Labotronics

Inductively Coupled Plasma Mass Spectrometer

LB-10ICPMS

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1. Introduction

Inductively Coupled Plasma Mass Spectrometer LB-10ICPMS provides a mass range from 2 to 260 amu for precise analysis of trace elements. It utilizes argon plasma to ionize samples, ensuring high ionization efficiency. It features an ETP detector and hexapole cell, ensuring accurate trace analysis by removing polyatomic interferences. Our spectrometer facilitates automated PC-controlled counting and stable plasma operation for high-sensitivity analysis.

2. Features

- High ionization efficiency
- Ultra-trace detection
- Stable axis calibration
- Flexible sampling options
- Advanced signal processing
- Durable construction
- Low background noise

3. Specifications

Model No.	LB-10ICPMS
Mass Range	2 to 260 amu
Testing Range	≥ 108
Sensitivity	Be ≥ 2×10^6 (cps/mg/L) In ≥ 35×10^6 (cps/mg/L) U ≥ 30×10^6 (cps/mg/L)
Detection Limit	Be ≤ 10 In ≤ 2 U ≤ 2 (ng/L)
Resolution	0.6 to 0.8 amu
Isotope Ratio	≤ 0.3% (107Ag/109Ag)
SNR	≥ 50×10^6 (Signal-to-Noise Ratio)
Quality Axis Stability	≤ 0.05 amu/24 h
Stability RSD	Short term ≤ 3% Long term ≤ 4%
Oxide Ion	≤ 3%
Double Charged Ion	≤ 3%
Background Noise	≤ 2 cps (full quality range)
Abundance Sensitivity	≤ 1×10^{-6} (low-quality end) ≤ 5×10^{-7} (high quality end)
Plasma Ion Source	Argon plasma
Collision Cell	Hexapole collision cell
Detector	Electron multiplier - ETP double-mode detector, electron multiplier with dynodes arranged in two parts
Mass Spectrometer Unit	Quadrupole mass spectrometer
Autosampler	Total: 250 cups, 50mL (10) + 15mL (240)
Gas Used	He/H2 and He/NH3 at 0 to 10mL/min
Sample Spray Chamber	Impact bead chamber (electronically cooled), quartz
Peristaltic Pump	3-channel
Plasma Torch	One-piece quartz torch, 1.5mm injector
Vacuum System	3 stages, with isolated turbopumps
Counting and Analog Switch	PC controlled
Chiller Connection Kit	Yes
High-Frequency Output	1.6KW
High-Frequency Power Supply	27 MHz, Solid state
Cooling Water	Single-phase 200 to 230 V, 50/60 Hz, 2 kW

Power Supply	Single-phase 200 to 240 V ± 10%, 50/60 Hz, 6 Kw
Dimension	1300 × 700 × 800 mm
Gross Weight	400 kg

4. Applications

Inductively Coupled Plasma Mass Spectrometer LB-10ICPMS is ideal for detecting trace elements, conducting food safety testing, and analyzing ultra-trace impurities in semiconductor materials. It also plays a crucial role in medical diagnostics and nuclear monitoring of radioactive elements.

