and stop sample HV.

☞ — Start the function **"Close"** from the airlock box.  
Closing.

### 2.4.2 ISOLATION VALVE VESSEL / ANALYSIS CHAMBER

- Preliminary conditions :**
1. Any other procedure is activated.
  2. Compressed air pressure > 4 bars.
  3. Vessel chamber Rod in their guides
  4. vessel chamber and analysis chamber pumped or ventilated.

☞ — Start the function **"Open"** from the Airlock box.

■ **Case 1 : Several parts are ventilated**

If the airlock valve is closed ( **EP9** ) and all parts pumping are stopped, then Opening.

■ **Case 2 : Several parts are pumped**

If the airlock valve is closed ( **EP9** )

if the analysis chamber vacuum UHV1A <  $10^{-8}$  torr and if the vessel chamber vacuum UHV3B <  $10^{-7}$  torr, then

Opening. And Stop the sample HV.

☞ — Start the function "**Close**" from the airlock box.  
Closing.

## 2.5 VACUUM CONTROL BY THE SUN

Several menus allowing a control or a simple display of all the functions of the automate are available from the RS232 serial link of the microprocessor 68070, through the SUN window "interface vacuum or trough a VT terminal

To know the several interconnections, please refer to the plane # 45263.

### ☐ TERMINAL VT MODE

Several menus allowing a manual control of all the functions of the automate are available from the RS232 serial link of the microprocessor 68070 (P631) link 45629330 PORT2, through the SUN window "interface vacuum or trough a VT terminal

For more details, refer to the "Appendix"

### ☐ SYNOPTIC SUN MODE

All status of the machine will be visible from the vacuum synoptic through the RS232 serial link of the microprocessor 68070 (P631) link 45629330 PORT1.




All procedures allowing to set the Nanosims under vaccum and to contol all the severals parts (valves...) will be available

### 3 VACCUM WINDOW MENU

## APPENDIX

### VACUUM WINDOW ' GENERAL MENU '

GENERAL MENU	
<b>a = “Interactivity”</b>	<b>: Access to the « Interactivity menu »</b>
<b>d = “Test vacuum functions”</b>	<b>: Access to the « Basic functions »</b>
<b>e = “Test vacuum gauges”</b>	<b>: Access to the « Vacuum measurement »</b>

- 1 :  Type “a” and return to activate the 'interactivity menu'.
- 2 :  Type “ ” and return to activate the selected function.  
 Type “0” and return go back to the 'general menu'.

INTERACTIVITY MENU	
<b>c: print_on</b>	<b>Displays every dialogue 68070/user</b>
<b>d: print_off</b>	<b>Desactivation of previous displays</b>
<b>e: print status</b>	<b>Pump or Vent status reading</b>
<b>f: chge_stat_source--&gt; PUMP</b>	<b>Status Pump of source</b>
<b>g: chge_stat_source--&gt; VENT</b>	<b>Status Vent of source</b>
<b>h: hours_baking</b>	<b>Baking hours reading</b>
<b>i: chge_stat_vessel--&gt; PUMP</b>	<b>Status Pump of the vessel</b>
<b>j: chge_stat_vessel--&gt; VENT</b>	<b>Status Vent of the vessel</b>
<b>k: chge_stat_multicollection --&gt; PUMP</b>	<b>Status Pump of the multicollection</b>
<b>l: chge_stat_multicollection --&gt; VENT</b>	<b>Status Vent of the multicollection</b>
<b>m: print stat selector</b>	<b>keyboard adress table</b>
<b>n: chge_stat chamber --&gt; PUMP</b>	<b>Status Pump of the main chamber</b>
<b>o: chge_stat_chamber --&gt; VENT</b>	<b>Status Vent of the main chamber</b>
<b>p: stop_survey</b>	<b>Vacuum survey system desactivation</b>
<b>q: autorisation_survey</b>	<b>Vacuum survey system activation</b>
<b>r: chge_stat_airlock --&gt; PUMP</b>	<b>Status Pump of the airlock</b>
<b>s: chge_stat_airlock --&gt; VENT</b>	<b>Status Vent of the airlock</b>
<b>v: PROM version</b>	<b>EPROMS Version reading</b>

<b>0: general menu</b>	<b>Return to general menu</b>
------------------------	-------------------------------




## STATUS

Function	Closed	Midel position	Open
EP10	= 1	3	= 2
EP13	= 4	12	= 8
EP9	= 64	192	= 128
EP11	= 256	768	= 512

Function	Full speed	Stop
PT1	0	4
PT3	0	16
PT5	0	64
PM	1	3
PM	accel 2	3

Electronic	0	OFF
Electronic	32768	ON

## VACUUM MEASUREMENT

- 1 :  Type “e” and « return » to activate the test 'vacuum gauges'.
  - 2 :  Type “x” and « return » to activate the selected function.
-  To go back to the 'general menu', type « **222.** »

Function	Address	Pressure value ( torr )
TC1A	0	$1.33 \cdot 10^{-3}$
UHV1A	1	$4 \cdot 10^{-6}$
UHV2A	2	$9.36 \cdot 10^{-7}$
UHV3A	3	$4 \cdot 10^{-7}$
UHV1B	4	$4 \cdot 10^{-6}$
UHV2B	5	$6 \cdot 10^{-7}$
UHV3B	6	$9 \cdot 10^{-7}$



# **The CAMECA NANOSIMS 50 L**

## **Sample Exchange user's guide**

## Summary

<b>1</b>	<b>SAMPLE EXCHANGE</b>	<b>3</b>
1.1	LOADING SAMPLES INTO THE INSTRUMENT	4
1.2	UNLOADING SAMPLES FROM THE INSTRUMENT	9
<b>2</b>	<b>MOUNTING</b>	<b>10</b>

## Figure

FIGURE 1:	SCHEMATIC OF THE SAMPLE AIRLOCK SYSTEM.	3
FIGURE 2:	PHOTO OF THE SAMPLE AIRLOCK SYSTEM	3
FIGURE 3:	SAMPLE HOLDER (TOP) AND SAMPLE SHUTTLE (BOTTOM).	4
FIGURE 4:	THE NITROGEN BALLOON.	4
FIGURE 5:	THE AIRLOCK CONTROL PAD.	5
FIGURE 6:	THE AIRLOCK DOOR OPEN.	5
FIGURE 7:	ALIGN THE SHUTTLE WITH THE BRACKET	6
FIGURE 8:	LOCK THE SAMPLE HOLDER/SHUTTLE	6
FIGURE 9:	LOCK THE SAMPLE HOLDER/SHUTTLE	7
FIGURE 10:	THE LOADING ARM HANDLES HAVE TWO PARTS:	7
FIGURE 11:	ROTATE THE CAROUSEL BY TURNING THE CRANK.	8

## 1 SAMPLE EXCHANGE

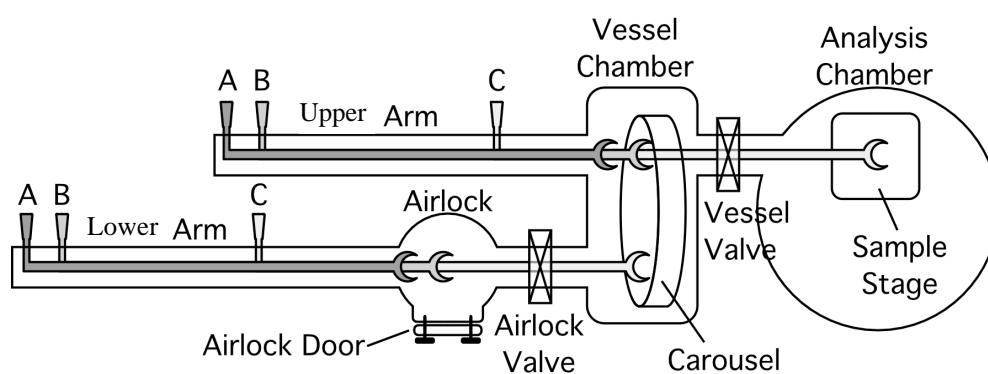


Figure 1: Schematic of the sample airlock system.

Note the three positions A, B, and C for both sample loading arms.

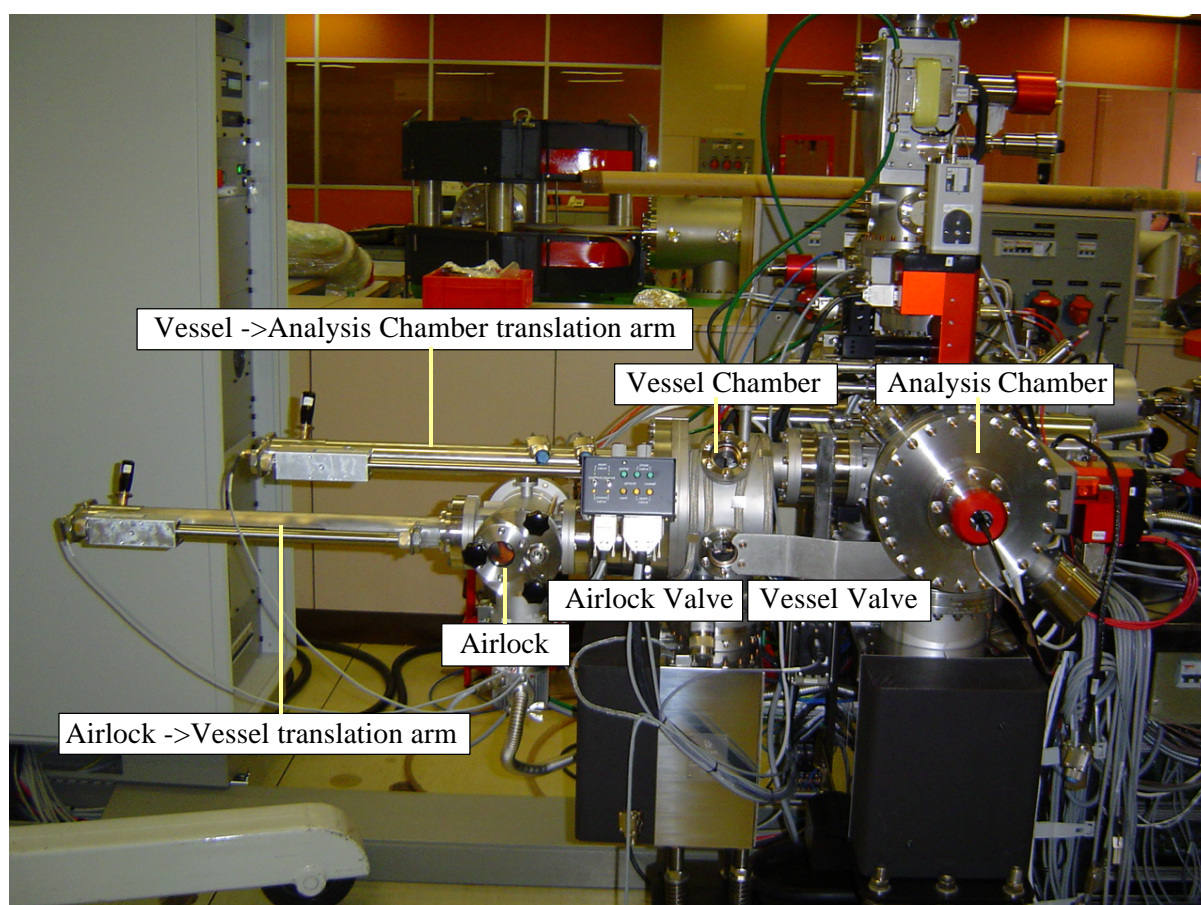


Figure 2: Photo of the sample airlock system

[Summary](#)

## 1.1 LOADING SAMPLES INTO THE INSTRUMENT

Refer to Figure 1 for terms used in the following description of the sample loading process. The process described here assumes that a sample has to go all the way from outside into the analysis chamber. In many cases, however, samples will remain in the carousel for intermediate storage.

- ❑ Mount samples into the sample holder and attach the holder onto the sample shuttle (see Figure 3). (refer to the & “[Mounting](#)”



Figure 3: Sample holder (top) and sample shuttle (bottom).

The sample holder gets screwed on top of the shuttle for use in the instrument. The hole on the right side of the shuttle is where the sample loading arms attach.

- ❑ Make sure, the outer arm is in position A and the airlock valve is closed.
- ❑ Verify that the nitrogen balloon is inflated. This is where the nitrogen comes from that vents the airlock.



Figure 4: The nitrogen balloon.

[Summary](#)

- ❑ Vent the airlock by pressing the 'Airlock Vent' button on the airlock control pad. There is a 30 s delay, during which the venting process can be aborted by pressing 'Pump'. Wait until the light stops blinking and the 'Vent' light stays on (see Figure 5).

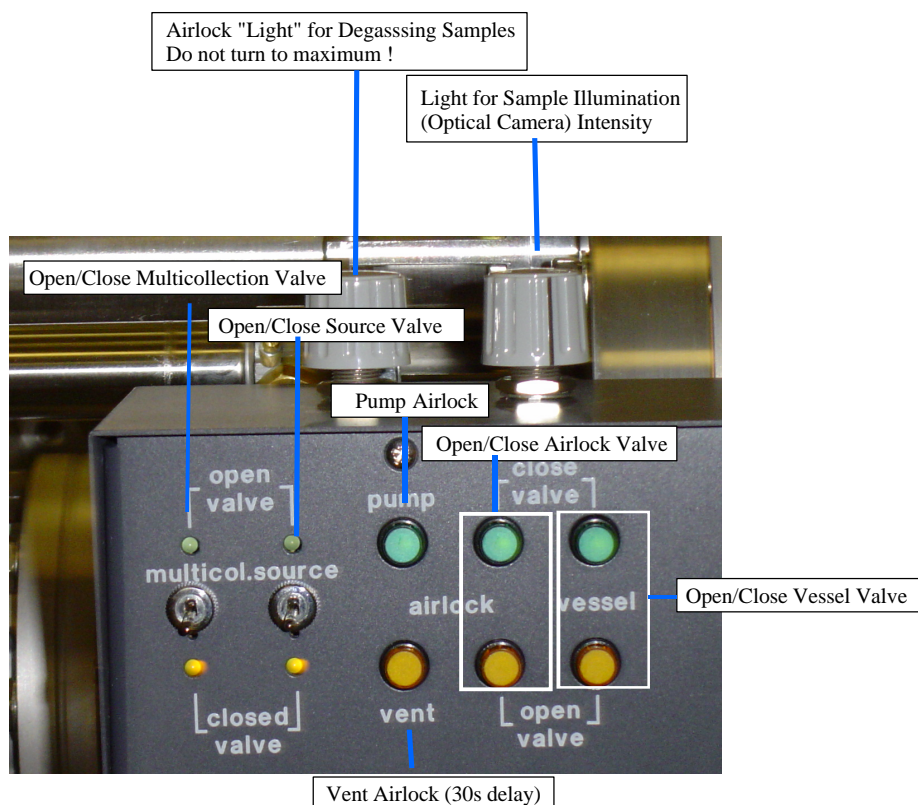


Figure 5: The airlock control pad.

- ❑ Open the airlock door by unscrewing the three black knobs. Pull out the door until the rods are fully extended (see Figure 6).



Figure 6: The airlock door open.

[Summary](#)

- ❑ Use gloves to insert the holder/shuttle assembly into the bracket on the inside of the airlock door. Check that the rear finger can be forcibly inserted in the shuttle

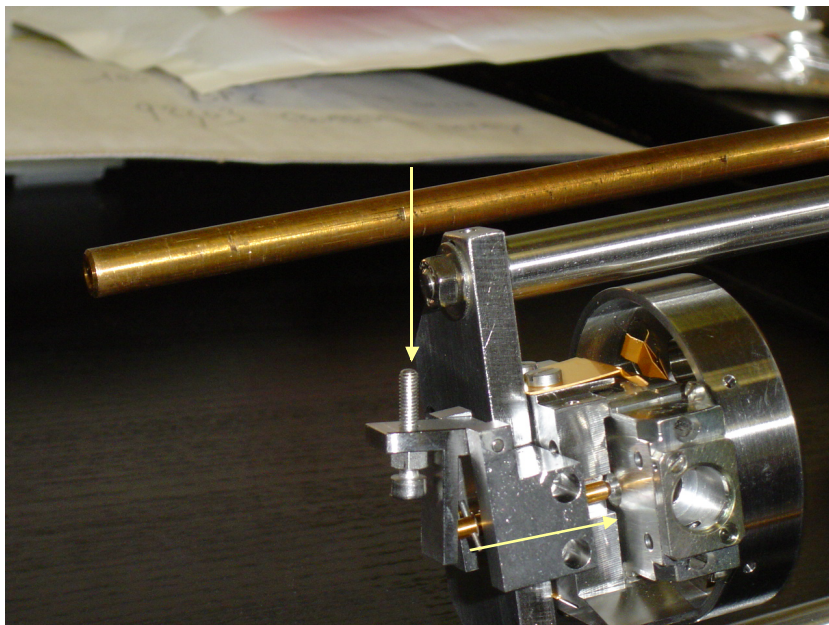


Figure 7: Align the shuttle with the bracket

After inserting the shuttle into the airlock bracket, Check that the small shaft at the rear can be freely inserted in the shuttle

- ❑ Close the airlock door and tighten the three knobs.
- ❑ Lock the shuttle by closing the outer loading arm sample lock (see Figure 8).



Figure 8: Lock the sample holder/shuttle

Lock the sample holder/shuttle in place by lifting this knob up, turning it, and pushing it down. If it does not go down all the way, the sample is not inserted correctly.

[Summary](#)

- ❑ Evacuate the airlock by pressing the 'Airlock Pump' button on the airlock control pad. There is a 30 s delay. Wait until the light stops blinking and the 'Pump' light stays on (see Figure 5).



*Figure 9: Lock the sample holder/shuttle*



*Figure 10: The loading arm handles have two parts:*

The loading arm handles have two parts:  
the black handle and the copper ring.

- The black handle can be rotated to attach or release the shuttle. In the orientation shown here, the loading arm is in the 'Release' mode (see marking '— — —' on top). Rotating the black handle by 180° changes the arm to the 'Attach' mode.
- The copper ring holds the loading arm in its current position. Pull the ring up (Hold on!) to move the arm to a new position. Before releasing the handles make sure the copper ring is back in one of the holes along the channel marking the positions A, B, and C.

[Summary](#)

- ☐ Move the outer loading arm to position B (see Figure 1) and attach the shuttle as shown in Figure 10.
- ☐ Once the pressure in the airlock is below  $5 \times 10^{-7}$  torr, open the airlock valve by pressing 'Airlock Open Valve' on the airlock control pad (see Figure 5). Wait until the 'open' light stays on.
- ☐ Open the outer loading arm sample lock (see Figure 8).
- ☐ Make sure the carousel is in a correct position. Look through the 'Vessel Chamber Viewport' to verify that there is an empty position on the carousel.
- ☐ Move the outer loading arm to position C (see Figure 1) and release the shuttle as shown in Figure 10.
- ☐ Move the outer loading arm back to position A.
- ☐ Close the airlock valve by pressing 'Airlock Close Valve' on the airlock control pad (see Figure 5). Wait until the 'close' light stays on.
- ☐ Rotate the carousel to move the sample to the position where the inner loading arm can reach it (see Figure 11).



*Figure 11: Rotate the carousel by turning the crank.*

- ☐ Lock the shuttle by closing the inner loading arm sample lock (see Figure 8).
- ☐ Move the inner loading arm to position B (see Figure 1) and attach the shuttle as shown in Figure 10.
- ☐ Open the vessel valve by pressing 'Vessel Open Valve' on the airlock control pad (see Figure 5). Wait until the 'open' light stays on.
- ☐ Make sure the sample stage is in the loading position and there is no sample in the analysis chamber. The 'Holder' window on the SUN has a special button for moving the stage to the loading position.

[Summary](#)

- ☐ Open the inner loading arm sample lock (see Figure 8).

- ☐ Move the inner loading arm to position C (see Figure 1) and release the shuttle as shown in Figure 10.
- ☐ Move the inner loading arm back to position A.
- ☐ Close the vessel valve by pressing 'Vessel Close Valve' on the airlock control pad (see Figure 5). Wait until the 'close' light stays on.
- ☐ Move the sample stage to the desired position.

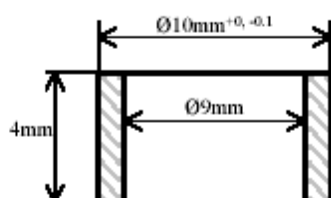
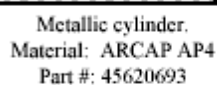
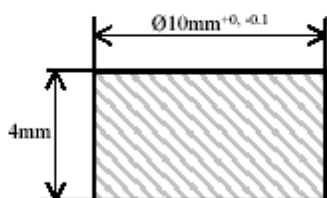
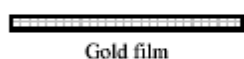
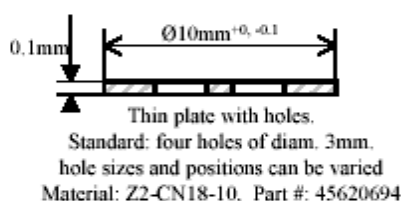
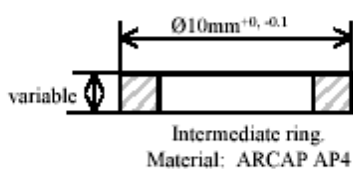
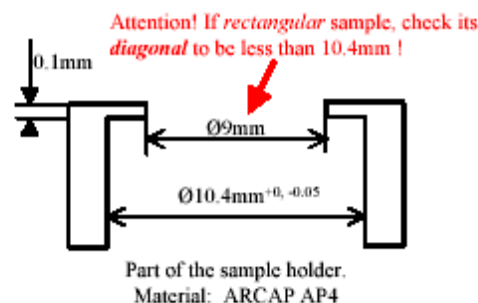
## **1.2 UNLOADING SAMPLES FROM THE INSTRUMENT**

The procedure for unloading samples is analogous to the loading procedure described above (only backwards).

[Summary](#)

### NanoSIMS 50 sample mounting.

Some examples of the use of a 10mm hole sample holder. (drawings not to scale)



Embedding ring.  
Material: ARCAP AP4, Part #: 45620692

Attention! If *rectangular* sample to be embedded, check its *diagonal* to be less than 9mm !