5. Instrument Introduction

5.1 Functionality Overview

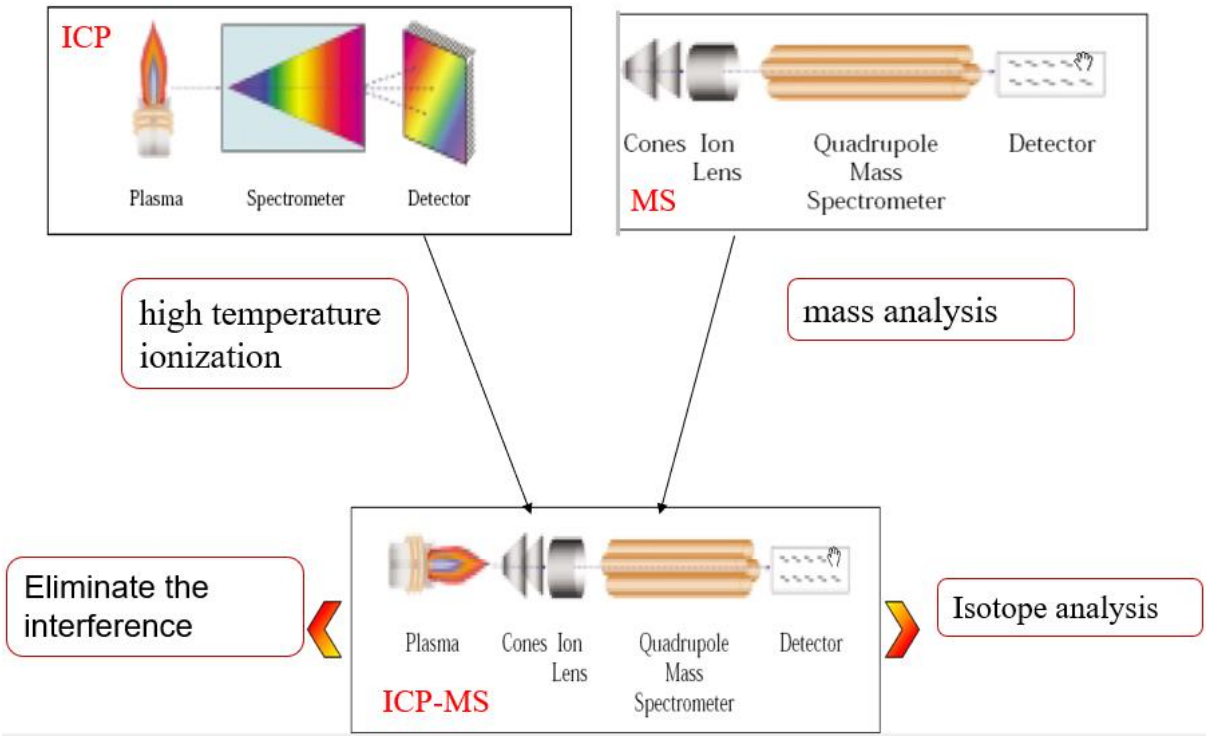


Figure-1

5.2 Instrument Composition

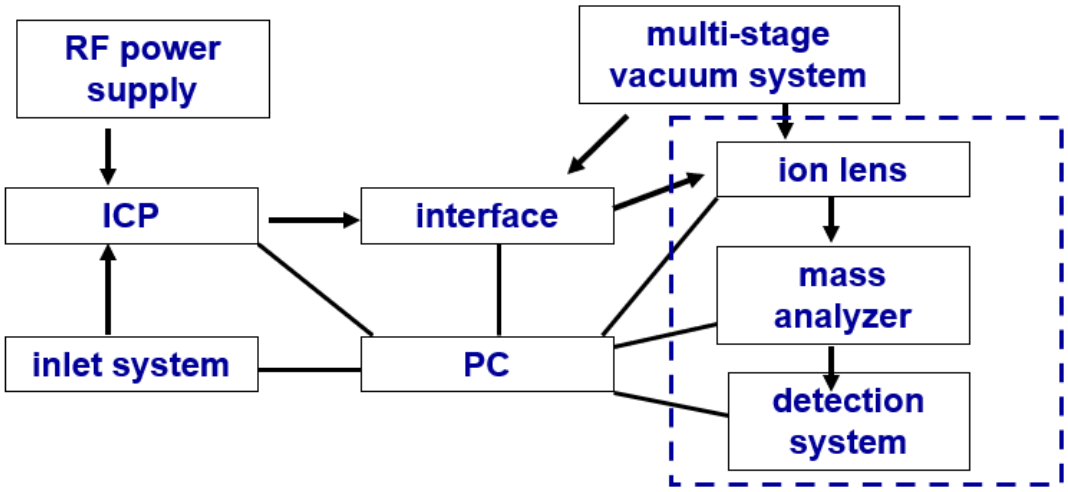


Figure-2