Thin flat sample glued or fixed with **non-degassing**  
( $< 1\text{E-}9$  Torr) conductive double-side sticky tape



Thicker flat sample glued or fixed with **non-degassing**  
( $<1\text{E-9 Torr}$ ) conductive, double-side sticky tape



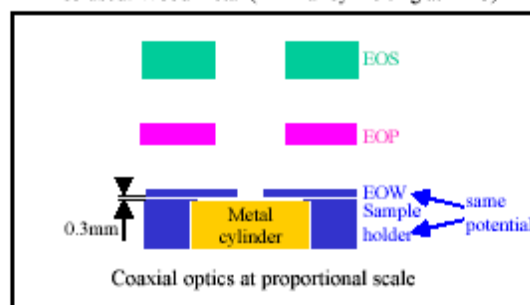
Small particles pressed into a gold foil



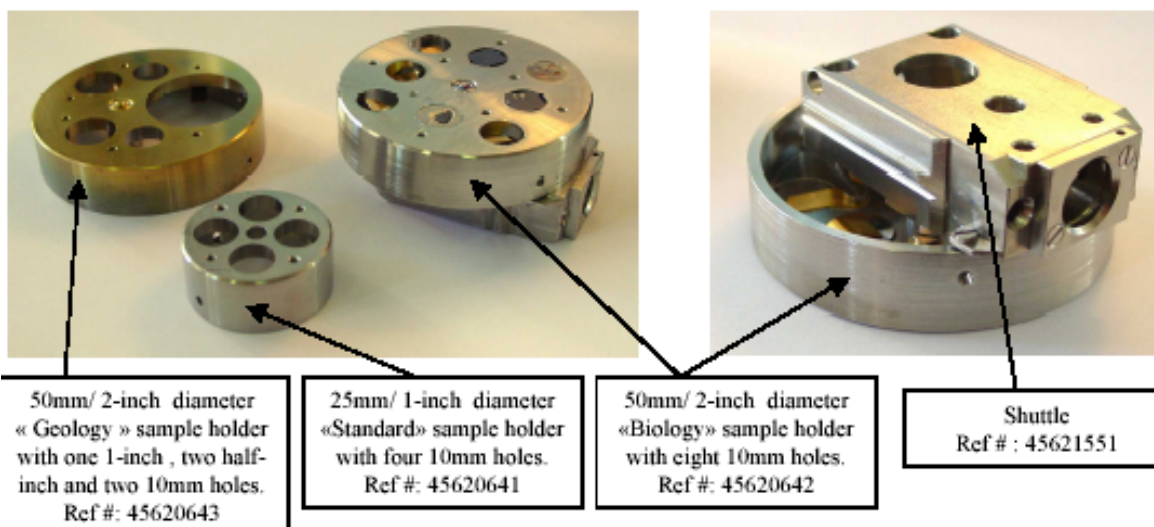
Small sample(s) analyzed through the holes  
of the thin top « grid » or « plate »



Embedding in **high vacuum resin** or metal in metallic cylinder, then polished (or not if it is flat) and gold coated if needed.  
Ex: Korapox 439 epoxy ([www.koemmerling-chemie.de](http://www.koemmerling-chemie.de)),  
Varian Torr Seal Low Vapor Pressure Resin ([www.varianinc.com](http://www.varianinc.com)).  
Also used: Wood metal (In-Bi alloy melting at 78°C)



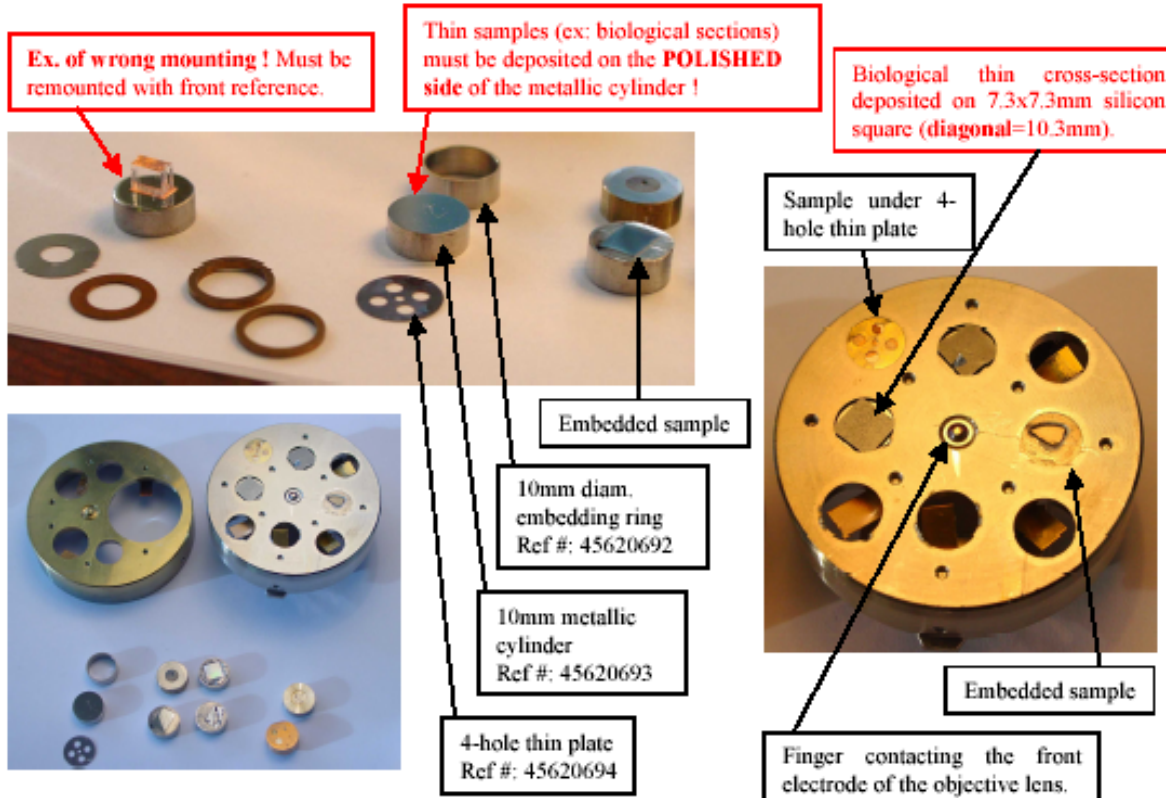
## Summary



Reverse view of the « Biology » sample holder, unscrewed from its shuttle. One can see the springs pushing the sample cylinders in their hole against their lips.

It is possible to simultaneously load two shuttles on the NanoSIMS sample stage : two 1-inch sample holders, or one 1-inch and one 2-inch sample holder. Note that the second 1-inch sample holder can be brought in SIMS position but not in the optical microscope position. It is generally used to store standard samples.

The NanoSIMS is delivered with eight shuttles and nine sample holders: two "standard", five "biology" and two "geology". The respective numbers can be modified on request at the time of order.



[Summary](#)

Special thanks to Franck J Stadermann (\*) for providing a preliminary version of this manual

(\*) © FRANK J STADERMANN  
[fjs@wuphys.wustl.edu](mailto:fjs@wuphys.wustl.edu)

Laboratory for Space Sciences  
Physics Department, CB 1105  
Washington University  
1 Brookings Drive  
St. Louis, MO 63130, USA

[Summary](#)



# **The CAMECA NANOSIMS 50 L**

## **Daily Startup and Shutdown user's guide**

## Content

<b>1</b>	<b>DAILY STARTUP AND SHUTDOWN</b>	<b>3</b>
1.1	SUN COMPUTER STARTUP	3
1.2	NANOSIMS HARDWARE STARTUP	3
1.3	AUTOMATIC SOURCE STARTUP	5
1.4	AUTOMATIC SOURCE SHUTDOWN	7
1.5	NANOSIMS HARDWARE SHUTDOWN	7
1.6	SUN COMPUTER SHUTDOWN	8
<b>2</b>	<b>BASIC ION BEAM TUNE-UP</b>	<b>8</b>
<b>3</b>	<b>MECHANICAL SETTINGS (*)</b>	<b>10</b>
3.1	DIAPHRAGMS, ENTRANCE- AND EXIT-SLIT	10
3.2	ENERGY SLIT	11
3.3	HEXAPOLE POSITION	12
3.4	STAGE Z-CONTROL	12
3.5	EXIT SLITS	13

## Figures

FIGURE 1: ICON	5
FIGURE 2: STOP, START AND DEGAS BUTTONS OF THE SOURCES WINDOW	5
FIGURE 3: SCHEMATIC VIEW OF AN APERTURE STRIP	10
FIGURE 4: SCHEMATIC VIEW OF THE ENERGY SLIT CONTROL	11

## 1 DAILY STARTUP AND SHUTDOWN

This section briefly describes the necessary steps for starting and stopping the NanoSIMS hardware, the SUN computer and the sources. These are only the steps that would be done on a daily basis before and after working with the instrument, i.e., this description does not include instructions for a complete instrument shutdown.

### 1.1 SUN COMPUTER STARTUP

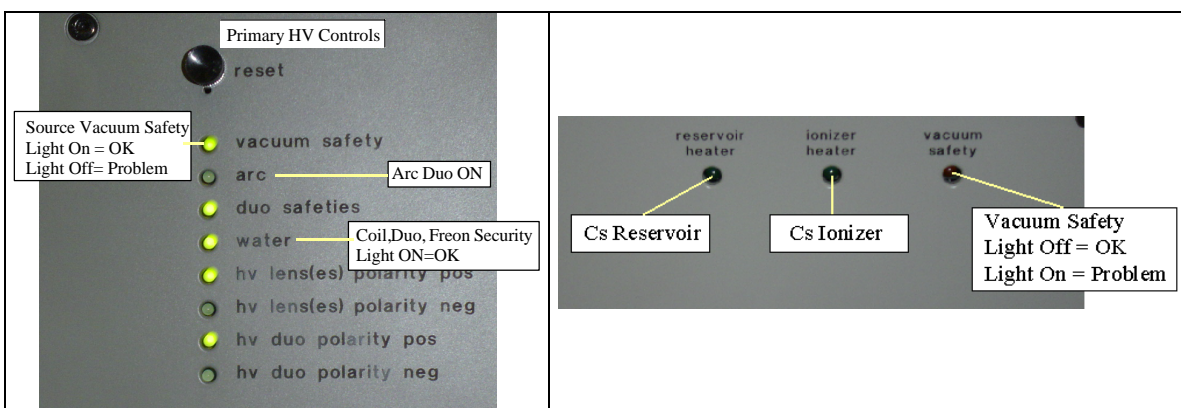
The SUN should remain running at all times. After a while, a screen saver turns off both of the big SUN monitors. Move the mouse a little bit to 'wake up' the monitors. This may take up to 15 seconds, so be patient. There is no need to press any buttons on the monitors. If everything is fine, the CAMECA software should already be running (i.e. there should at least be the vertical button bar window).

If for some reason, you find yourself logged out of the OpenWindows environment, log on as user 'ims'. OpenWindows and the CAMECA software should then start up automatically.

### 1.2 NANOSIMS HARDWARE STARTUP


Other than the sources, not much on the instrument really gets shut down and thus not much has to be started up again. It may be a good idea, though, to verify a few things before starting to work with the NanoSIMS:

- ☐ Check the vacuum status (from the SUN or from the vacuum control panel).
- ☐ Make sure the three vacuum safety lights are in the 'OK' status.



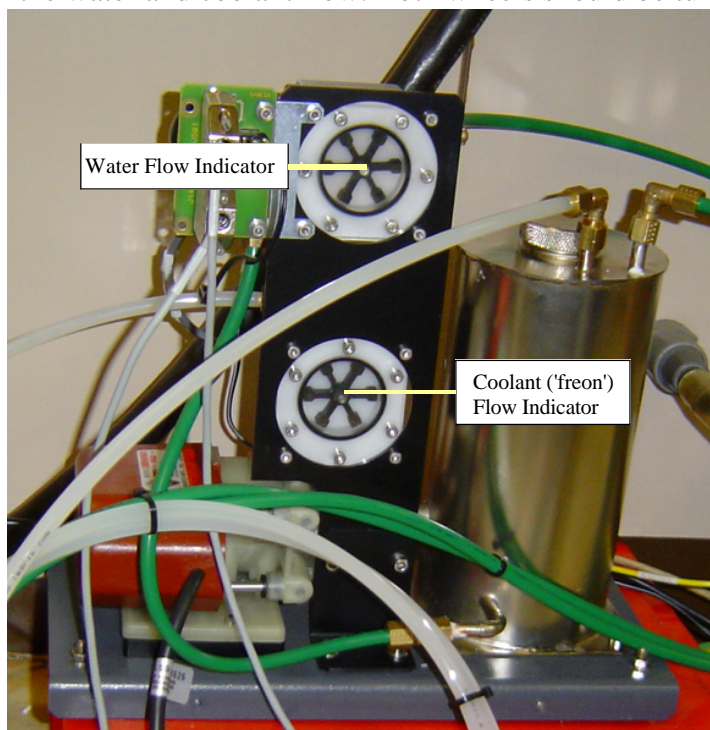
- ☐ Turn on the sample illumination (if necessary).
- ☐ Check what sample (if any) is in the analysis chamber.


[Content](#)

- ☐ Turn on the instrument HV (if necessary) by pressing button 
- ☐ Switch ON the monitor RTI (real time imaging) monitor (the leftmost one of the three monitors).
- ☐ Make sure the NMR control is turned on if you want to use the NMR regulation



- ☐ Check the water and coolant flow. Both wheels should be turning.



- ☐ Remember to unlock the dedicated keyboard  once you start using it.

[Content](#)

### 1.3 AUTOMATIC SOURCE STARTUP

Note: At this time, this is only an instruction for starting up the Cs source. Open the Vacuum window from the button bar (see [Figure 1](#)). Click the vacuum button a second time. This will close the window, but keep the vacuum program running. The button should now look as shown in Figure 1.



Figure 1: Icon

*The icon is red (as opposed to blue), indicating that the vacuum program is currently loaded. The small green box shows that the connection between the vacuum program and the rest of the software is working.*

- ☐ Open the 'Keyboard Preset' window from the button bar.  
If no file has been loaded yet (or if there is, but you want to use a different one for startup) click on 'Load'.
- ☐ Choose a '.isf' file for Cs primary ions that has recently been used and that has 'valid' information.
- ☐ Click OK to open this file.
- ☐ Select a valid setting. Then click on 'Valid' this will send all of the settings from this file to the dedicated keyboard of the NanoSIMS (and thus to the instrument itself). Now all of the parameters of the instrument are the same as at the time when this setup file was saved.
- ☐ Select 'Sources' from the button bar and wait for the window to open.  
In the 'Sources' window, the polarity should be positive and 'Cs' should be selected.  
All three values for Cs (Ionizer, Reservoir, and HV) should be at zero now (otherwise the Cs source is still on).



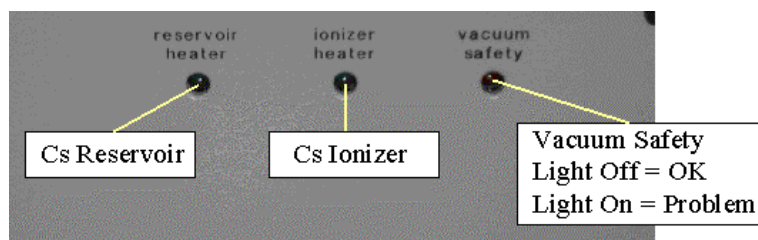
Figure 2: Stop, Start and Degas buttons of the Sources window

[Content](#)

- ❑ Now move the mouse over the Start button, without clicking. After a moment, a yellow box should appear showing Cs source startup values that come from the '.isf' setup file that was loaded earlier. It should contain useful values for ionizer, reservoir and HV. If all values shown are zero, you have to enter some numbers manually later (see below).
- ❑ To start the Cs source, click on the Start button.
- ❑ In the next window you should see the values from the '.isf' files that were also shown in the yellow box earlier. If you are happy with these numbers, click 'OK'. If you want different values or if everything is zero, enter new values for Ionizer, Reservoir and HV and then click 'OK'.
- ❑ Next enter the number of hours until you want the Cs source to start up. This is useful if you go through this whole routine the evening before you want to use the Cs source. You can set it to automatic startup, so that everything is up and running by the time you come to the lab in the morning. If you want to start right now, enter nothing or 0.00 and continue.

The Cs source should now slowly start up. During 1 minute (\*) the HV will go to the desired value and then the ionizer will gradually increase, which will also take 1 minute. Next comes a waiting time of 10 minutes after which the reservoir current will be turned on gradually (also 1 minute). At the end you will get a message saying that startup is completed.

If all went well, the Ionizer and Reservoir lights on the electronic cabinet should now be on



*If these lights did not come on, you have a problem. One possible reason is that the vacuum program is not connected right (see description above). It is also possible, that the coolant flow is insufficient. The vacuum in the source chamber has to be below  $2 \times 10^{-5}$  torr for the Cs source to operate.*

(\*) defined by the “setup” software

[Content](#)

If you go to the Tuning window and select 'Detection Mode: FCp', you should see the slowly increasing primary beam current. Make sure the beam is actually in the primary FC



(the light on button 'CFp' in should be on).

A typical startup value for Cs current in FCp is between 50 and 100 nA. A current below 30 nA is considered too low.

## 1.4 AUTOMATIC SOURCE SHUTDOWN


Again, this is only for the Cs source.

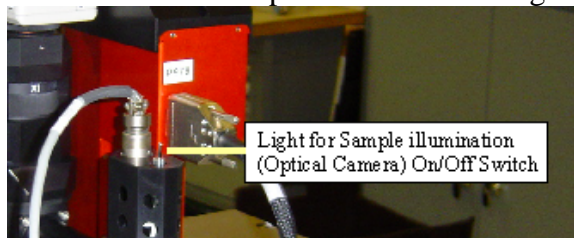
- ☐ Go to the Sources window and click on the Stop button (see Figure 2).
- ☐ Choose a time for shutdown (empty = 0.00 = now) and continue. Then select Yes or No to decide whether you want or not restart the source after it cools down.
  - If No, the source will remain stopped after Shutdown
  - If Yes, enter the number of hours you want until the source to start up again

⇒ *Don't forget that the time needed to cool down the source is not included*

## 1.5 NANOSIMS HARDWARE SHUTDOWN

Most components of the instrument do not get turned off on a routine basis. When you are done with the instrument, do only the following steps:

- ☐ Lock the dedicated keyboard by pressing button 
- ☐ Turn off the sample illumination light with the on/off switch



- ☐ Turn off the RTI monitor (that's the left one).
- ☐ Remove your sample from the analysis chamber unless you will be the next user on the instrument.

[Content](#)

## 1.6 SUN COMPUTER SHUTDOWN

Don't actually shut down the computer. Clean up the desktop by closing unnecessary windows, but leave the menu button bar open. Do not logout from the OpenWindows environment. After a while, the screen saver will turn off both SUN monitors.

## 2 BASIC ION BEAM TUNE-UP

Once there is a Cs primary beam, a basic tune-up of the primary and the secondary ion optics can be started.

- ☐ Begin with these aperture settings: D0-off, D1-3, ES-off, AS-off, EnS-open.
- ☐ Go to the 'grooved Si wafer' sample. This standard sample has grid etched into it with a grid width of 10  $\mu\text{m}$ .
- ☐ Verify that the optical camera is in focus.
- ☐ If the optical camera is out of focus, adjust the sample z-position (and not the camera focus).
- ☐ Turn the beam ON by turning FCp off on the keyboard or by turning the beam ON in Tuning.
- ☐ Now make sure that L0, L1, L2, C0x, C0y, C1x, C1y and Cx are at zero while the beam is ON in tuning. (You cannot change these values to zero while the FCp is on, because it needs its own special settings of these parameters.)
- ☐ Adjust the detectors in such a way that you get 28SI in one of the small EMs at a radius between 400 and 500 mm.
- ☐ Start the real time imaging (RTI) with this detector and adjust to a raster size of 50  $\mu\text{m}$ .
- ☐ With the RTI on, move the AS to completely block the beam (i.e. RTI image black).
- ☐ Now remove D1 (i.e. D1-off). This increases the primary beam current at the sample by a factor of 100 or so and cleans the surface.
- ☐ Wait 10 minutes for the cleaning to finish.
- ☐ Go back to D1-3.
- ☐ Then change back to AS-off.
- ☐ Change the raster size to 100  $\mu\text{m}$  and center D1-3 by centering the circle in the RTI image. D1 acts like a field aperture for the secondary beam, allowing only ions from an area 60% of the D1 size to pass.
- ☐ Now focus the primary beam with E0P, by watching the RTI image at a smaller raster size.
- ☐ Once focused, E0P should be at 8500 V. (Acceptable range 8480 – 8520 V.) If E0P is outside of this range, the sample height (stage z-control) is not correct.
- ☐ Next adjust E0S by maximizing the secondary ion signal. The bit value of E0S should be between 2800 and 2830.

[Content](#)

If you don't already know the FCo/FCp signal ratio, determine it now:

- ☐ Measure the primary beam current first with FCp and then with FCo (by clicking on 'FCo' in the holder window). Note that for the Faraday cups, the display in c/s is in raw counts, while the display in A is corrected by subtracting the background. The background value can be changed in the Setup Window.
- ☐ Now defocus the primary beam to around 3  $\mu\text{m}$ . This can be done by changing E0P by 100 V ( $8500 - 100 = 8400$ ) while still using D1-3
- ☐ Check the transmission with a stationary (i.e. not rastered) beam. At this point we would expect a  $^{28}\text{Si}$  transmission of 7-8%. This calculates to 440-500 kcps for every pA of primary beam current at the sample. If you do not get at least this 7-8% transmission, something is wrong. Do not continue the tune-up process.
- ☐ Maximize C4x and C4y (i.e. maximize the secondary ion signal by changing C4x and C4y).
- ☐ Maximize Q.
- ☐ Now insert ES-3 and center.
- ☐ Maximize E0S.
- ☐ Re-check C4x, C4y and Q.
- ☐ Insert AS-1 and center.
- ☐ Now check the pulse height distribution (PHD) of the detector used. The maximum should be between 150 and 200 mV. Adjust the EM HV if necessary.
- ☐ Check the threshold value from the PHD (should be at curve minimum).
- ☐ Now acquire a high mass resolution spectrum (HMR) of the  $\text{Si}^{28}$  peak.
- ☐ At this point you should get a mass resolution (MRP) of  $>5000$ .
- ☐ Use 'Tools' to scan C4x. Set C4x to center of peak, not necessarily the maximum. (C4y should be around zero.)
- ☐ Determine the MRP again.
- ☐ Vary Q up and down in 1 bit steps. After each change, determine the MRP. Continue until MRP is maximized.
- ☐ To further increase the MRP, do the following steps in the order shown. After each step, check C4x and Q again.
- ☐ Reduce EnS by 10%.
- ☐ Reduce EnS by 20%.
- ☐ Go to AS2.
- ☐ Go to ES4. (After each change of ES you have to retune EnS to get to the desired reduction again.)

[Content](#)

### 3 MECHANICAL SETTINGS (\*)

The different motorization options are:

- ☐ D0
- ☐ D1
- ☐ ES
- ☐ AS
- ☐ EnS
- ☐ Hexapole
- ☐ Z (Sample Stage)

(\*) Without motorization option:

There are a few instrument parameters that cannot be saved in setup file because they are not under computer control. These mechanical settings are for diaphragms, slits, the sample z-control and the hexapole position.

#### 3.1 DIAPHRAGMS, ENTRANCE- AND EXIT-SLIT

The diaphragms D0 and D1 have circular openings as shown in Figure 3. The entrance (ES) and aperture (AS) slits look fairly similar, except that the openings are rectangular. The sizes of all slits and diaphragms are listed in the 'Setup Soft.' window, which is available from the button bar on the SUN.

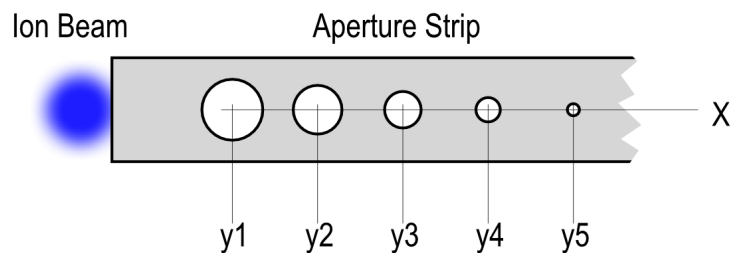
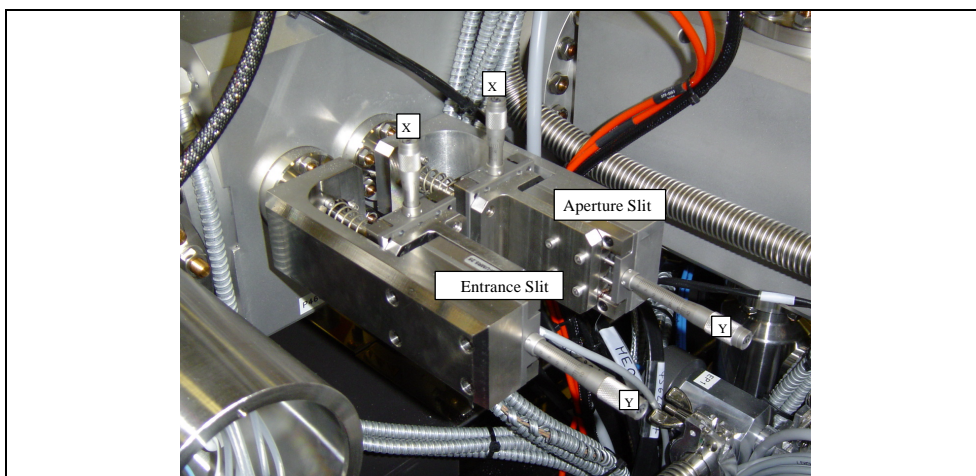


Figure 3: Schematic view of an aperture strip

*Diaphragms of different size can be selected by moving the strip in y direction to the positions y1 – y5. The x-position should be the same for all apertures. It is also possible to remove the strip completely to allow the maximum beam current to pass (this setting is shown here). The opening sizes are not shown to scale.*

[Content](#)



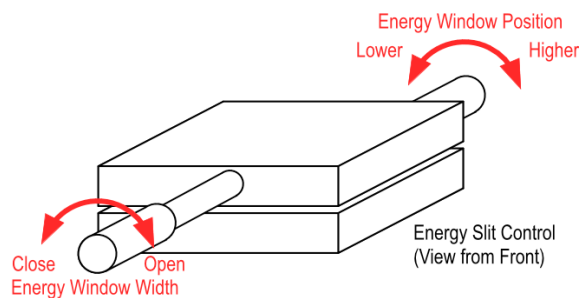
Below is typical a list of the positions of all openings in mm.

Name	x	y1	y2	y3	y4	y5
<b>D0</b>	9.50	12.05	9.05	6.05	3.05	n/a
<b>D1</b>	7.25	10.80	7.80	4.80	1.80	n/a
<b>ES</b>	5.45	11.06	9.06	7.06	5.06	3.06
<b>AS</b>	7.75	10.90	8.90	6.90	4.90	2.90

Convention: The different diaphragm and slit sizes are noted e.g. as D1-3 (third largest diaphragm for D1 at position y3) or as ES-1 (largest entrance slit at position y1). AS-off indicates that the AS strip is completely removed as shown in [Figure 3](#).

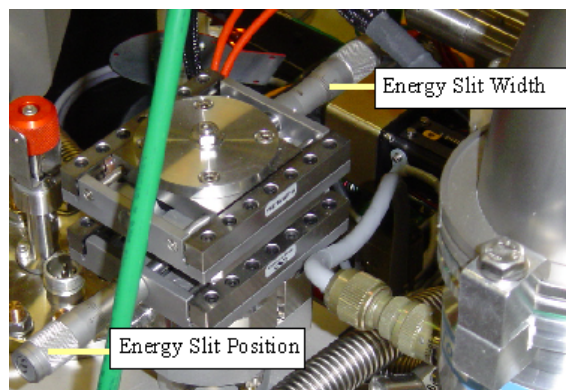
## 3.2 ENERGY SLIT

The energy slit (EnS) is continuously adjustable. The micrometer screw pointing toward the back of the instrument changes the position of the energy slit (i.e. it moves the low- and the high-energy edge together). The screw pointing toward the front of the instrument controls the width of the energy window (i.e. it moves only the high-energy edge of the slit).



*Figure 4: Schematic view of the energy slit control*

[Content](#)



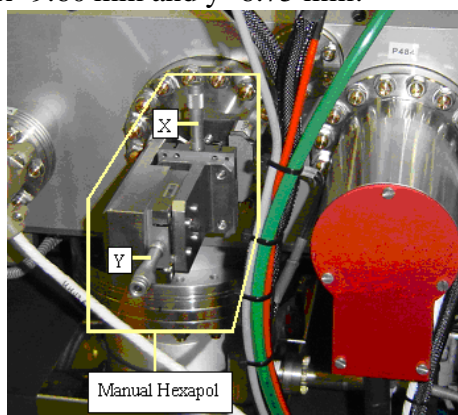
*seen from the front side of the NanoSIMS.*

Below a list of typical value for EnS

- Energy window width: ~1 V at 13.51 mm, 20 V at 13.01 mm, 40 V at 12.51 mm
- Position of low energy edge: 0 V at 14.20 mm, 25 V at 13.70 mm, 45 V at 13.20 mm

### 3.3 HEXAPOLE POSITION

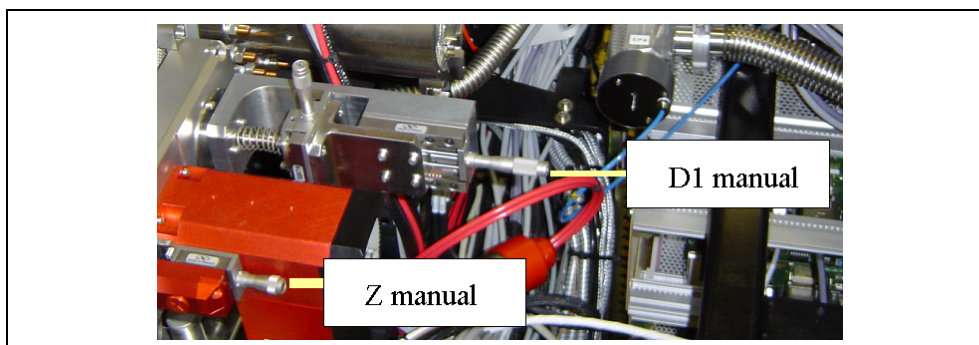
The hexapole is the only optical element whose position can be changed. The micrometer screws move the hexapole in x- and y-direction. Typical starting values are  $x=9.60$  mm and  $y=6.75$  mm.



### 3.4 STAGE Z-CONTROL

While the x- and y-movement of the sample stage is under computer control, the z-position has to be adjusted manually. The 'normal' position of the stage is around 3.0 mm. Note that the mm-reading has to be divided by 5.9 to get the actual movement of the sample stage. A higher number leads to a larger distance between the sample and the extraction lens.

[Content](#)



### 3.5 EXIT SLITS

Typical 'Slit command positions' for the moveable EMs (in mm):

<b>Trolley -&gt;</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Slit 1</b>	15.80	15.60	16.25	15.85
<b>Slit 2</b>	12.80	12.60	13.25	12.85
<b>Slit 3</b>	9.80	9.60	10.25	9.25

[Content](#)

Special thanks to Franck J Stadermann (\*) for providing a preliminary version of this manual

(\*) © FRANK J STADERMANN  
[fjs@wuphys.wustl.edu](mailto:fjs@wuphys.wustl.edu)

Laboratory for Space Sciences  
Physics Department, CB 1105  
Washington University  
1 Brookings Drive  
St. Louis, MO 63130, USA

[Content](#)



# **The CAMECA NANOSIMS 50 L**

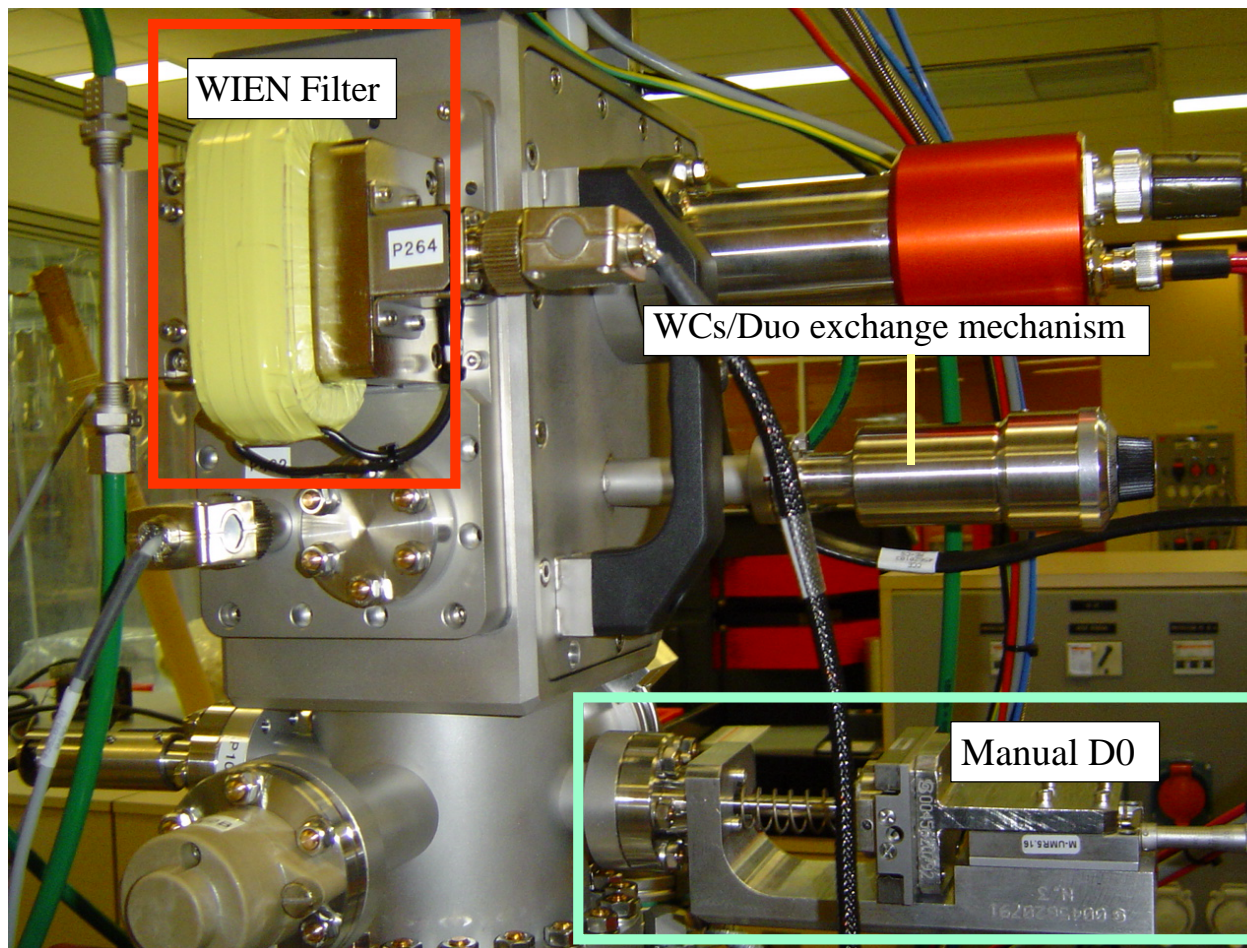
## **Picture Book user's guide**

## Summary

<b>WIEN FILTER &amp; CS SOURCE PLUG AND LENS L DUO</b>	<b>4</b>
<b>SAMPLE EXCHANGE CONTROL PAD</b>	<b>5</b>
<b>TIC &amp; HEXAPOLE</b>	<b>6</b>
<b>KEYBOARD</b>	<b>7</b>
<b>AIRLOCK AND VESSEL</b>	<b>8</b>
<b>SAMPLE STOP</b>	<b>9</b>
<b>UNLOCK / LOCK</b>	<b>10</b>
<b>AIRLOCK DOOR</b>	<b>11</b>
<b>MAGNET AND HALL PROBE</b>	<b>12</b>
<b>NMR PROBES</b>	<b>13</b>
<b>ANALYSIS CHAMBER</b>	<b>14</b>
<b>ENTRANCE AND APERTURE SLIT ASSEMBLY</b>	<b>15</b>
<b>SUBLIMATION PLUG</b>	<b>16</b>
<b>E- GUN AND CCD</b>	<b>17</b>
<b>PNEUMATIC CONTROL</b>	<b>18</b>
<b>ION PUMP CONTROLLER</b>	<b>19</b>
<b>RMN AND MULTI GAUGE CONTROLLER A &amp; B</b>	<b>20</b>
<b>CESIUM CONTROLLER</b>	<b>21</b>
<b>DUOPLASMATRON</b>	<b>22</b>
<b>P.M. PREAMPLIFIER FOR SECONDARY ELECTRON DETECTION</b>	<b>23</b>
<b>FCP, FC0 AND TIC PREAMPLIFIER / DISCRIMINATOR</b>	<b>24</b>
<b>PRIMARY HV CONTROLS</b>	<b>25</b>
<b>ENERGY SLIT</b>	<b>26</b>
<b>COOLING SYSTEM</b>	<b>27</b>

<b>ELECTRONICS</b>	<b>28</b>
<b>REAL TIME UNIT</b>	<b>29</b>
<b>B1 , B2 AND EXTERNAL COILS</b>	<b>30</b>
<b>VERTICAL COIL</b>	<b>31</b>
<b>PLUG FOR THE VERTICAL COIL</b>	<b>32</b>
<b>VERTICAL AND HORIZONTAL COILS</b>	<b>33</b>
<b>SAMPLE HOLDER</b>	<b>34</b>
<b>PLUGS FOR THE VERTICAL COIL</b>	<b>35</b>
<b>TROLEYS FOR THE MULTICOLLECTION SYSTEM (RIGHT VIEW)</b>	<b>36</b>
<b>TROLEYS FOR THE MULTICOLLECTION SYSTEM ( LEFT VIEW)</b>	<b>37</b>
<b>TROLEYS FOR THE MULTICOLLECTION SYSTEM (TOP VIEW)</b>	<b>38</b>
<b>1 TROLEY FOR THE MULTICOLLECTION SYSTEM (EM &amp;FC HOUSING)</b>	<b>39</b>
<b>MAGNET POLE PIECES</b>	<b>40</b>
<b>MAGNET POLE PIECES</b>	<b>41</b>
<b>MULTICOLLECTIONFLANGE</b>	<b>42</b>
<b>HEXAPOLE MOTOR</b>	<b>43</b>
<b>E.S AND FA MOTORS</b>	<b>44</b>

## Wien Filter & Cs source Plug and Lens L DUO

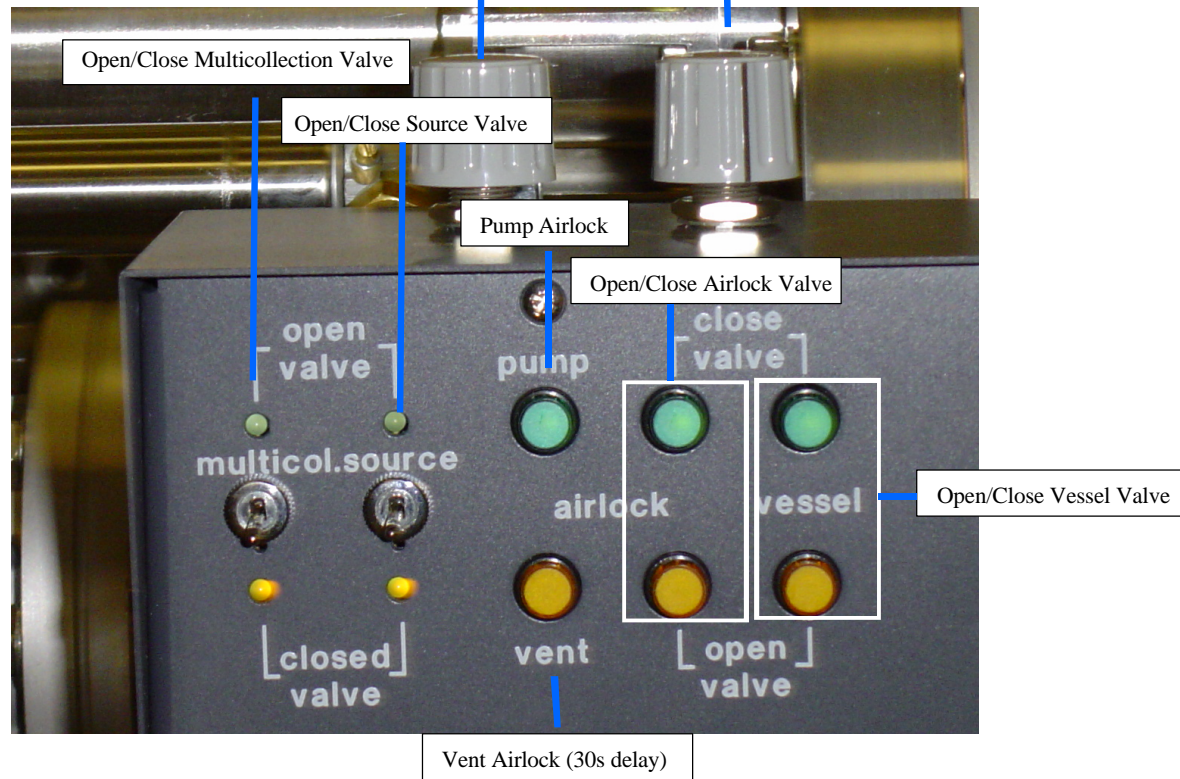


[summary](#)

## Sample Exchange control Pad

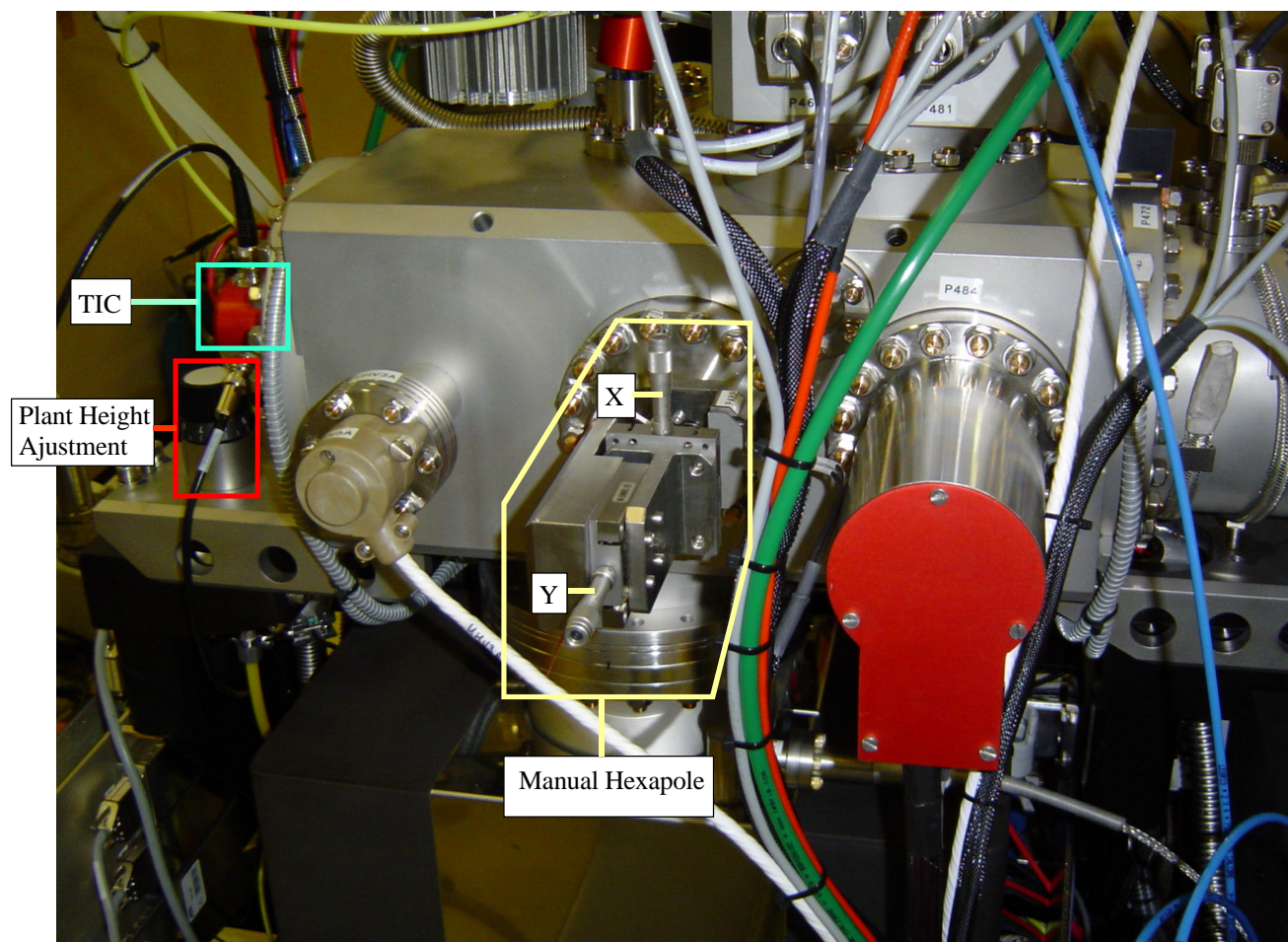
Airlock "Light" for Degassing Samples  
Do not turn to maximum !