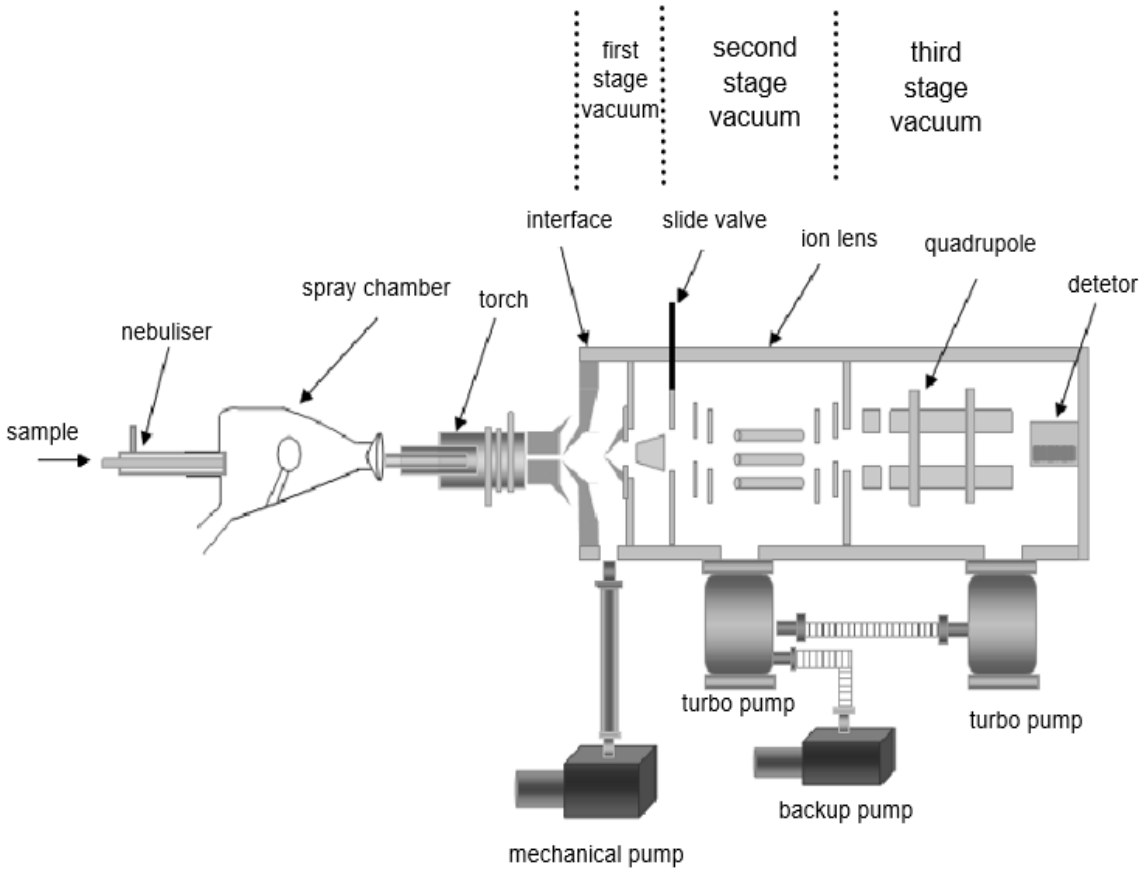


Figure-3

5.2.1 Sample Inlet Systems

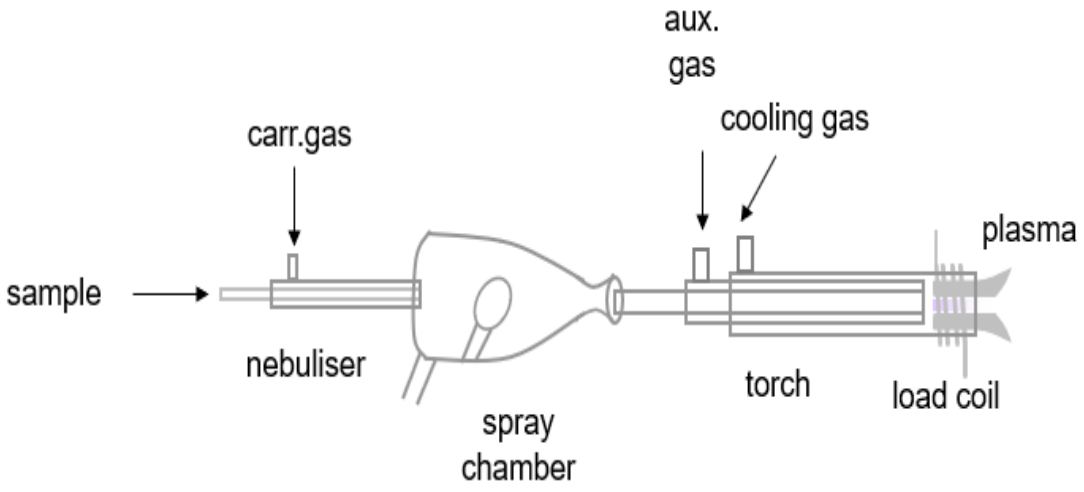


Figure-4

5.2.2 ICP Ion Source

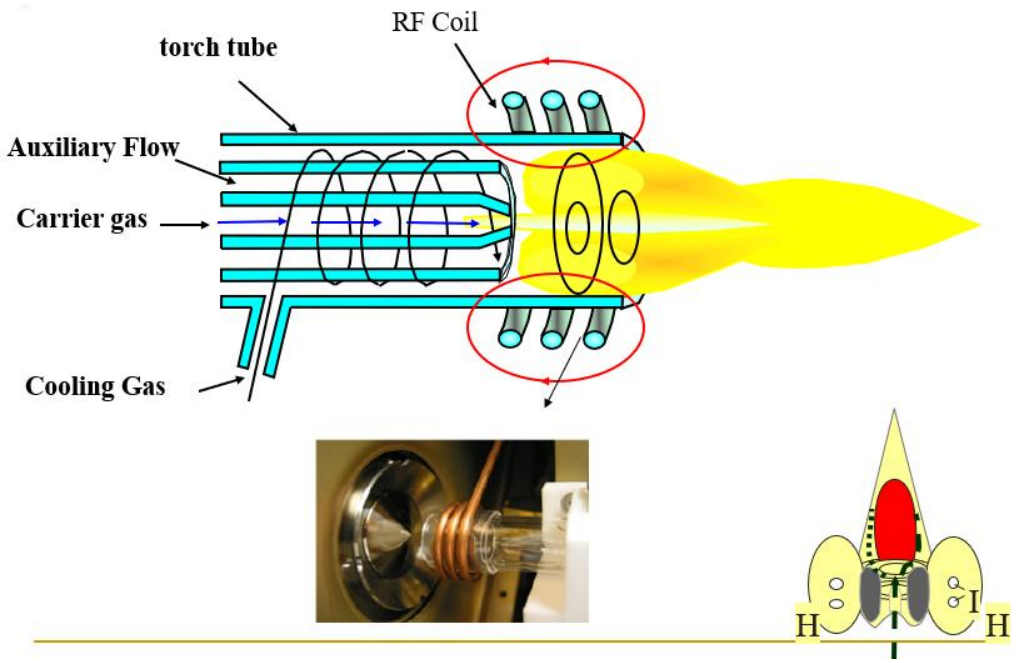


Figure-5

5.2.3 Interface

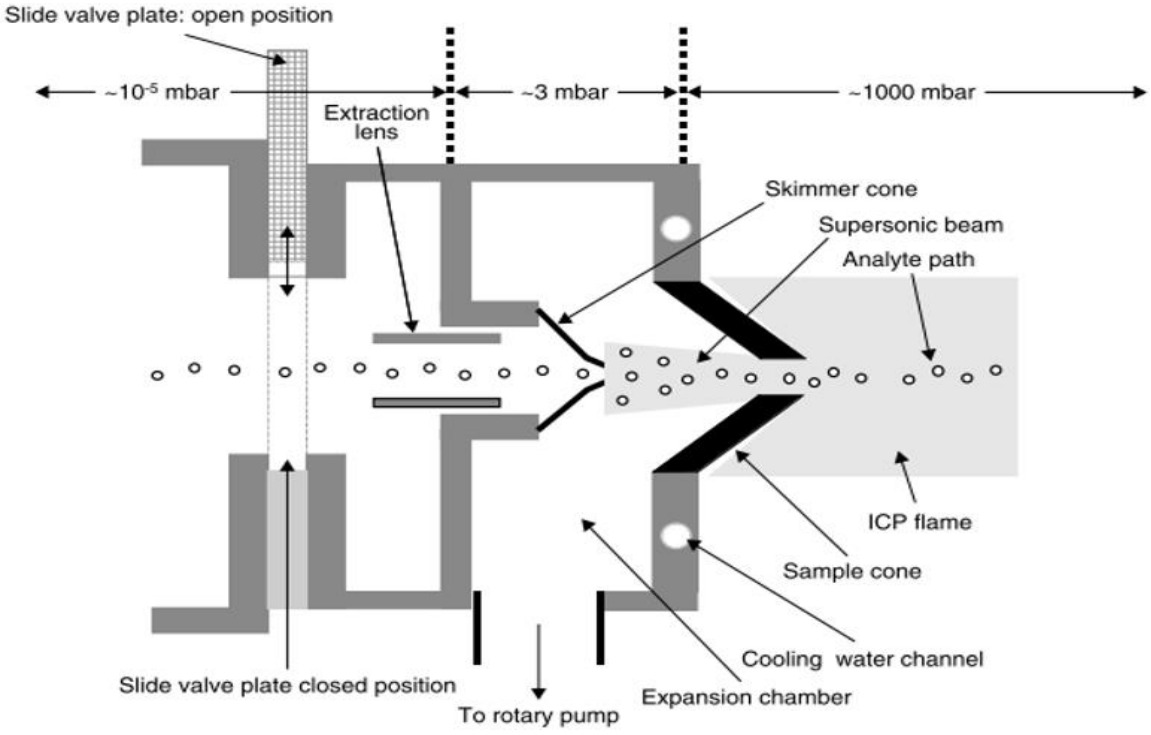


Figure-6

5.2.4 Lens Systems

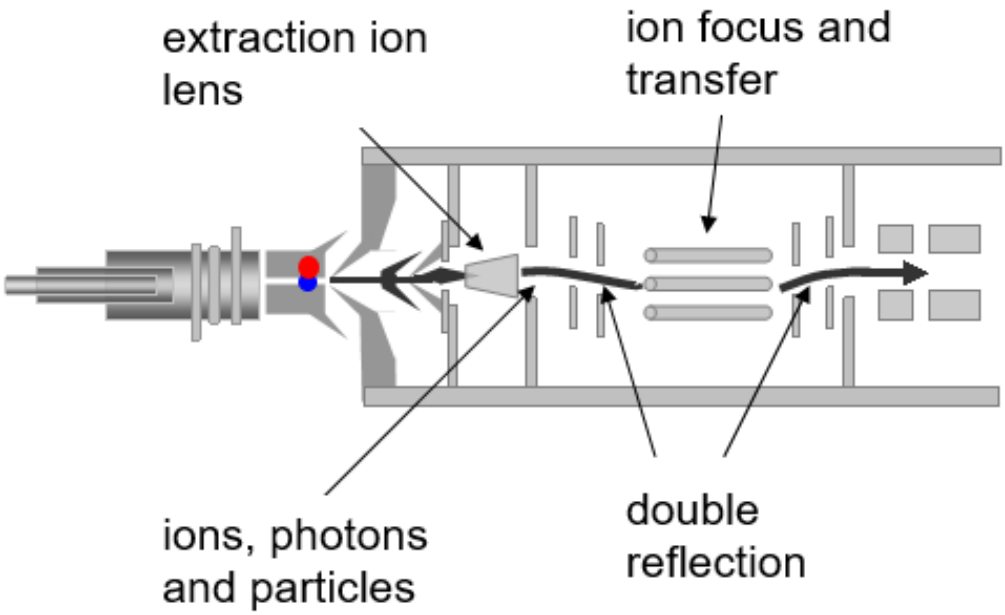


Figure-7

5.2.5 Quadrupole mass analyzer

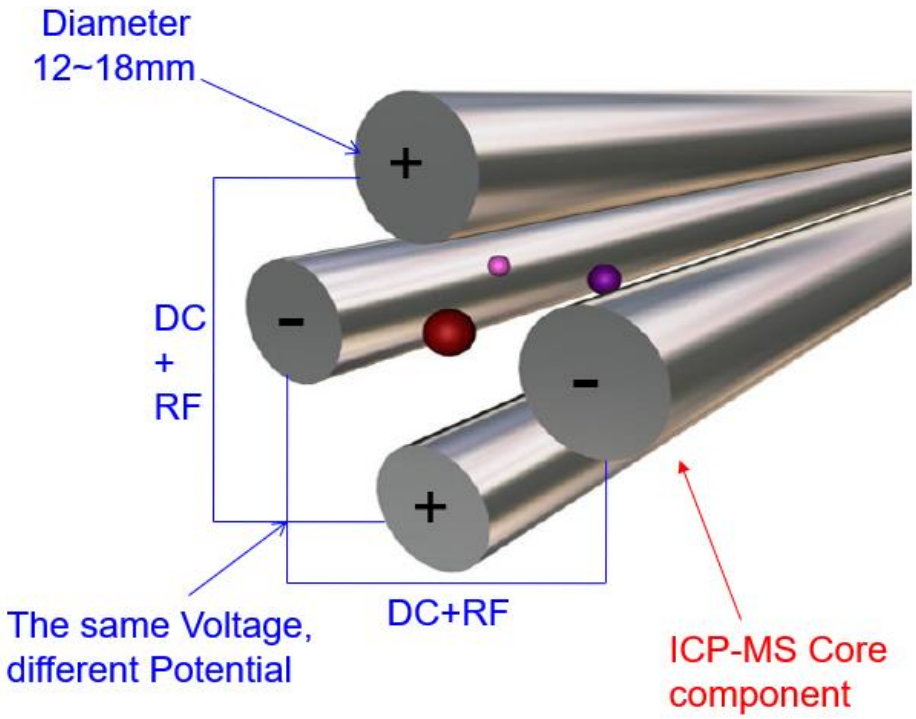