Light for Sample Illumination  
(Optical Camera) Intensity



[summary](#)

## TIC & Hexapole



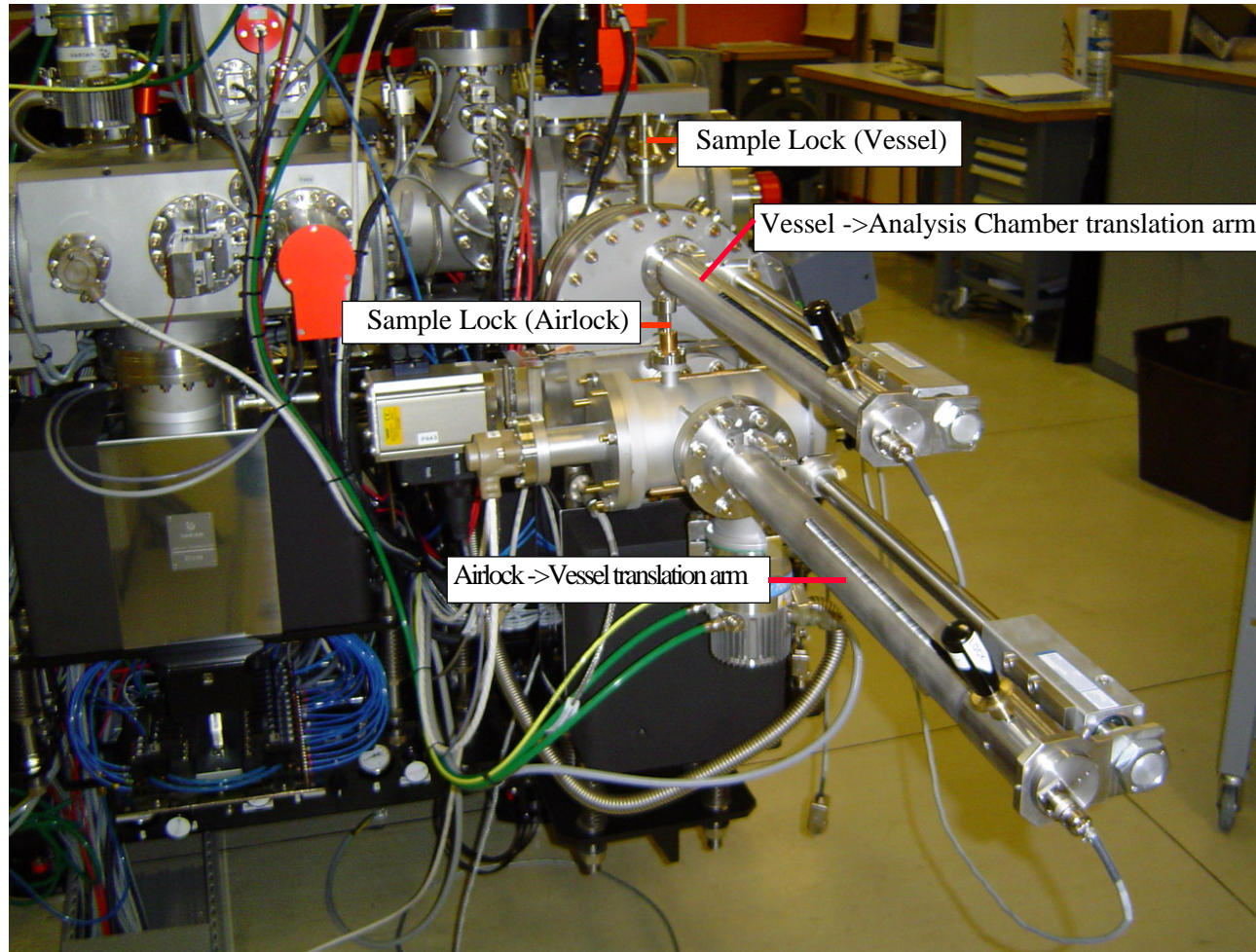
[summary](#)

## Keyboard



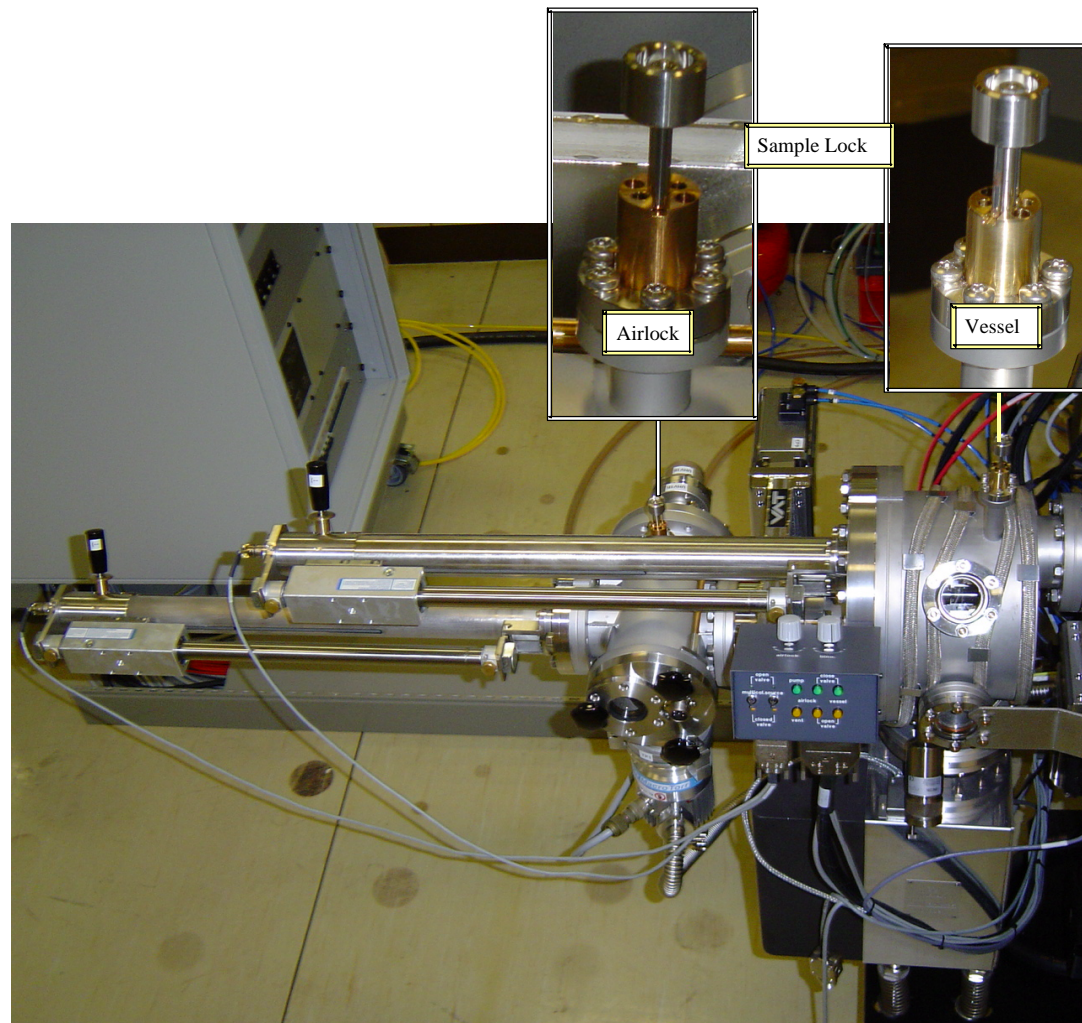
[summary](#)

## Airlock and Vessel



[summary](#)

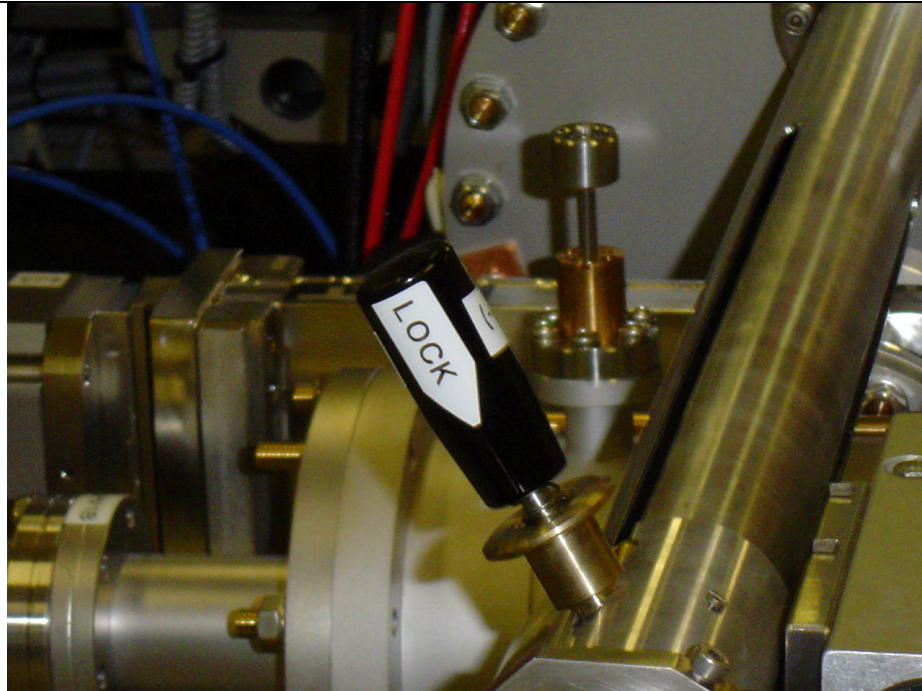
## Sample Stop



[summary](#)

## Unlock / Lock

Unlock

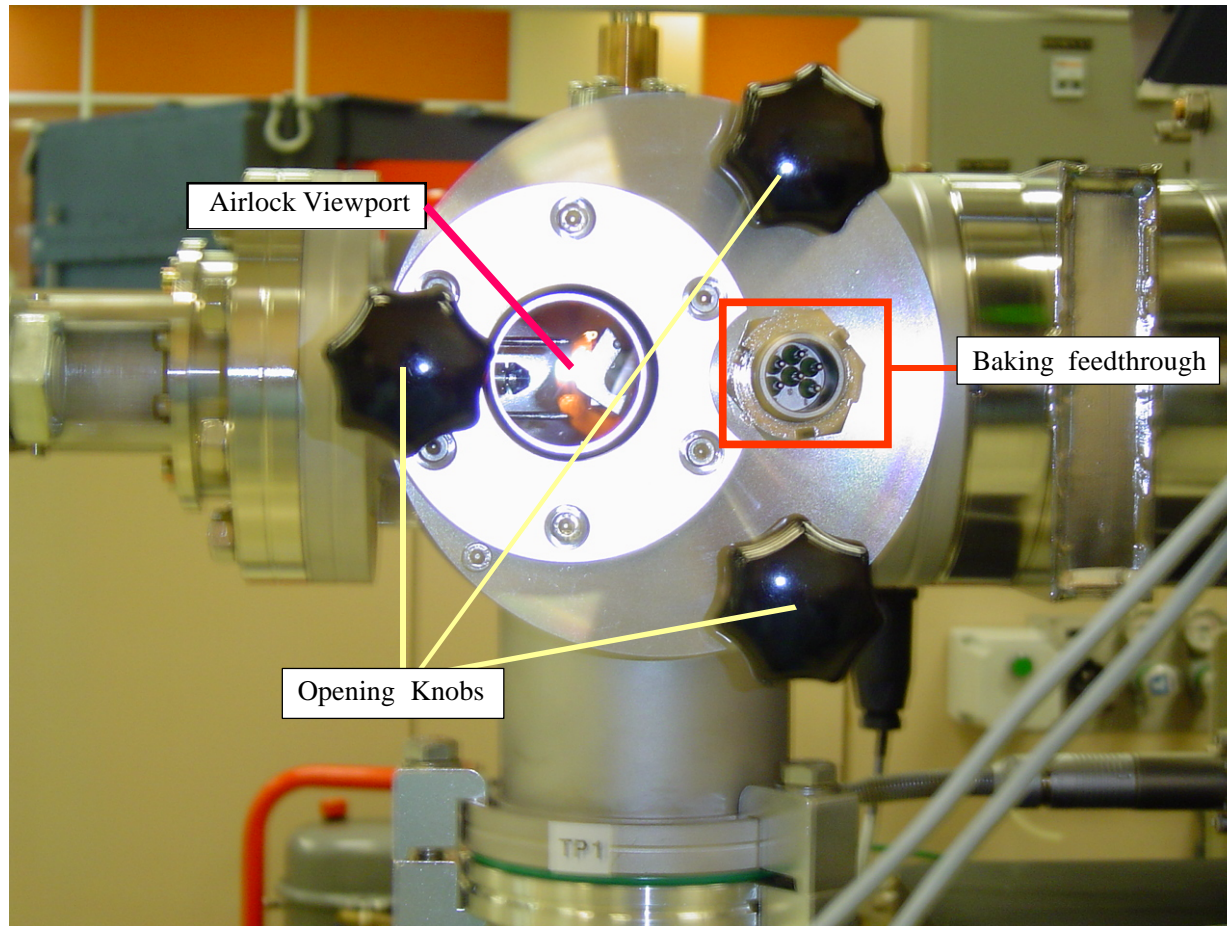


Lock



[summary](#)

## AirLock Door



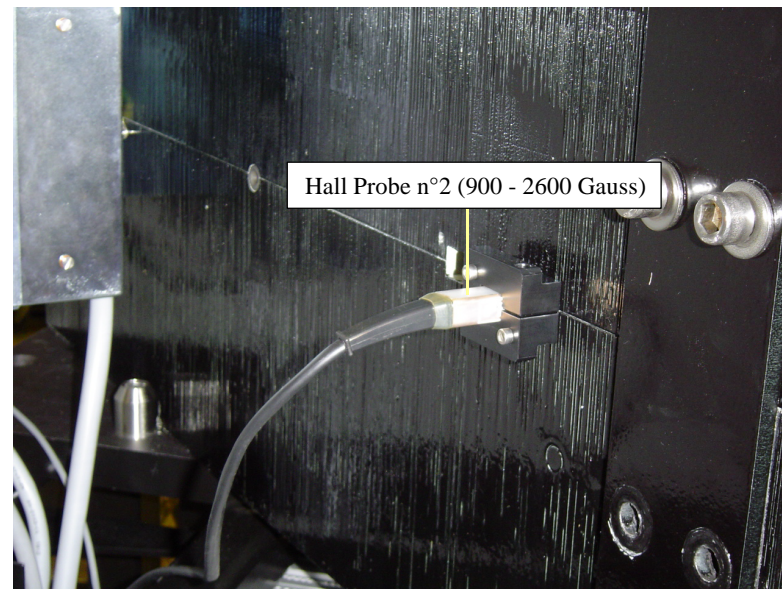
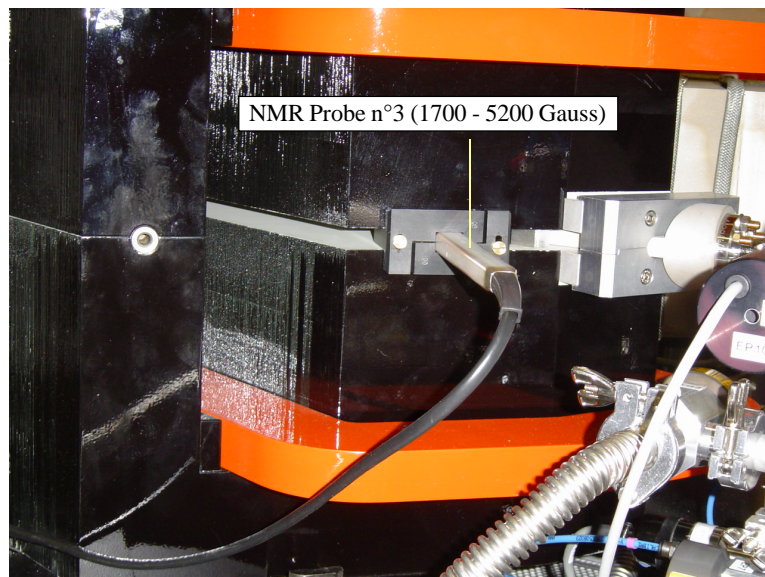
[summary](#)

## Magnet and Hall Probe



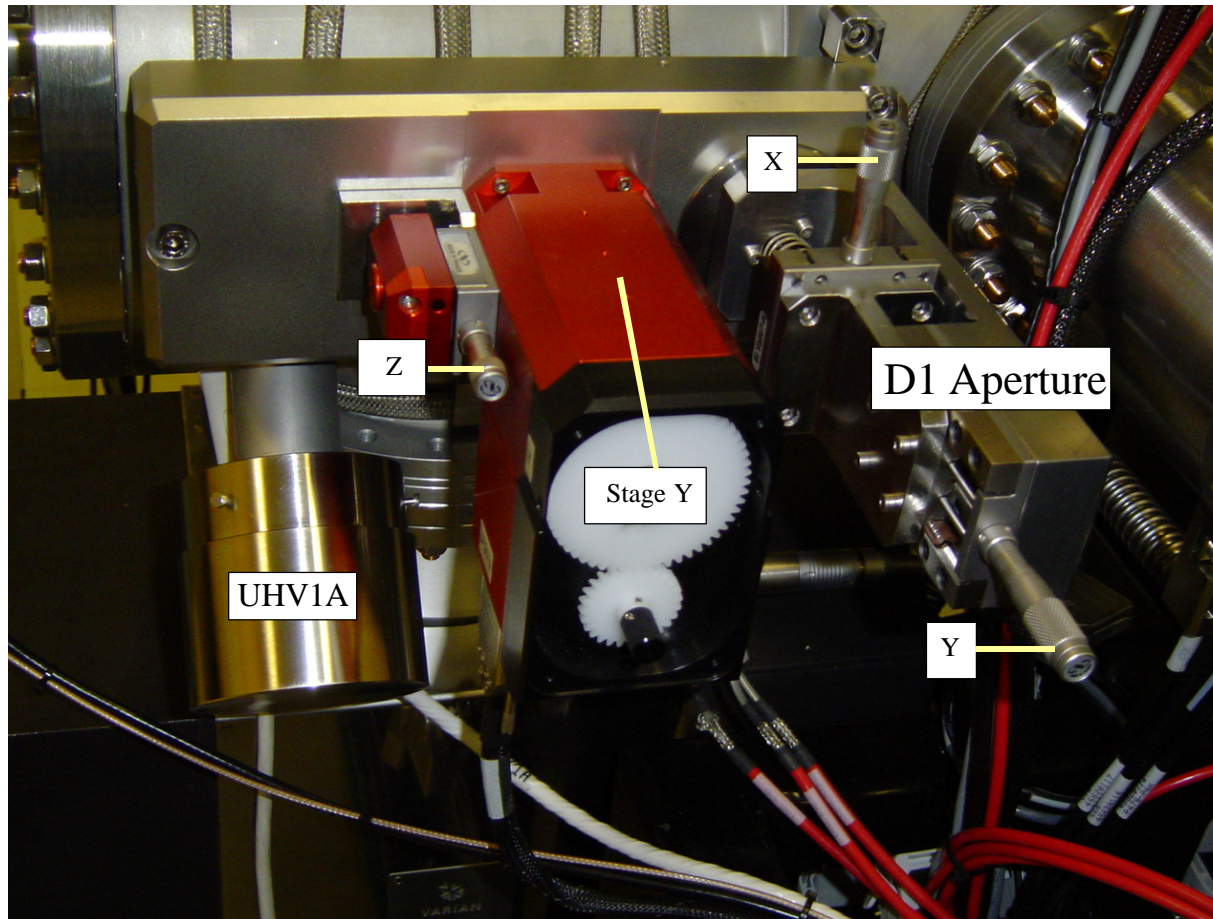
[summary](#)

## NMR Probes



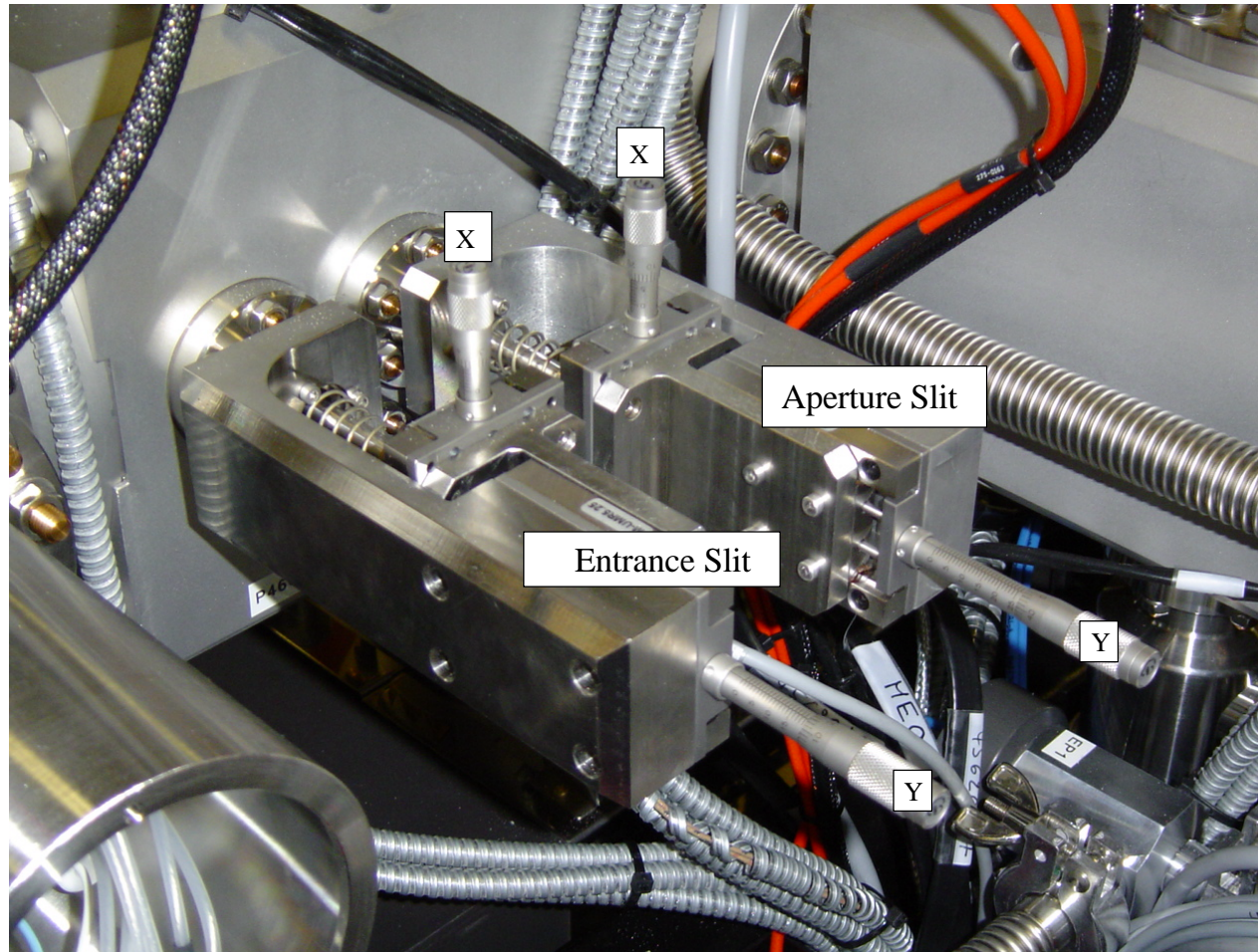
[summary](#)

## Analysis Chamber



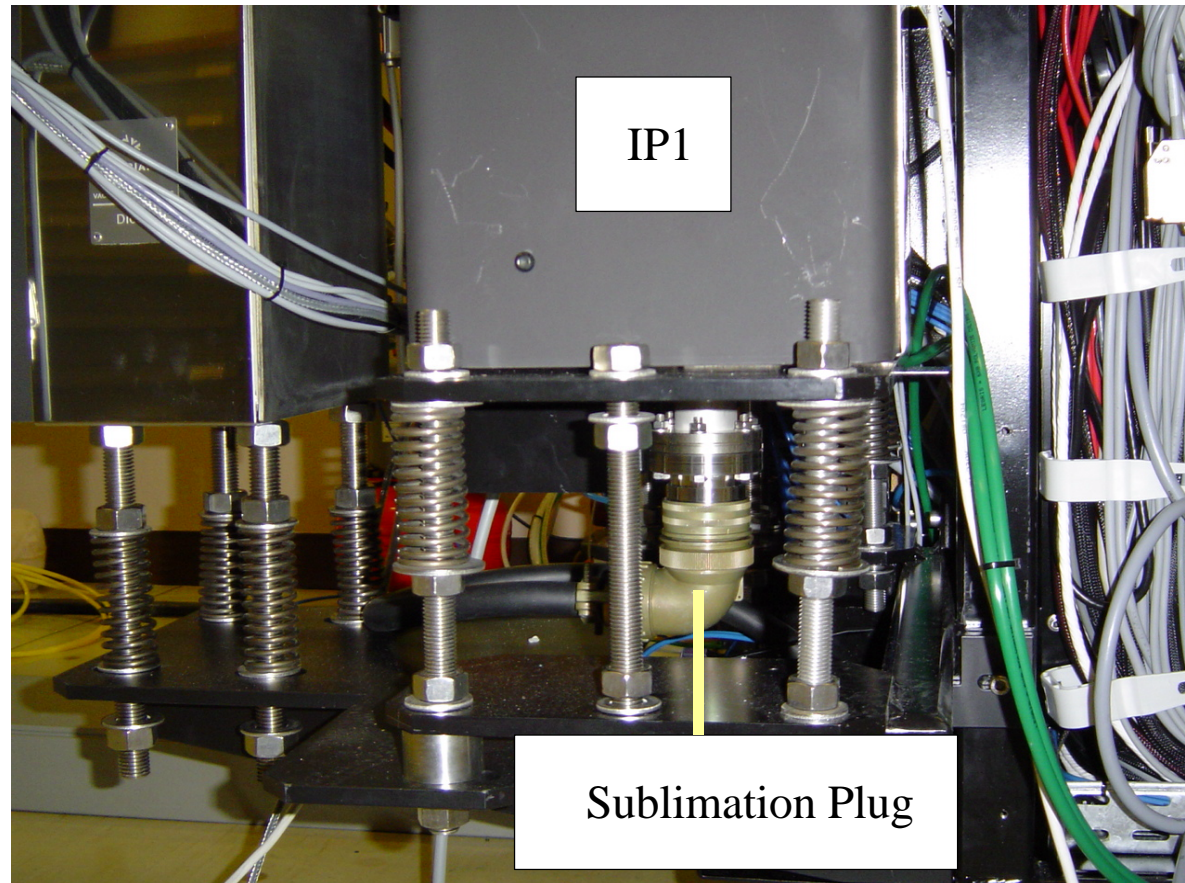
[summary](#)