Figure-8

5.2.6 Moving Track of Ion

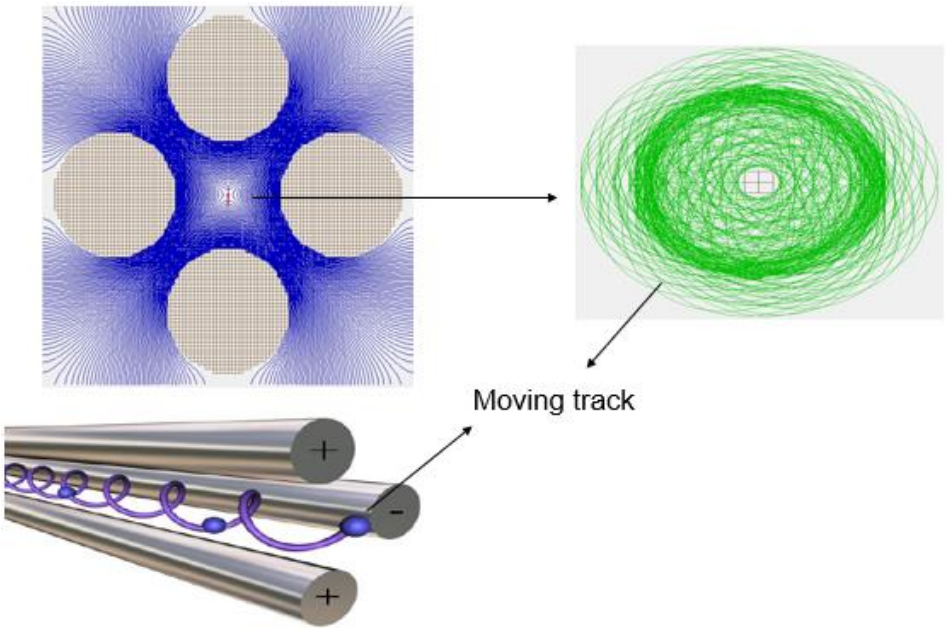


Figure-9

5.2.7 Ion detector

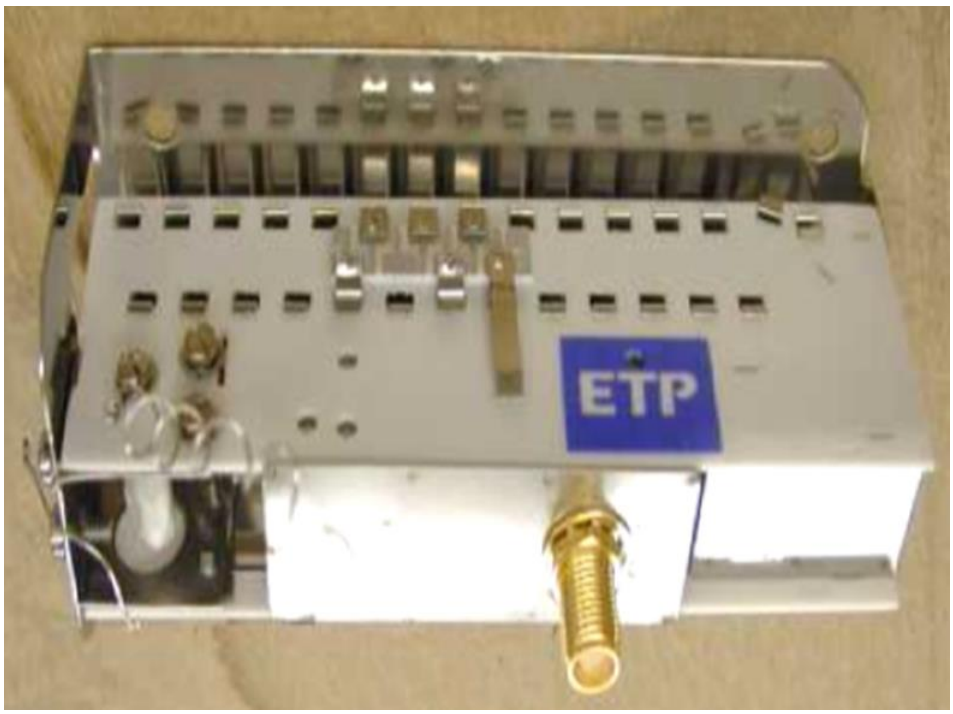


Figure-10 Discrete dynode electron multiplier (ETP)

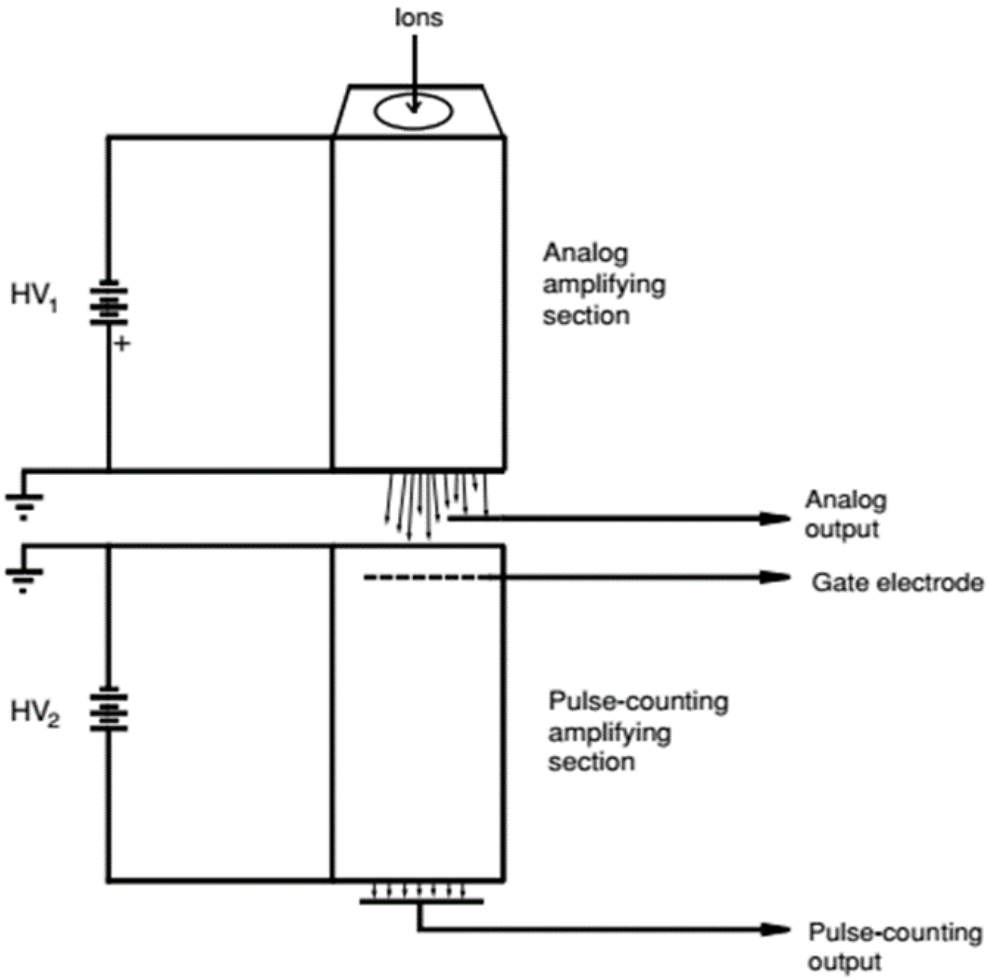

Ions
Analog
amplifying
section
HV1
+
Analog
output
Gate electrode
HV2
Pulse-counting
amplifying
section
Pulse-counting
output

Figure-11

6. Operations

6.1 Optimizing the signal

This chapter will guide you through the initial basic operational steps, including switching the instrument on, obtaining the first signal, and optimizing the instrument. The solution required for this practical 10 ppb tuning solution (Li, Co, Ce, In, U) is 1% HNO3.

Figure-12

6.1.1 Instrument Pre-Startup Status

Perform the following checks before switching the instrument into an operational state:

1) Ensure that glassware and cones are in position.
2) Check that the peristaltic pump tubing is in good condition and that the tubing is clamped.
3) Ensure that the air vents are opened.
4) Ensure that RF Power and Water tank Power are ON.
5) Ensure that the argon gas cylinder is opened.

6.1.2 Switching on the instrument

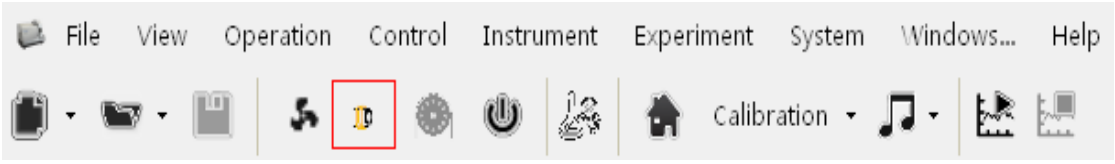


Figure-13

Click once on the Ignite button. The instrument will pass automatically through the start-up cycle which lasts approximately 90–120s.
The Status bar is showing in the left lower corner of the Main interface.