## Entrance and Aperture Slit Assembly



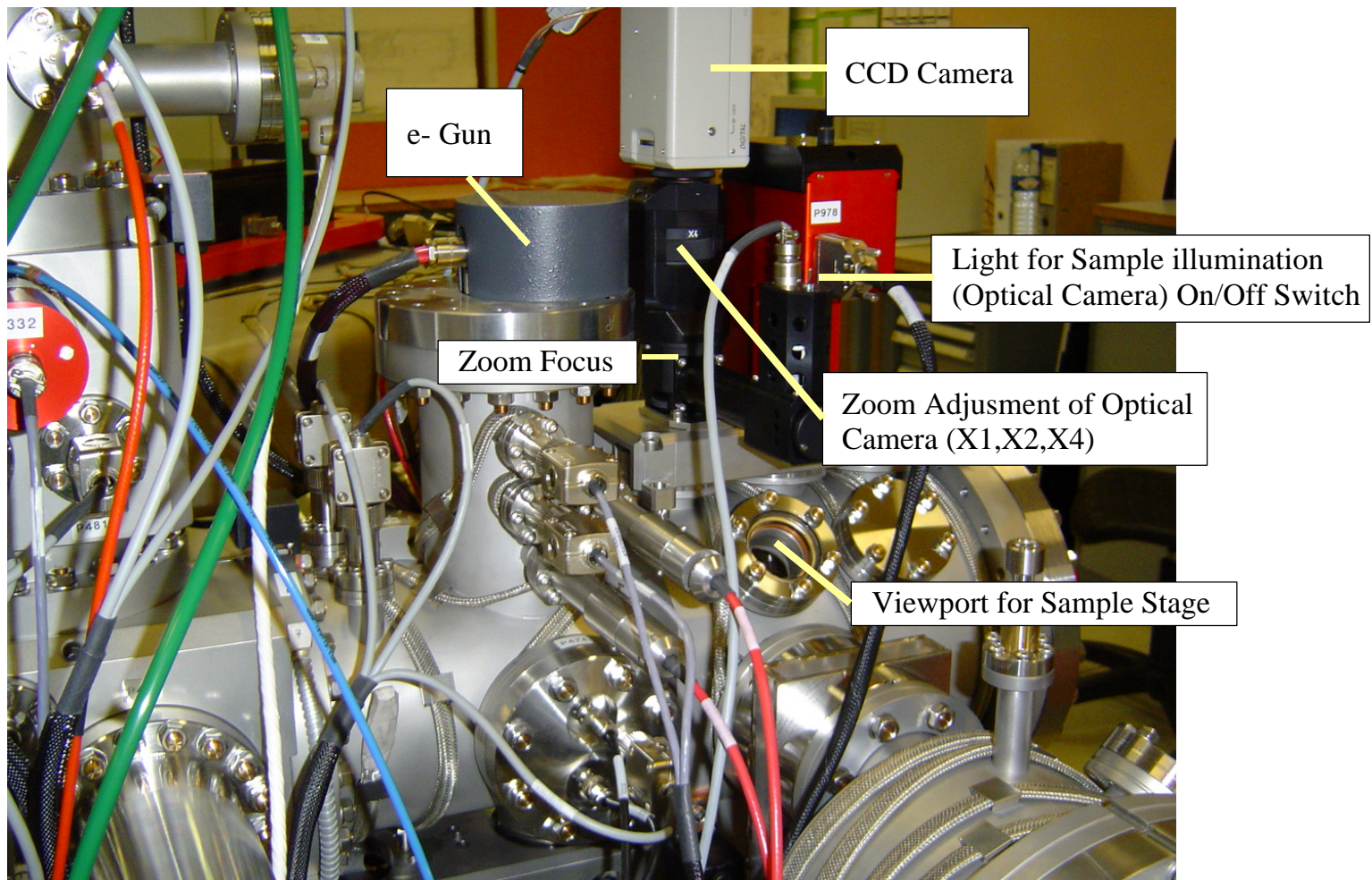
[summary](#)

## Sublimation Plug



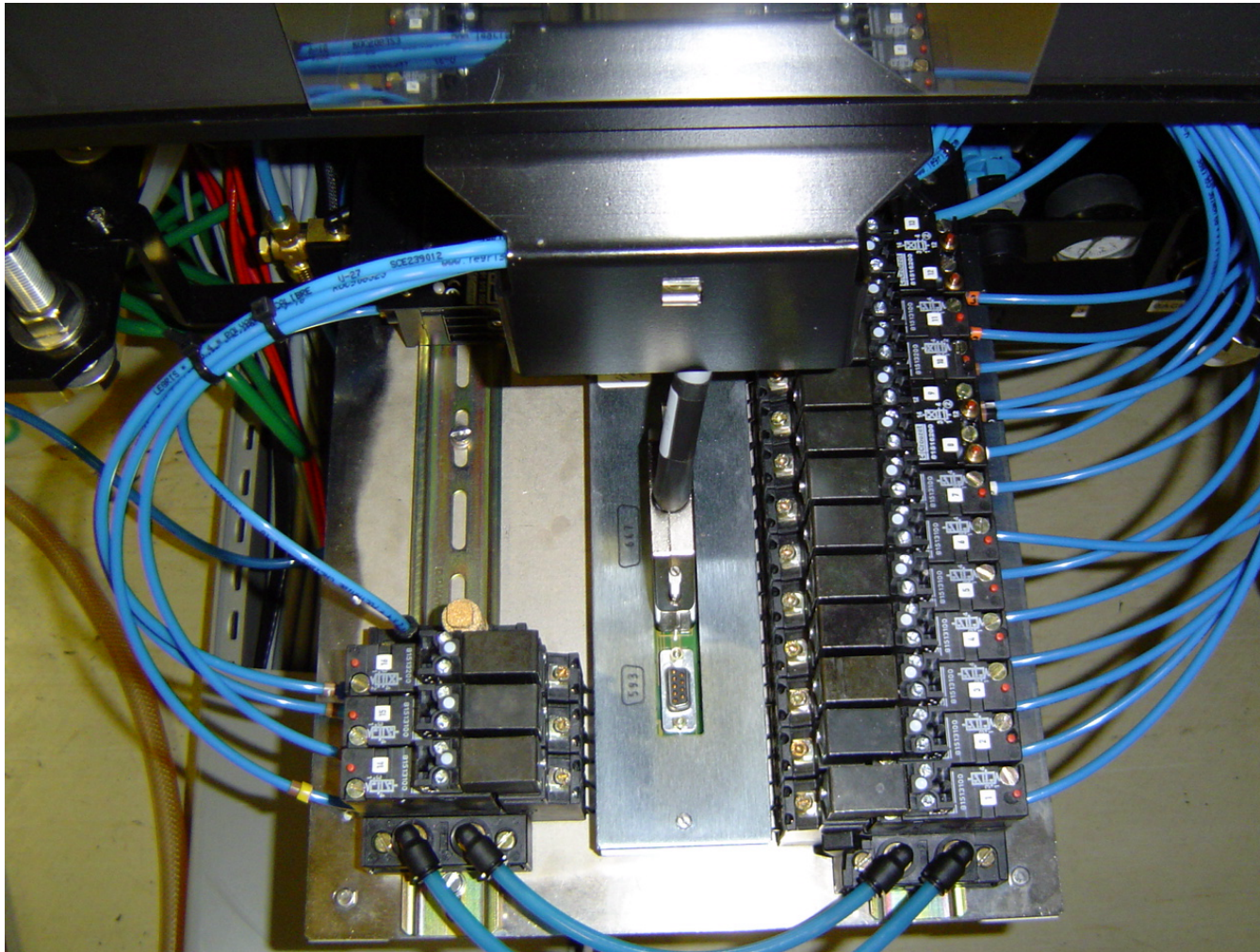
[summary](#)

## E- GUN and CCD



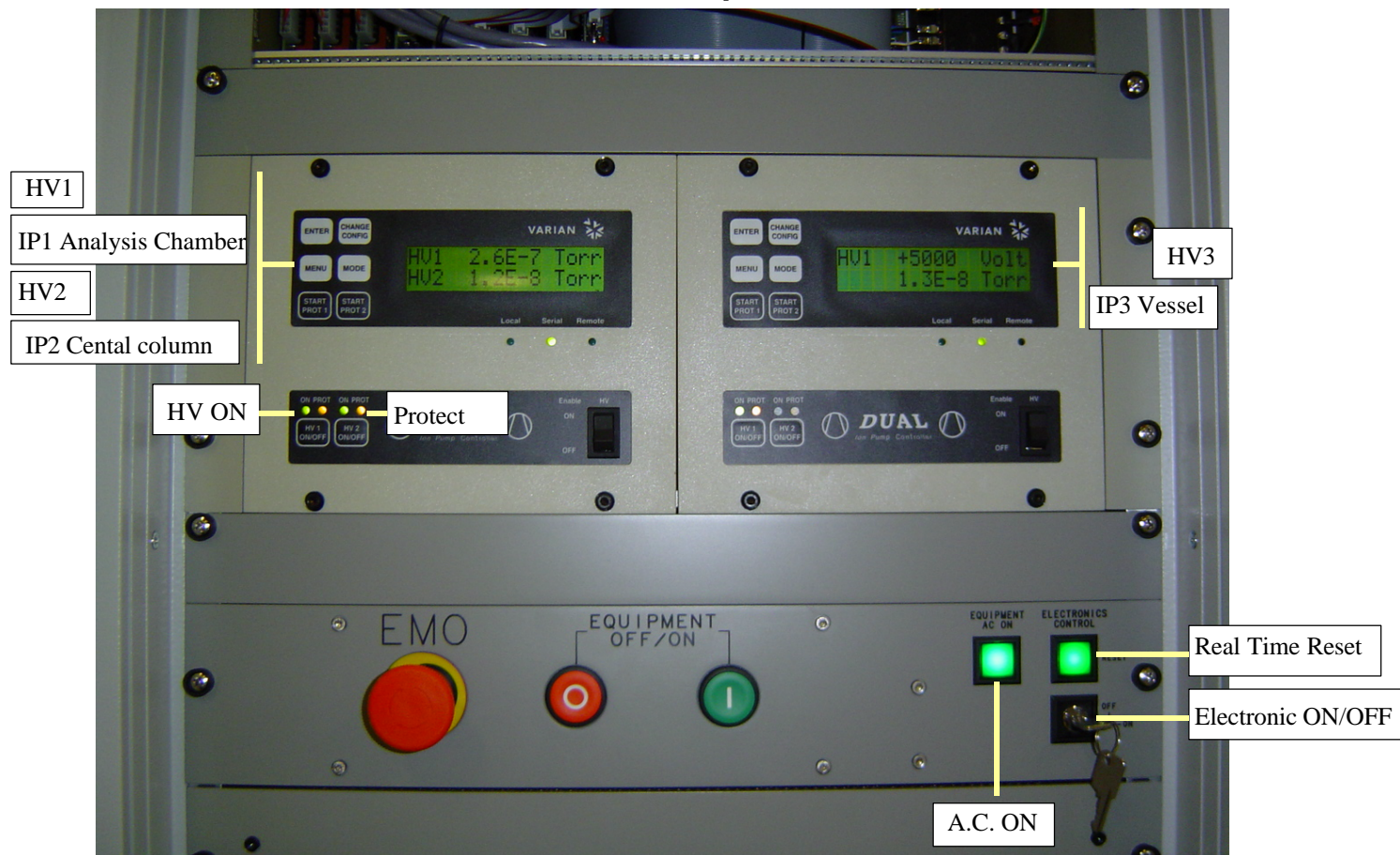
[summary](#)

## Pneumatic control



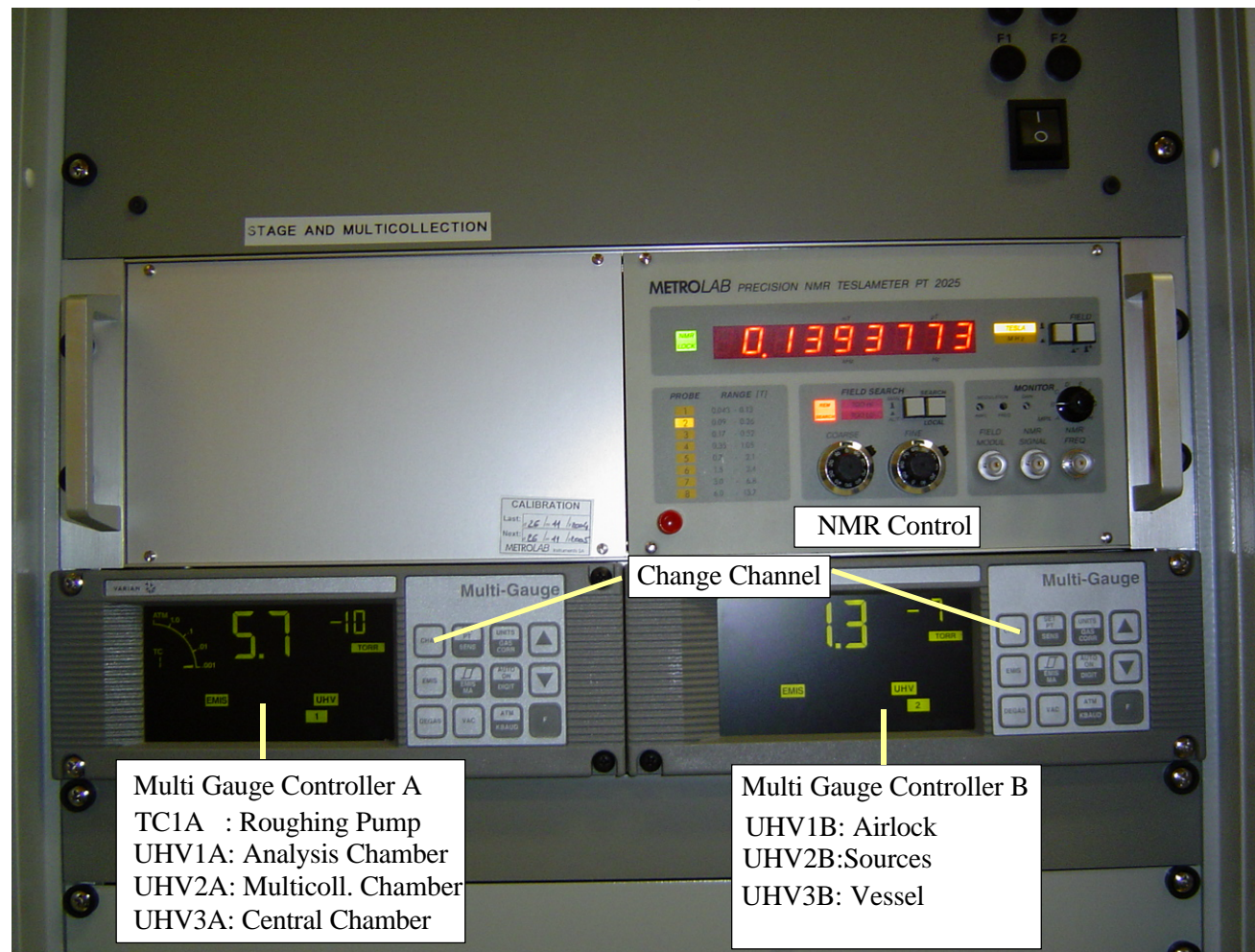
[summary](#)

## Ion Pump Controller



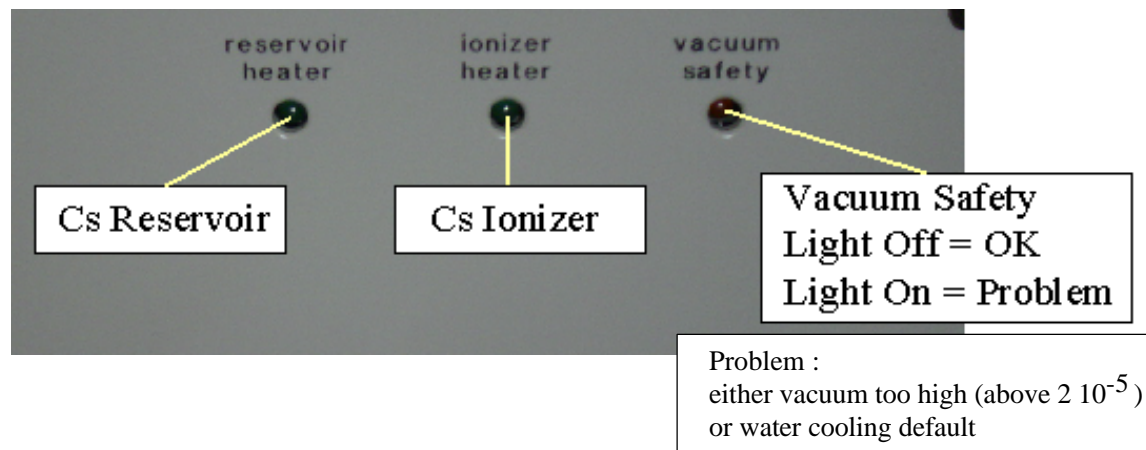
[summary](#)

## RMN and Multi Gauge Controller A & B



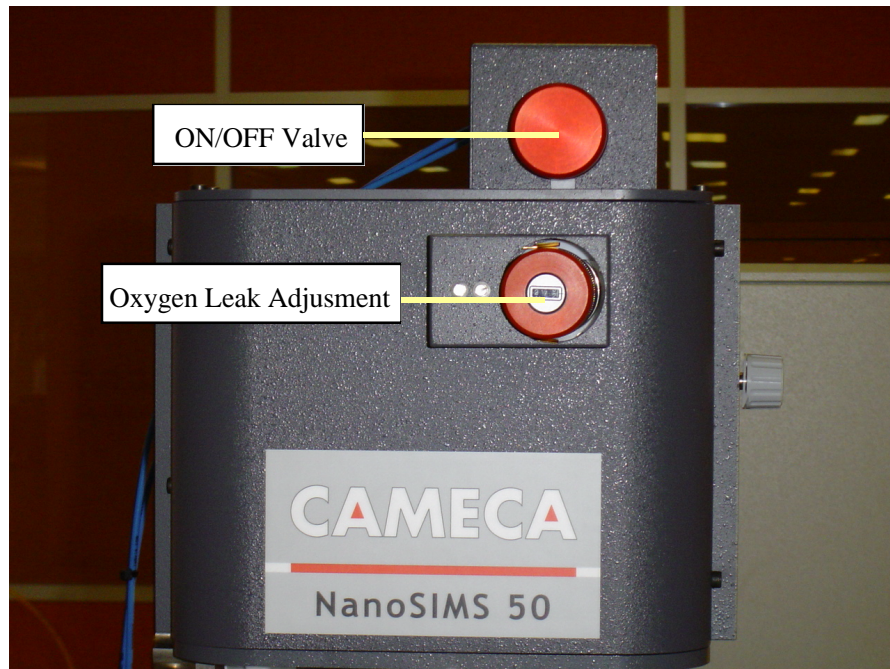
[summary](#)

## Cesium Controller

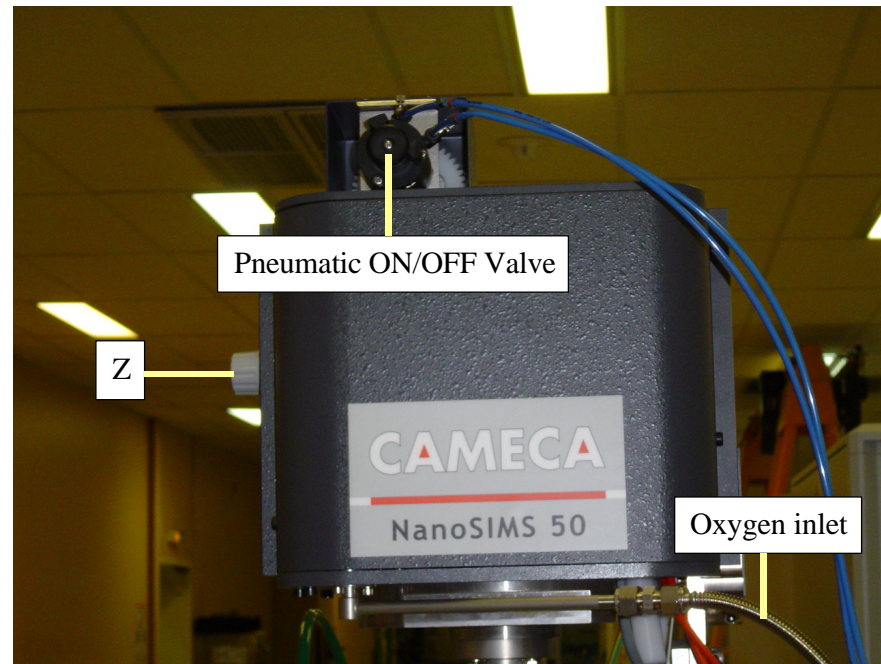


[summary](#)

## Duoplasmatron



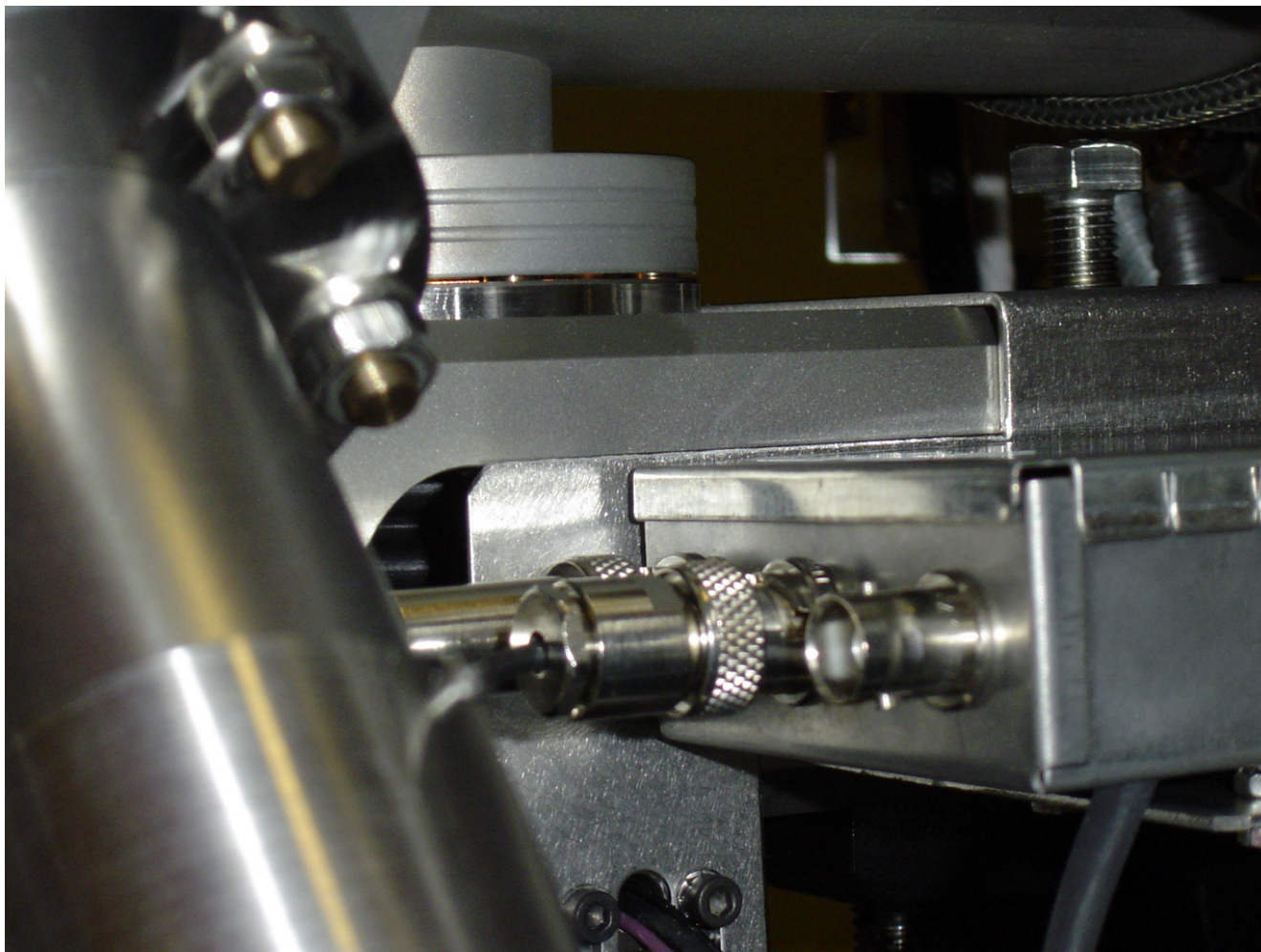
Manual N50  $\leq 112$



Automatic N50  $\geq 112$

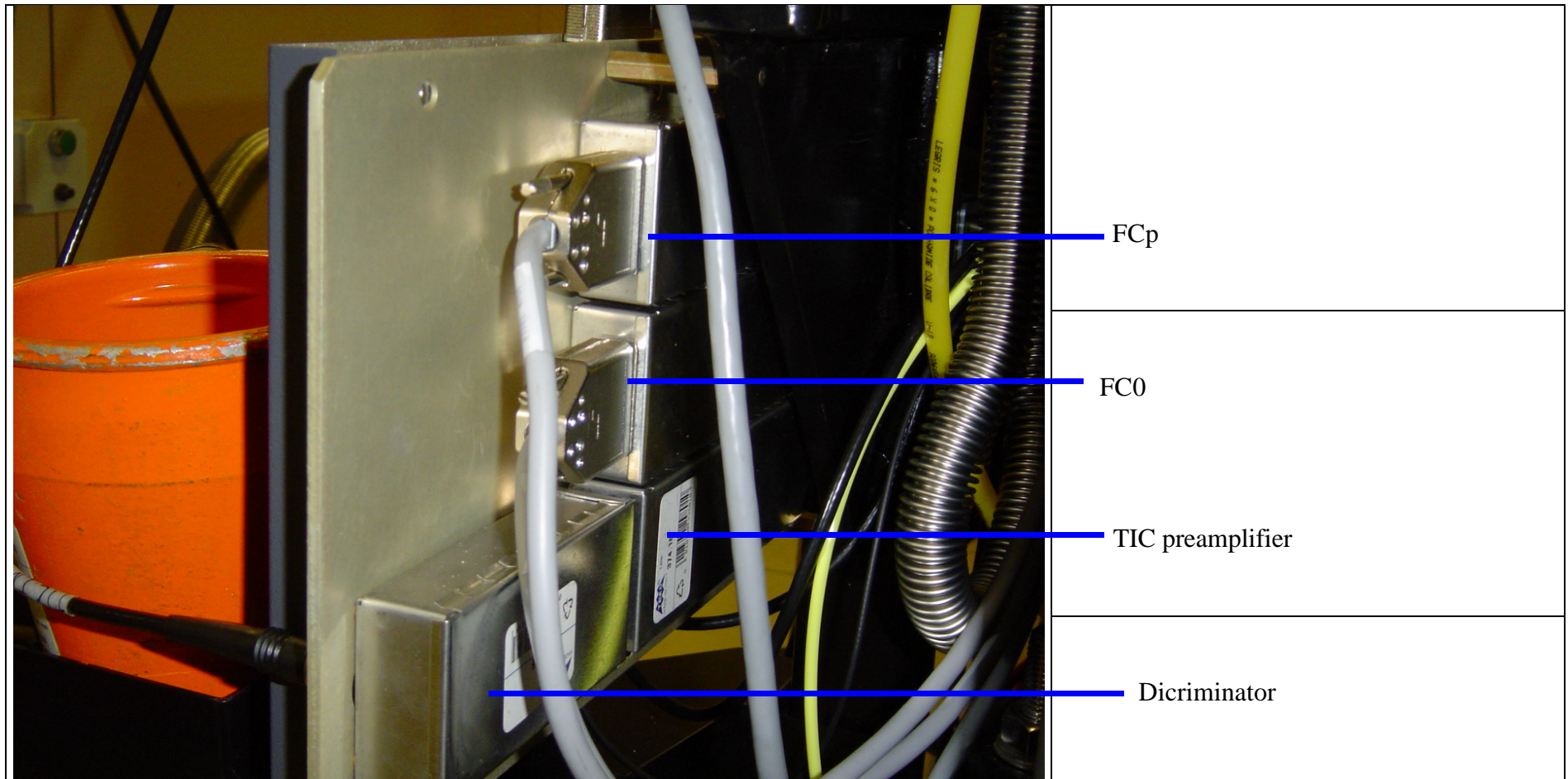
[summary](#)

### P.M. Preamplifier for secondary electron detection



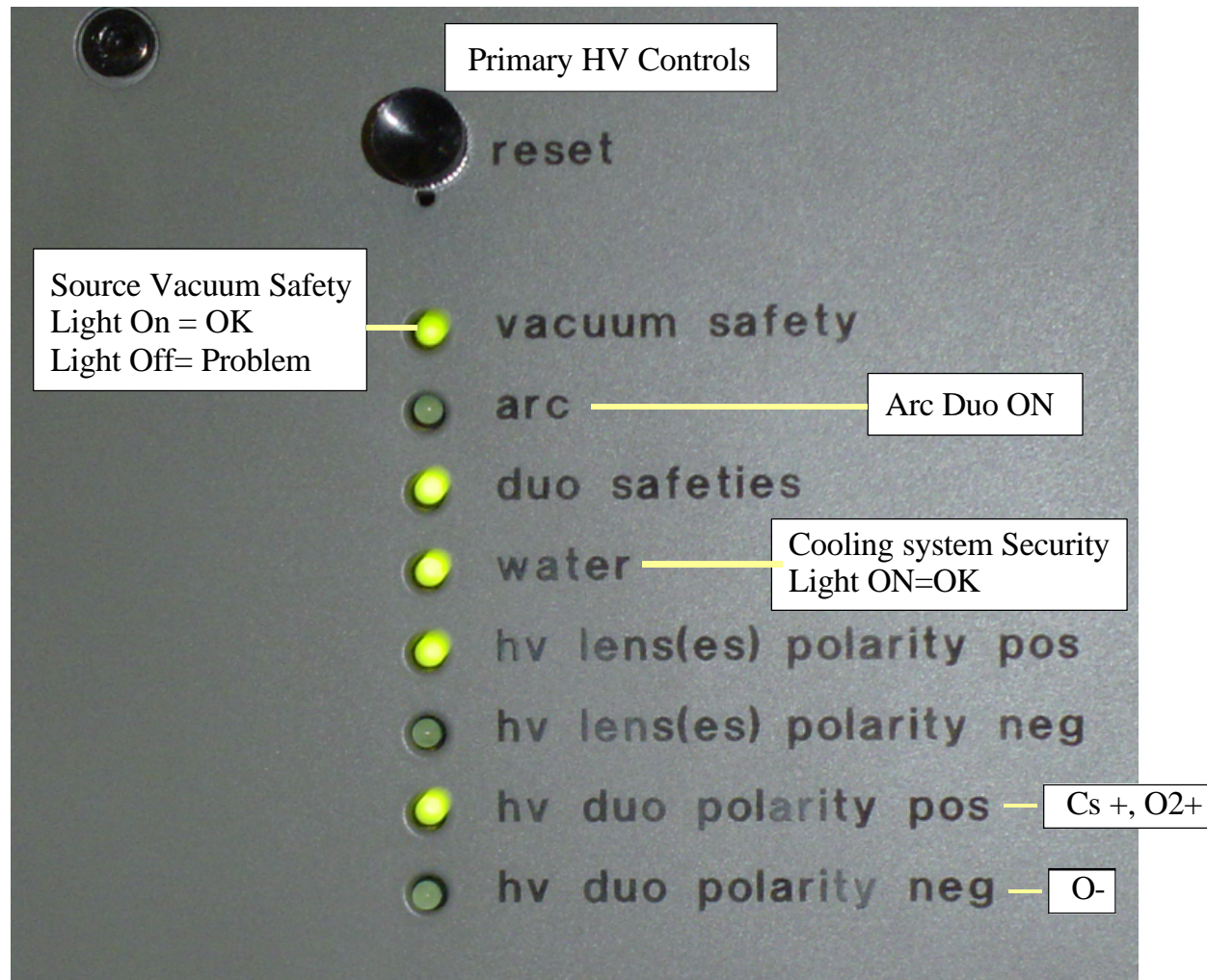
[summary](#)

## FCp, FC0 and TIC Preamplifier / Discriminator



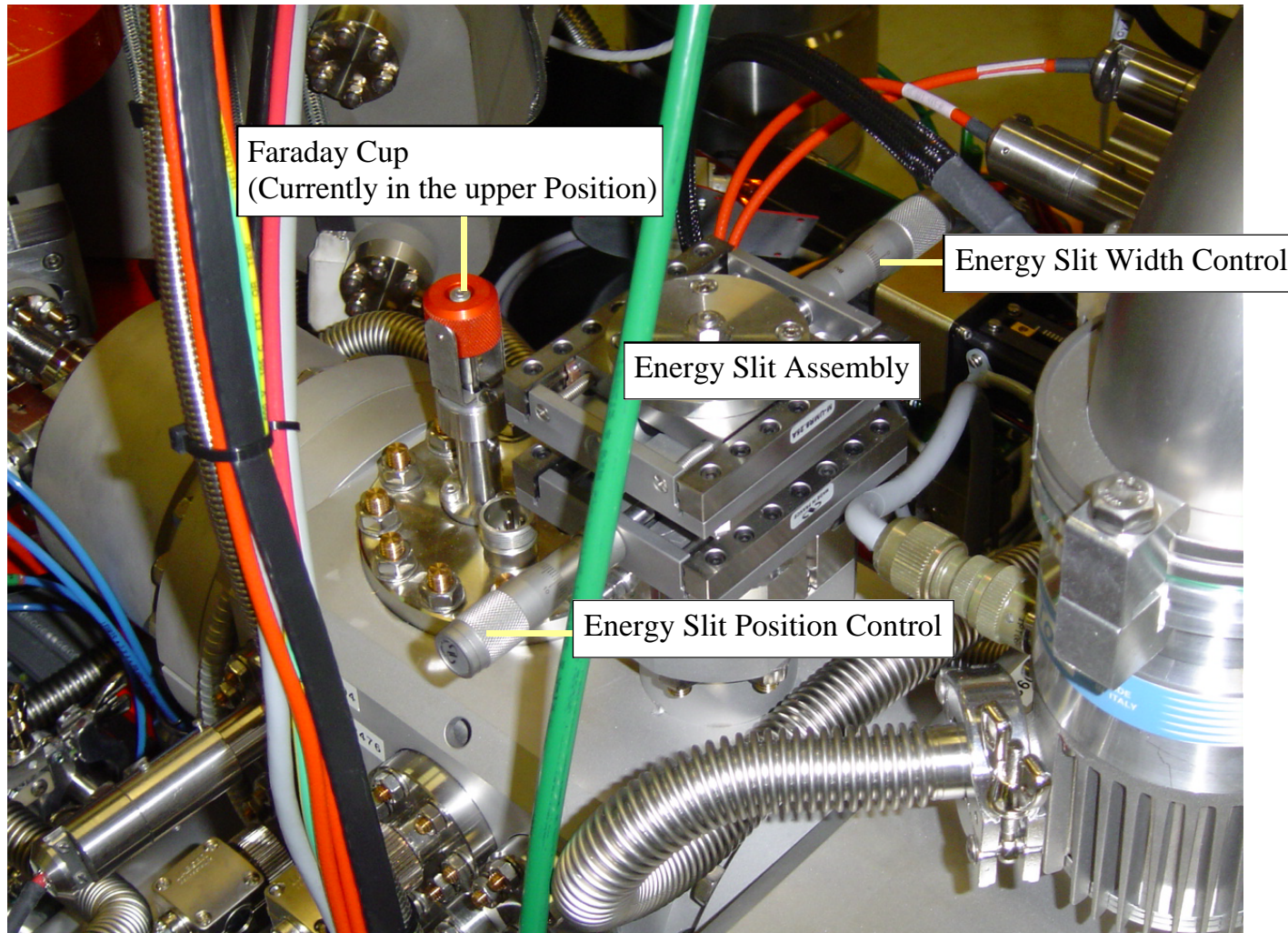
[summary](#)

## Primary HV Controls



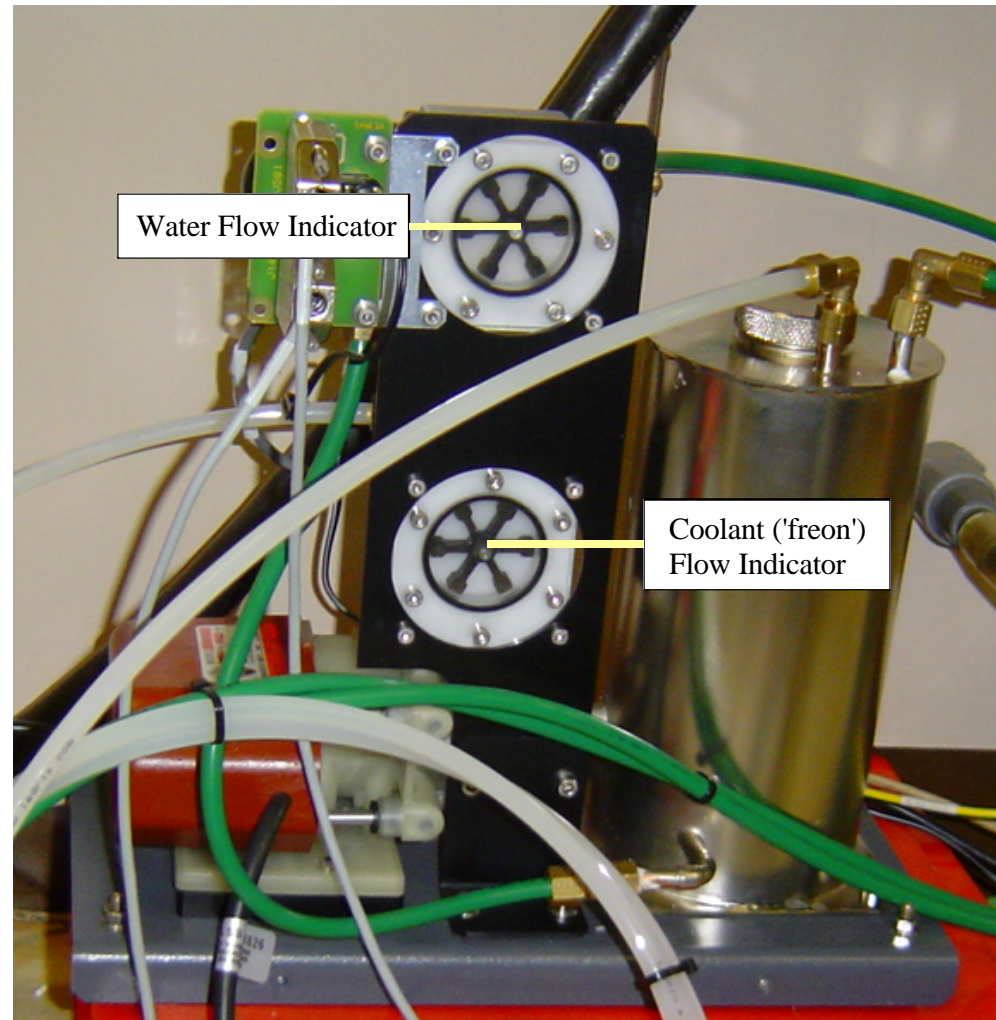
[summary](#)

## Energy Slit



[summary](#)

## Cooling System



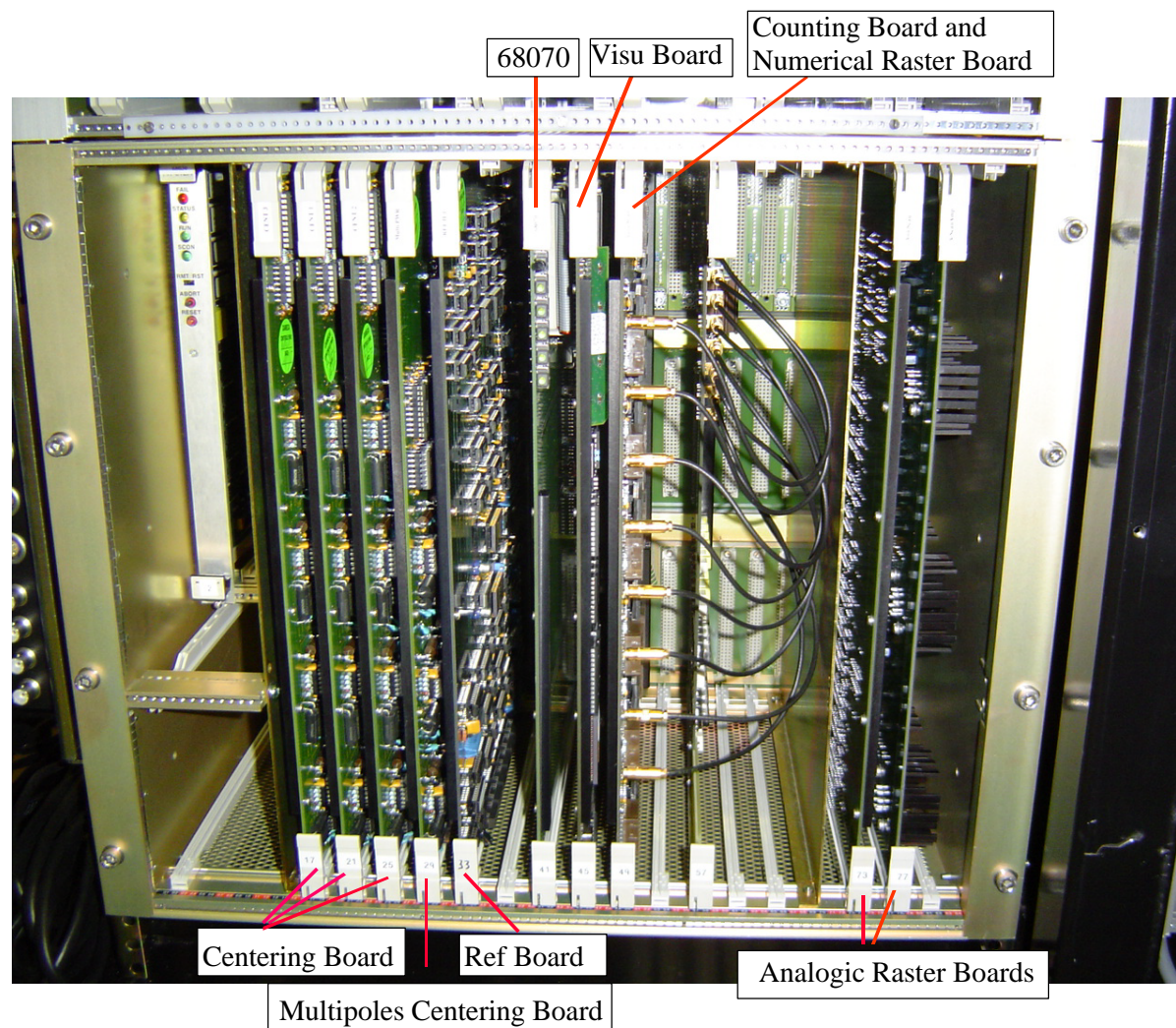
[summary](#)

## Electronics



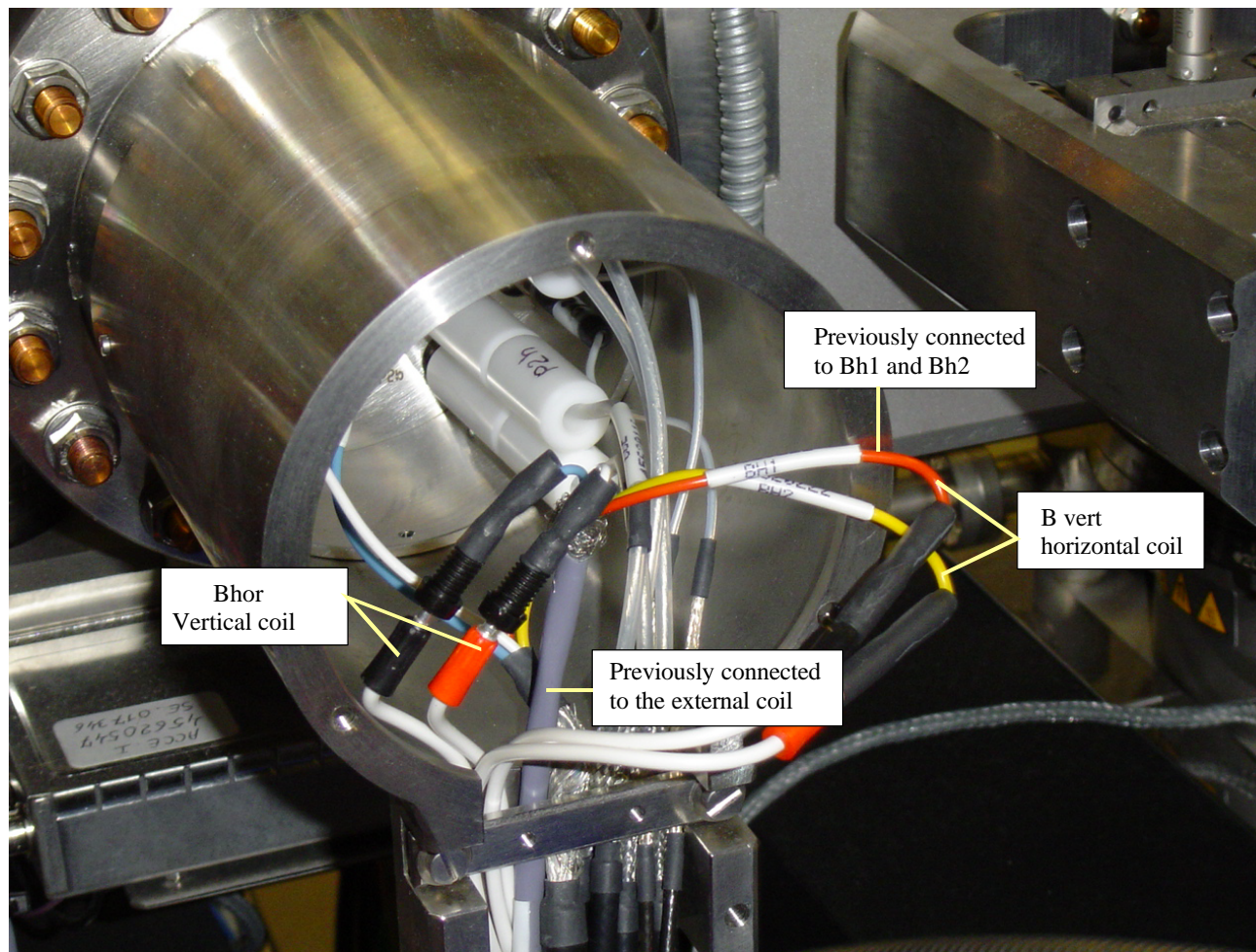
[summary](#)