Figure-14

6.1.3 Select Control Parameter

1) Selected Scan Type

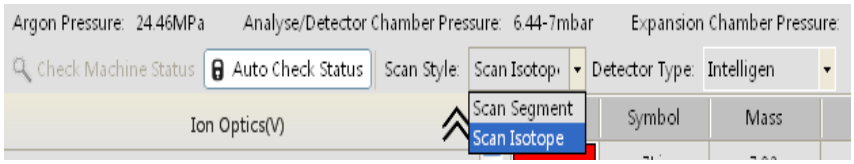


Figure-15

2) Selected Detector Type

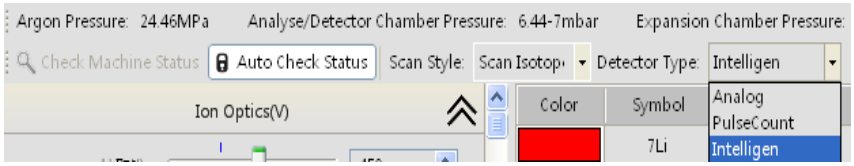


Figure-16

3) Add test isotopes

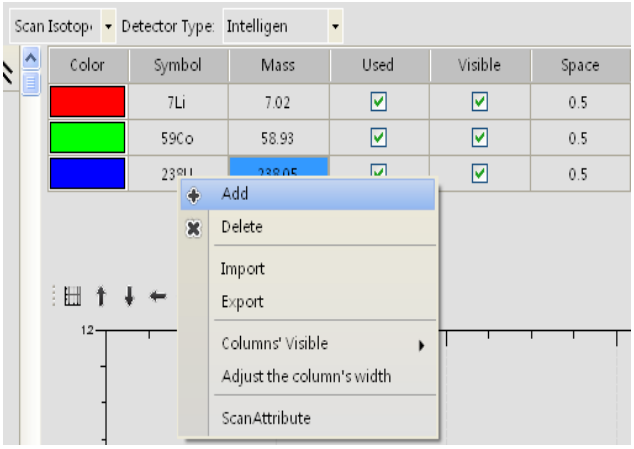


Figure-16

4) Input the right parameter of Space, Channel, and Dwell Time

Color	Symbol	Mass	Used	Visible	Space	Channel	Dwell Time(ms)	Resolution
	7Li	7.02	☑	☑	0.5	10	5	Standard
	59Co	58.93	☑	☑	0.5	10	5	Standard
	238U	238.05	☑	☑	0.5	10	5	Standard

Figure-17

5) Enter a Dwell time of 5 ms. Drag and drop can be used to fill down.

Color	Symbol	Mass	Used	Visible	Space	Channel	Dwell Time(ms)	Resolution
	7Li	7.02	☑	☑	0.5	10	5	Standard
	115In	114.90	☑	☑	0.5	10	5	Standard
	238U	238.05	☑	☑	0.5	10	5	Standard

Figure-18

6.1.4 Optimizing the Signal Manually

From this page, the correct configuration can be selected.
The user can optimize the signal either manually or automatically.
Usually, the Autotune option is used, but it is good practice to be familiar with the manual tuning process, which will be explained briefly. Optimize for the highest sensitivity while obtaining low levels of oxides and doubly charged species.

1) Click on the instrument icon to open this section.

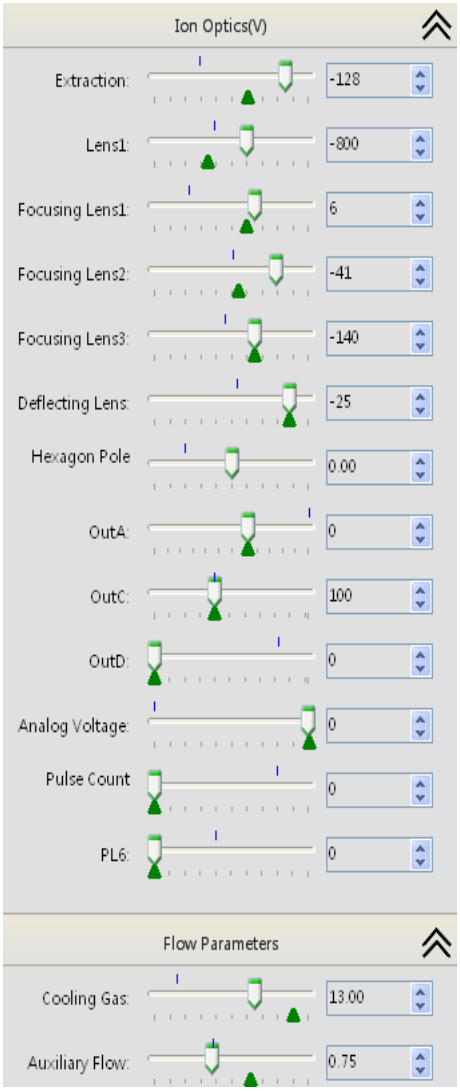


Figure-19

2) Click on the **Hide/Show** button to either hide or show the manual slide controls. The setting of the Hide/Show button is remembered on a per-user basis from the Windows log-on.

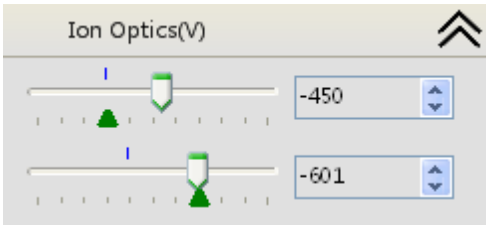


Figure-20

3) Show "**Ion Optics**". These parameters are the most common ones for tuning and have the greatest effect on signal stability and sensitivity.
4) Use the slider to select the default settings as shown.

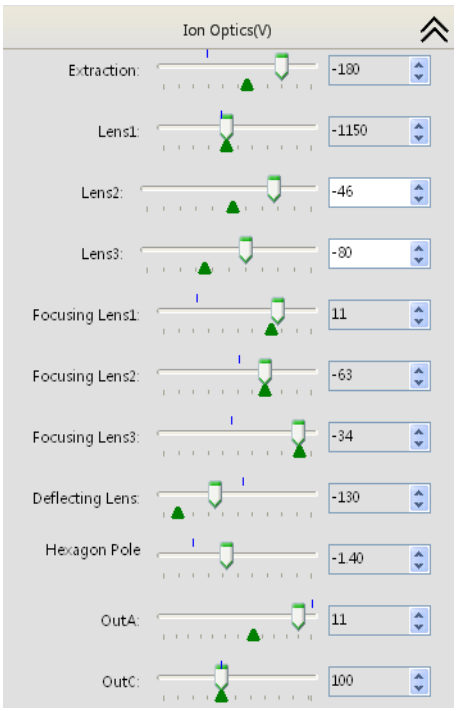


Figure-21

5) Click the scan button  , to start the Real Time Display (RTD).
6) The voltage will be changed when the slider is released. Assuming that the torch is generally centered on the sample cone, start with the Extraction Lens, followed by Lens 1, Lens 2, Lens 3, Focusing Lens 1, Focusing Lens 2, Focusing Lens 3, then the hexagon pole, monitoring how the signal changes with each adjustment. Continue adjusting each of the lenses in sequence, until the optimum signal has been obtained.
7) Click on **"Torch Position"** for fine adjustment of the tuning. The horizontal and vertical positions of the torch box might need re-positioning slightly when using different torch types or if the torch has been replaced.