## Real Time Unit



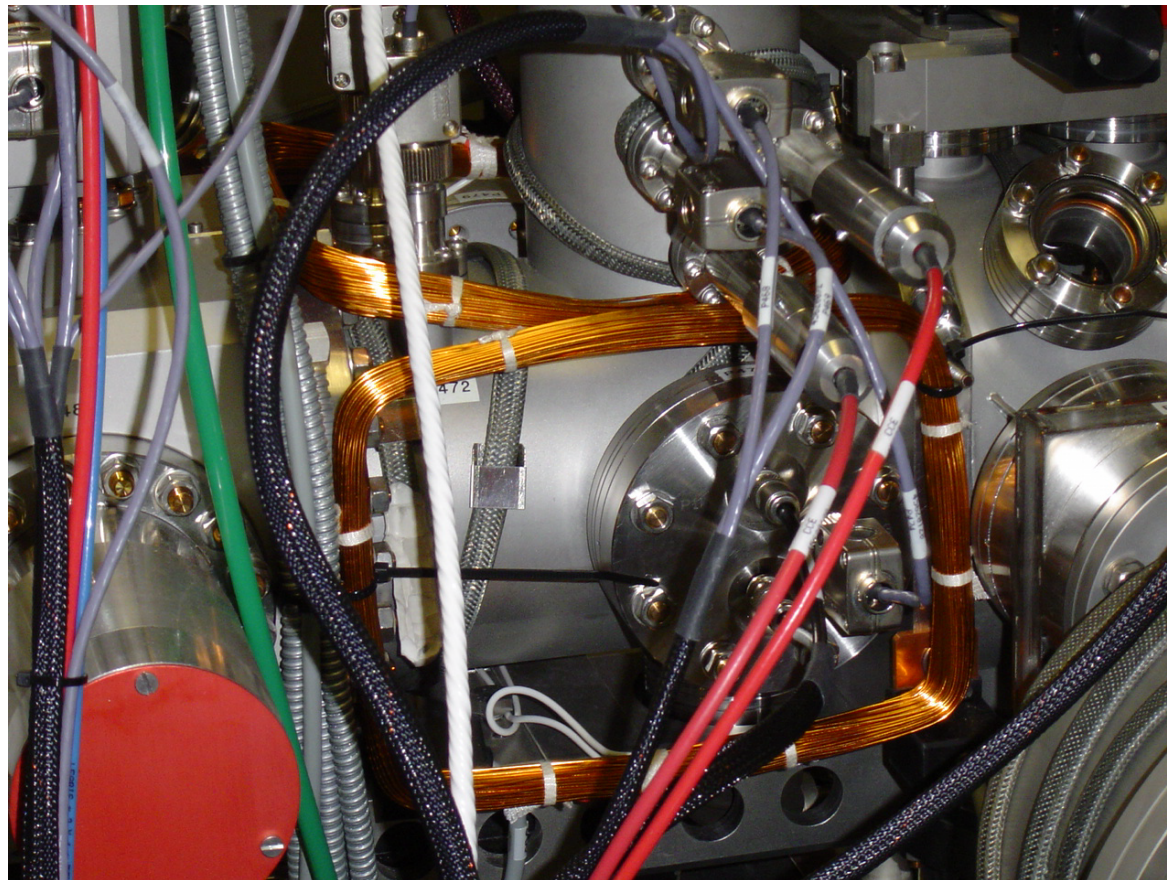
[summary](#)

## B1 , B2 and external coils



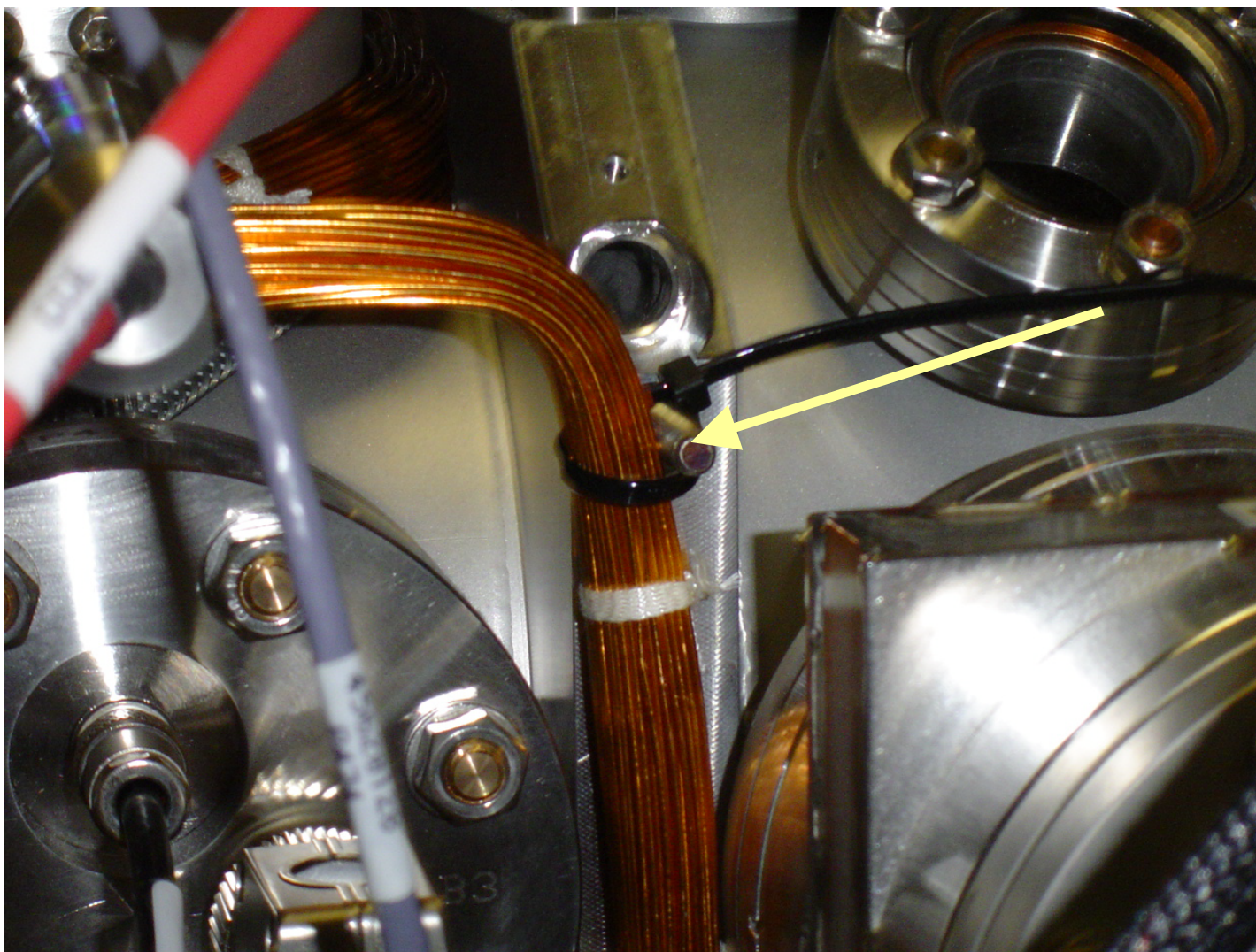
[summary](#)

## Vertical coil



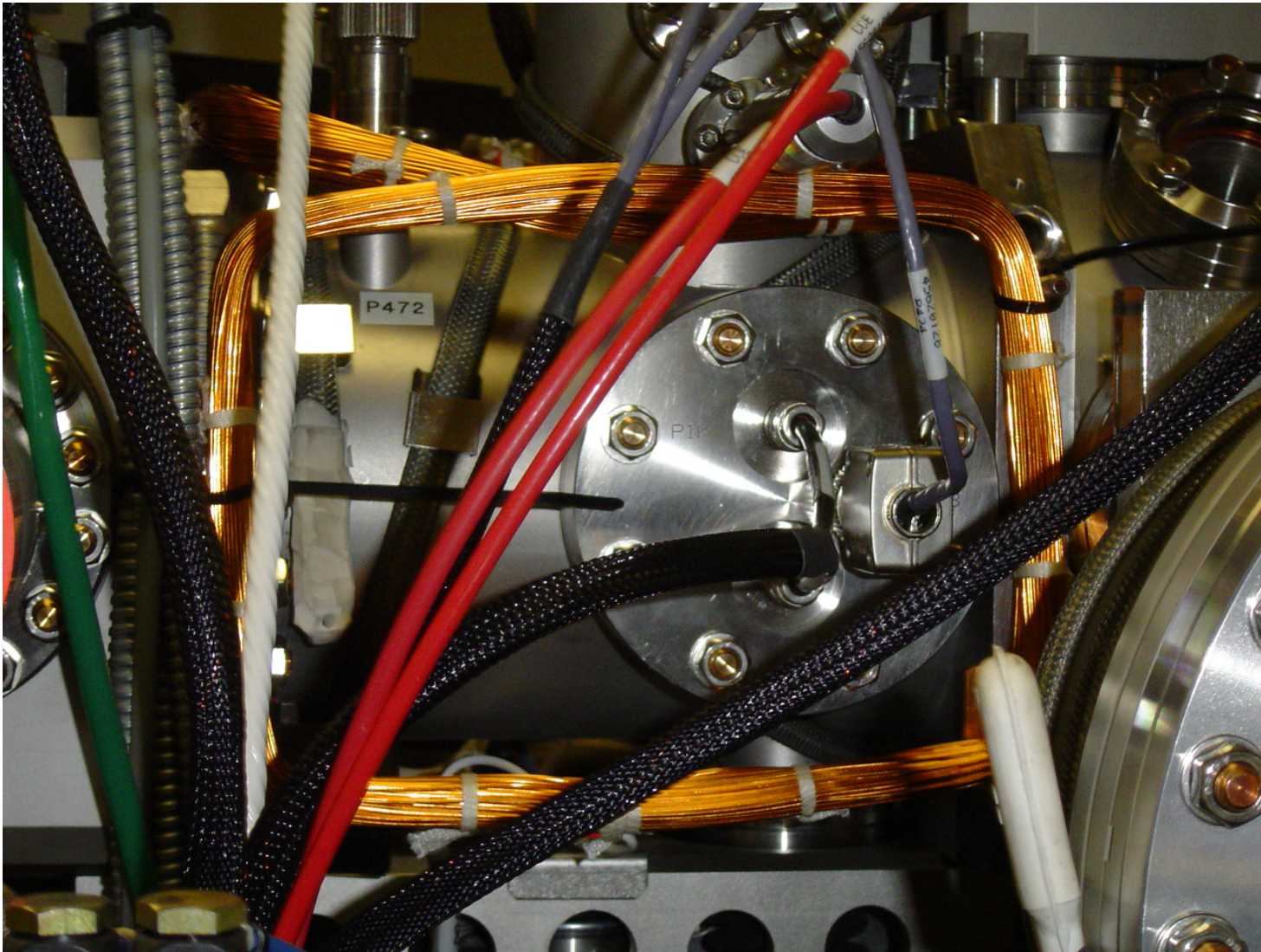
[summary](#)

Plug for the vertical coil



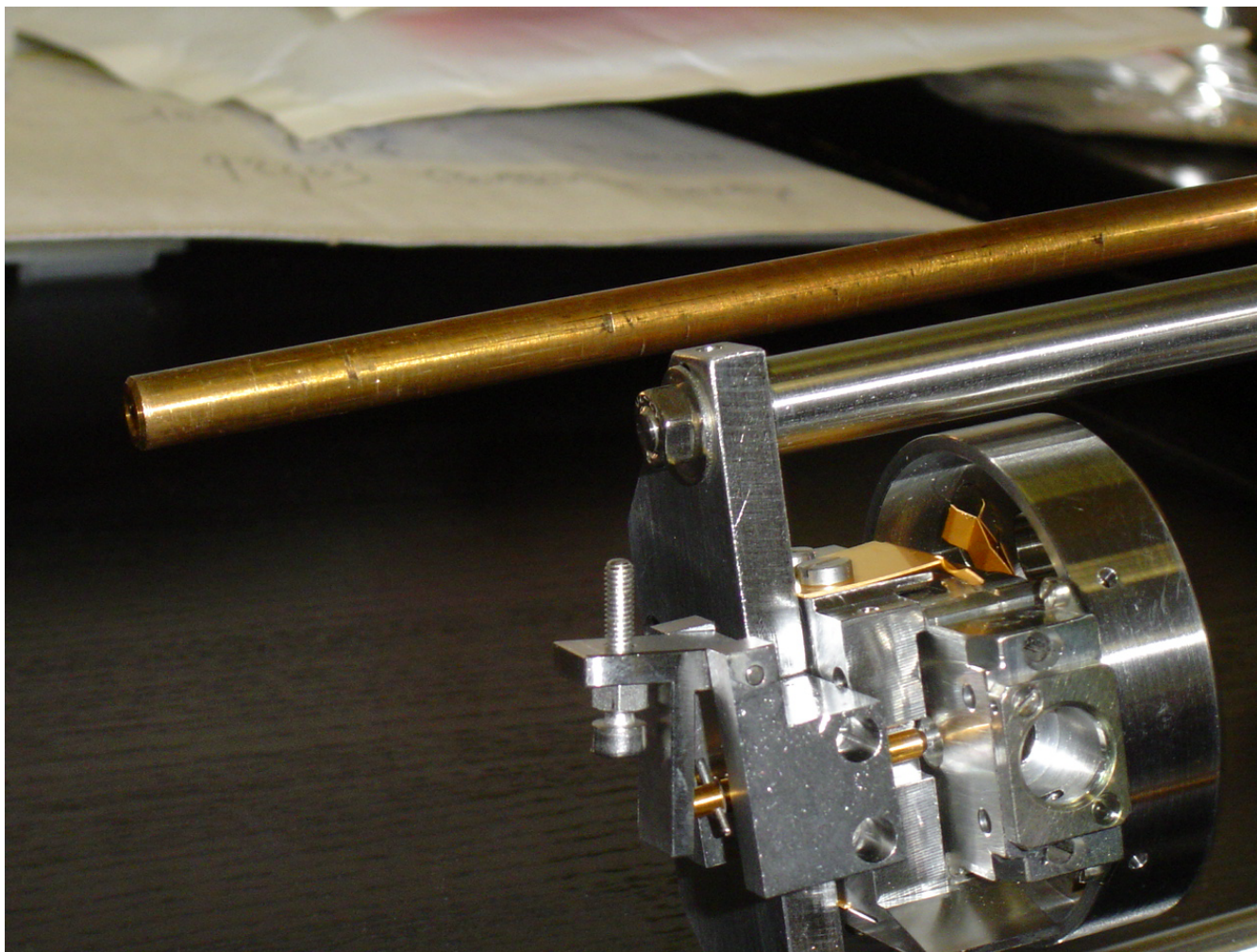
[summary](#)

## Vertical and horizontal coils



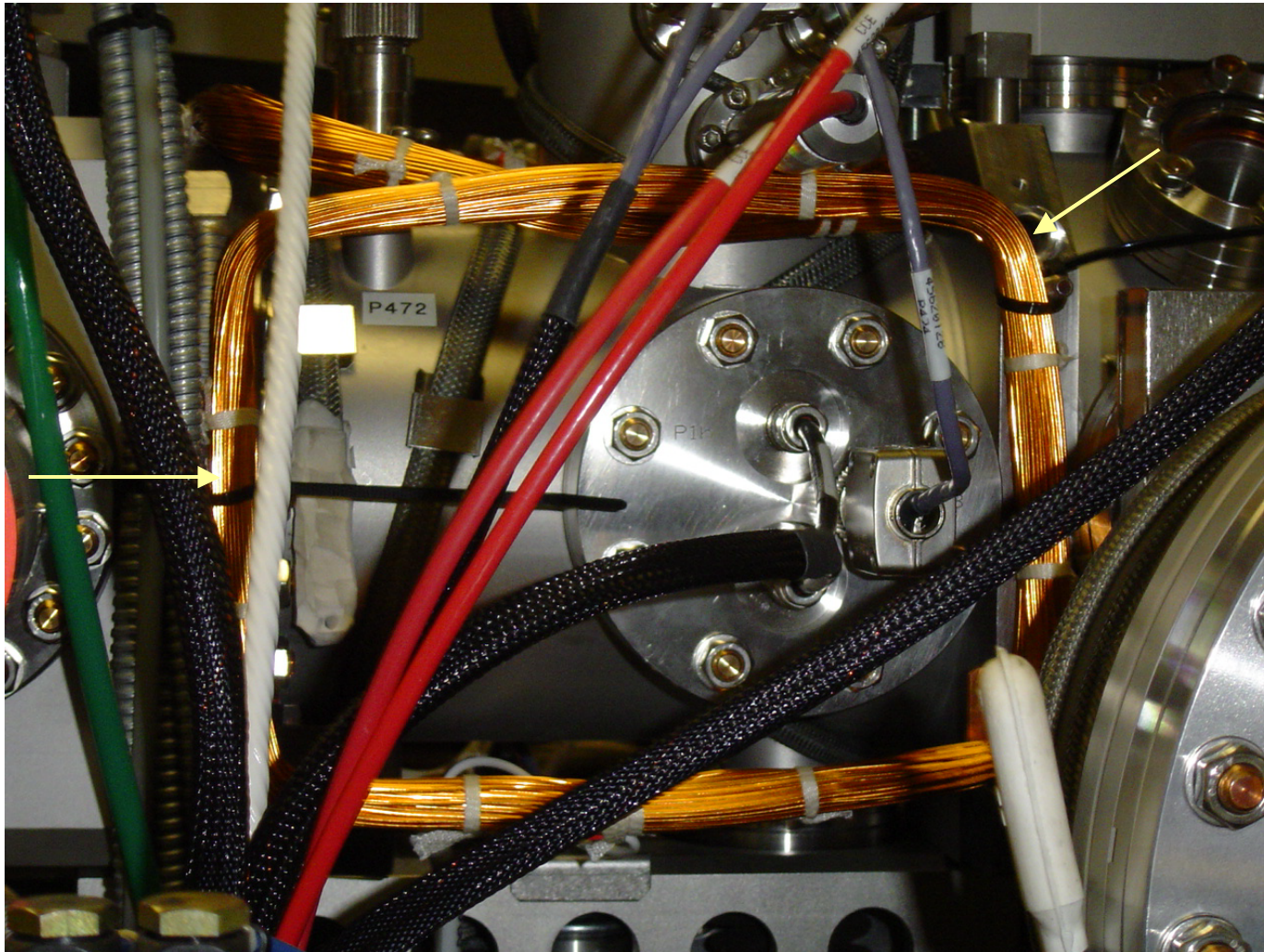
[summary](#)

## Sample Holder



[summary](#)

Plugs for the vertical coil



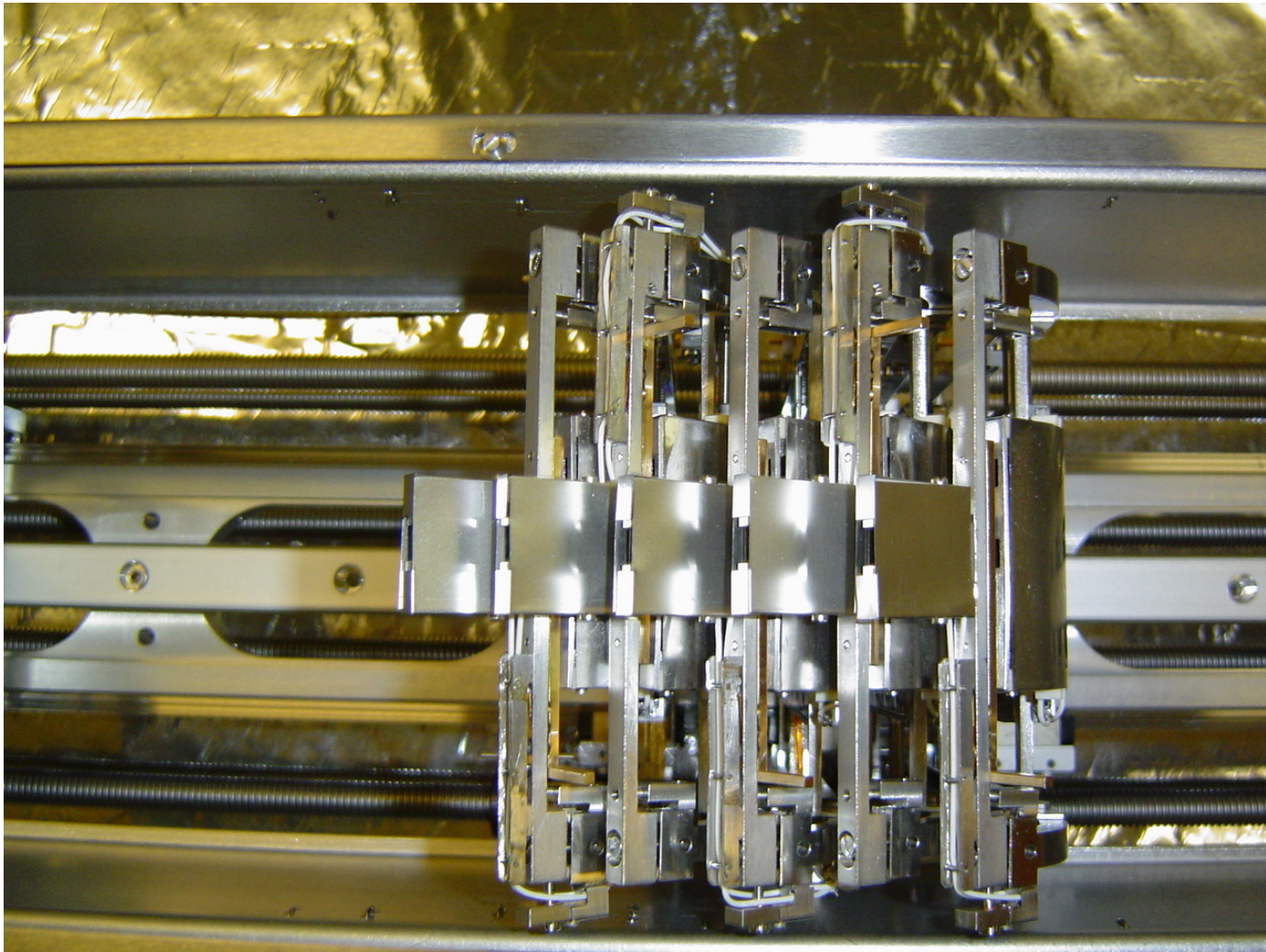
[summary](#)

**Troleys for the multicollecion system (Right view)**



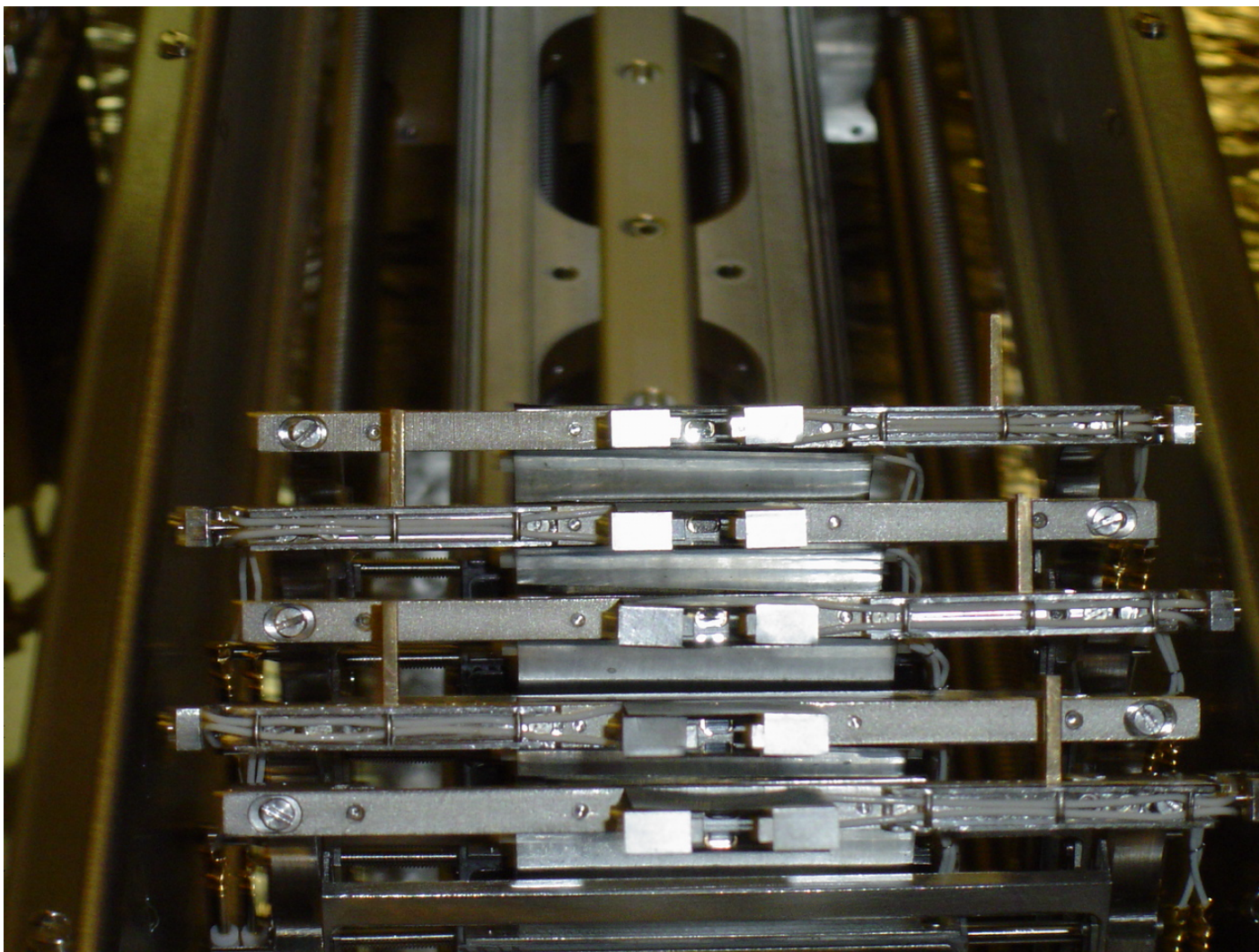
[summary](#)

**Troleys for the multicollection system ( Left View)**



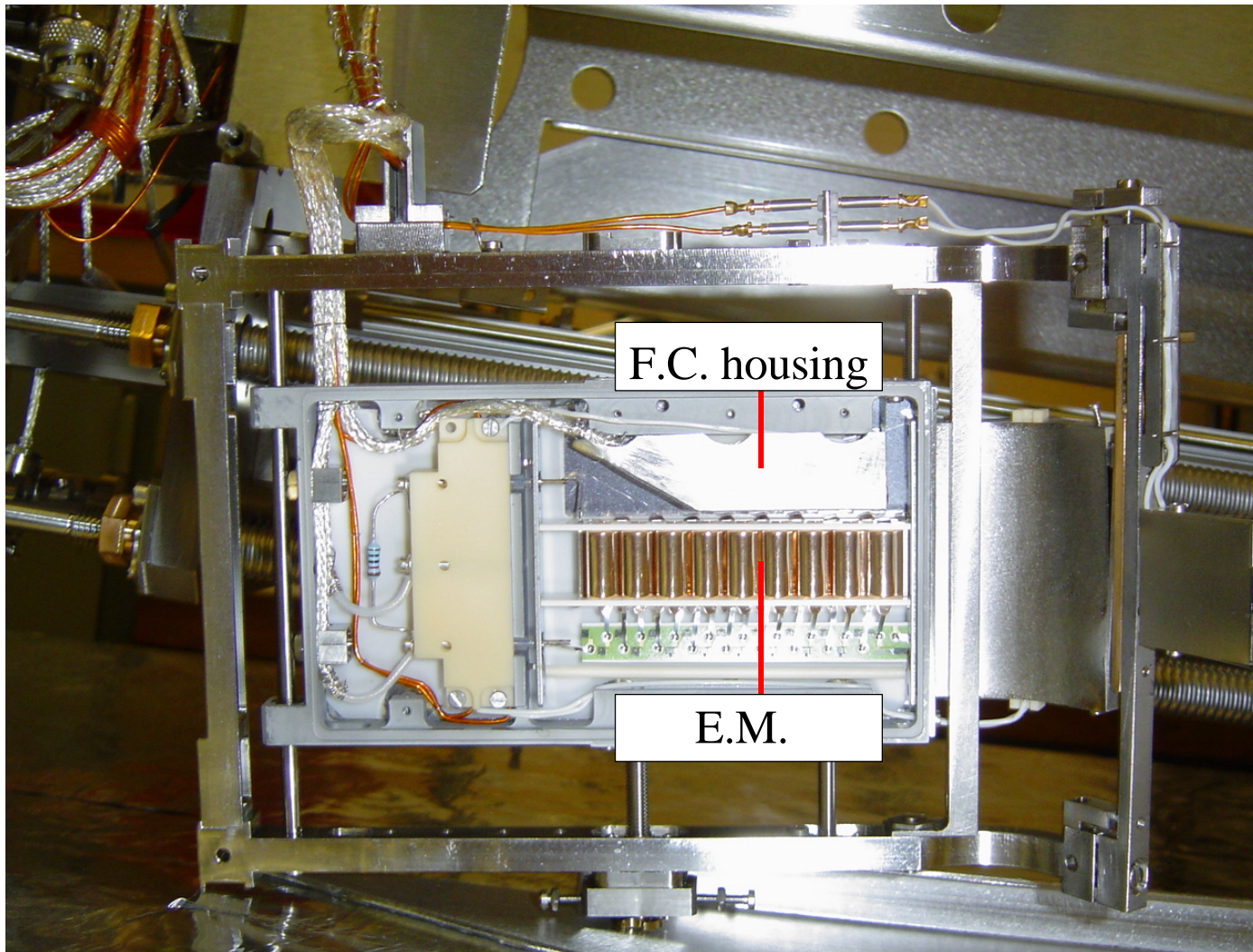
[summary](#)

**Troleys for the multicollecion system (top view)**



[summary](#)

## 1 Trolley for the multicollection system (EM &FC housing)



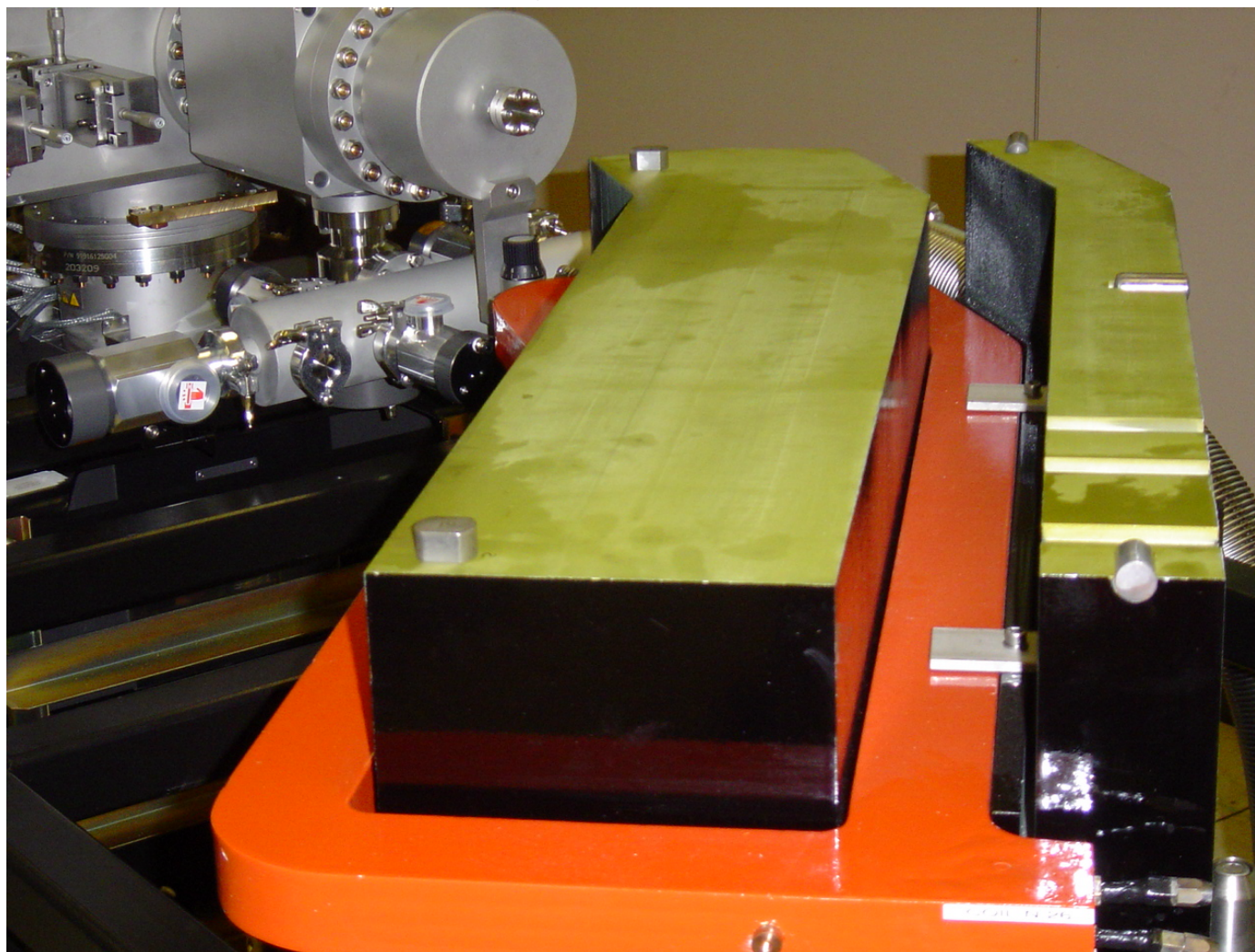
[summary](#)

## Magnet Pole Pieces



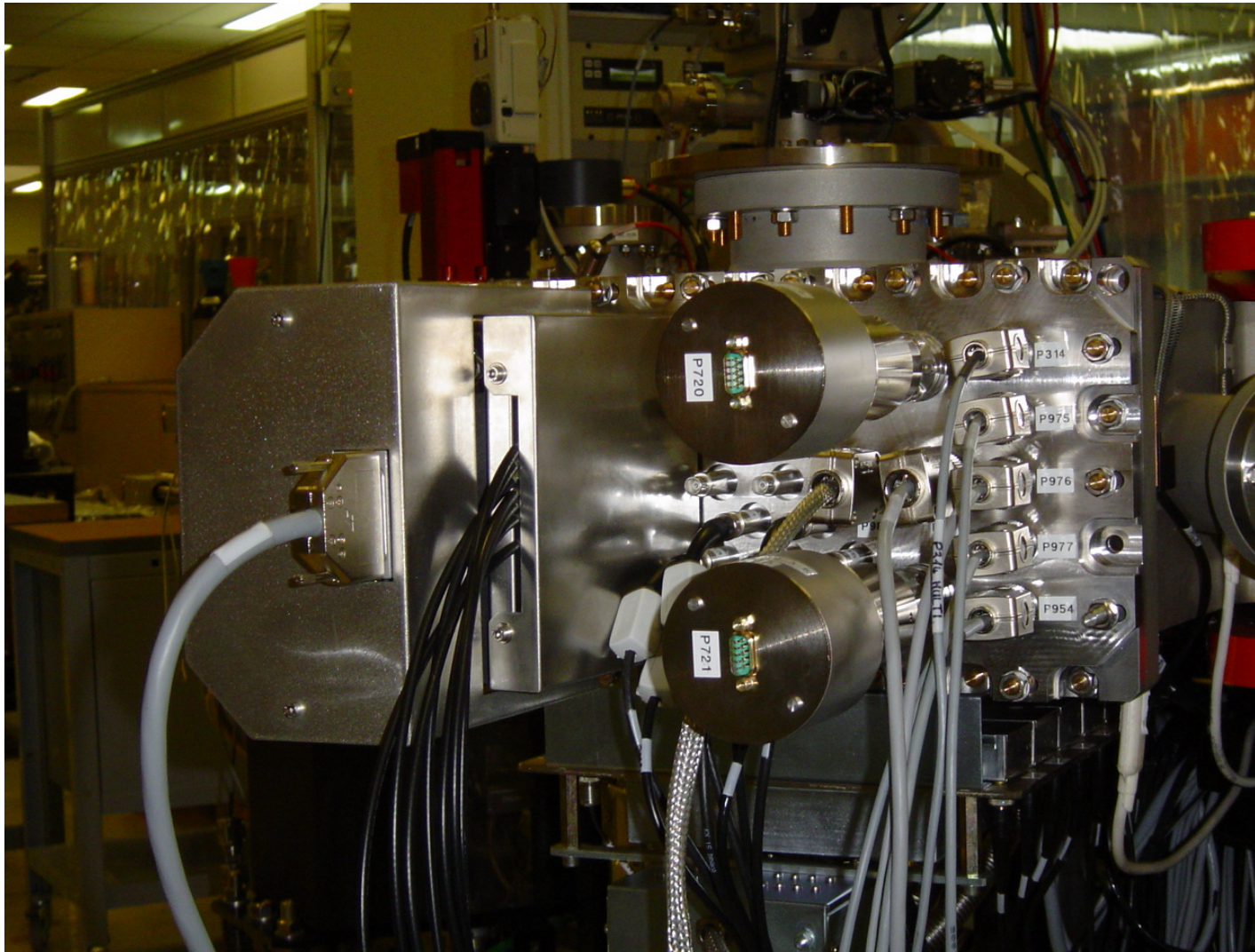
[summary](#)

## Magnet Pole Pieces



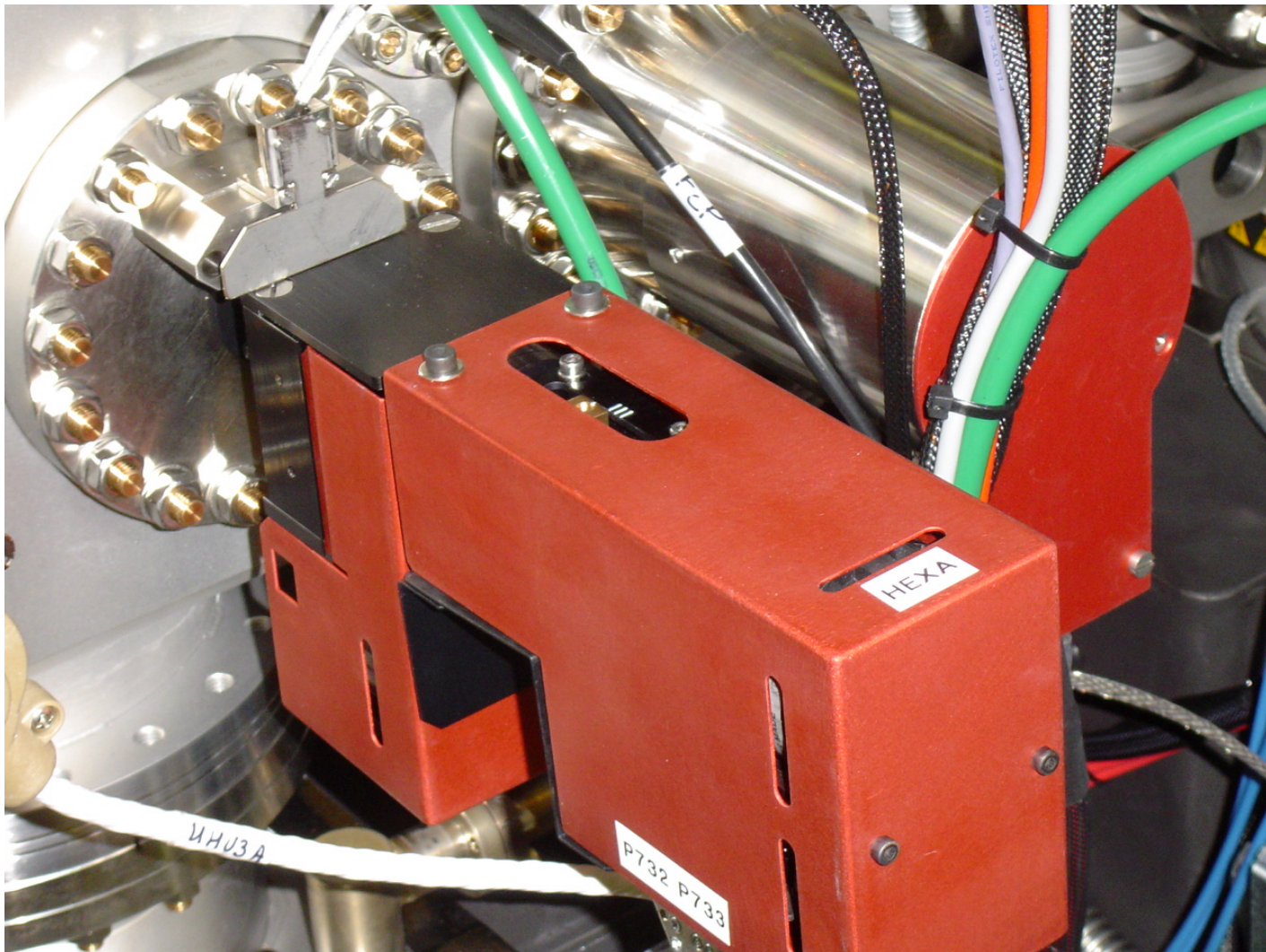
[summary](#)

## MulticollectionFlange



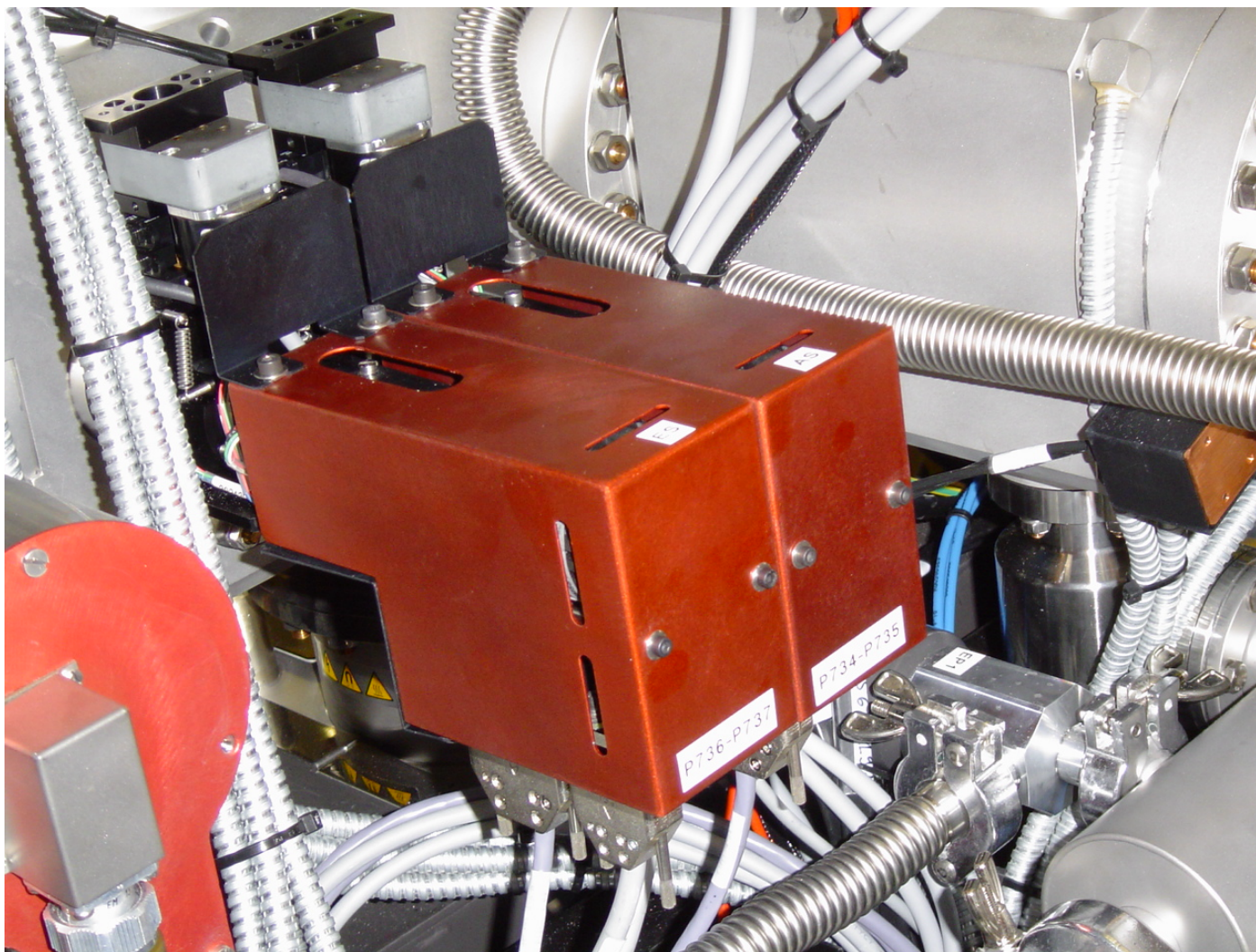
[summary](#)

Hexapole motor



[summary](#)

## E.S and FA motors



[summary](#)