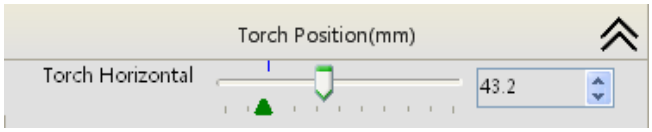


Figure-22

6.2 Instrument Calibration

This chapter will guide the user through all steps of instrument calibration. The instrument calibration wizard allows you to adjust the mass calibration, as well as the detector calibration to ensure a good wide dynamic range with a cross calibration of the pulse counting and analog modes of the detector.

6.2.1 Mass calibration

The software uses a mass calibration equation so that when a mass is selected for measurement, the control electronics can set the quadrupole to transmit that mass. The mass calibrations are stored such that any experiment can access them when the experiment is being run.

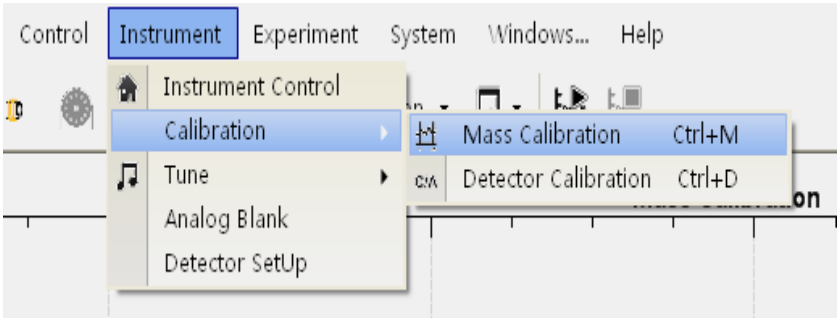


Figure-23

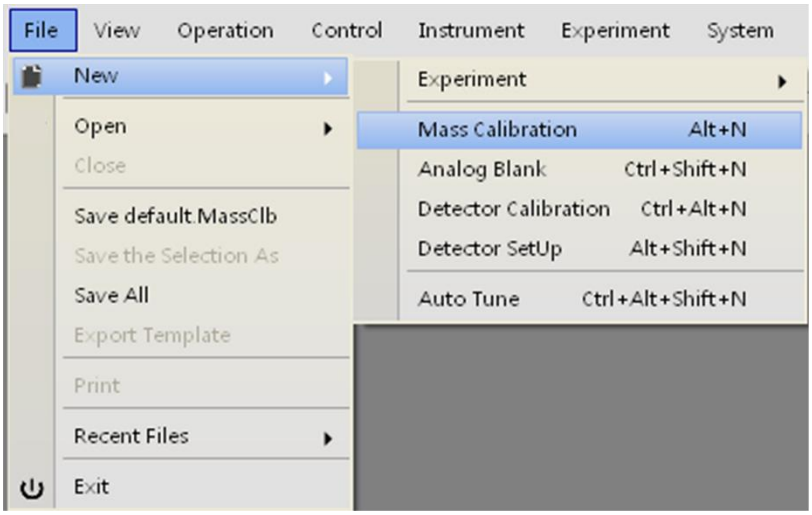
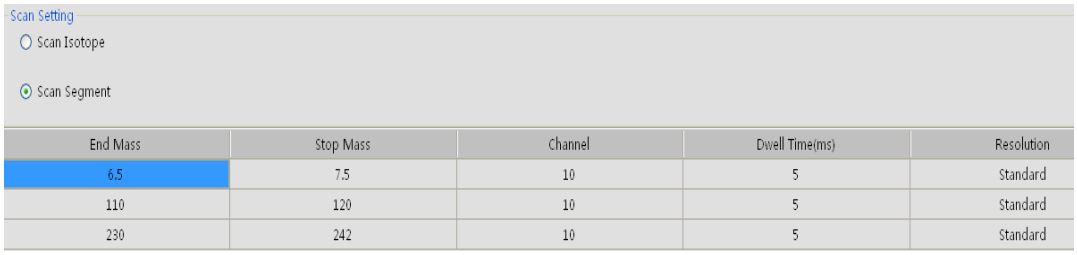


Figure-24

1) The mass calibration can view in Instrument> Calibration> Mass Calibration, or File> New> Mass Calibration.
2) There are two kinds of Scan settings. The default acquisition parameters for the mass calibration are as follows:

Symbol	Mass	Space	Channel	Dwell Time(ms)	Resolution
7Li	7.016004	0.5	10	5	Standard
59Co	58.9332002	0.5	10	5	Standard
238U	238.0507826	0.5	10	5	Standard

Figure-25



End Mass	Stop Mass	Channel	Dwell Time(ms)	Resolution
6.5	7.5	10	5	Standard
110	120	10	5	Standard
230	242	10	5	Standard

Figure-26

3) Click the right button of a mouse, to add or delete the element. Click ScanAttribute, and select the Parameter.

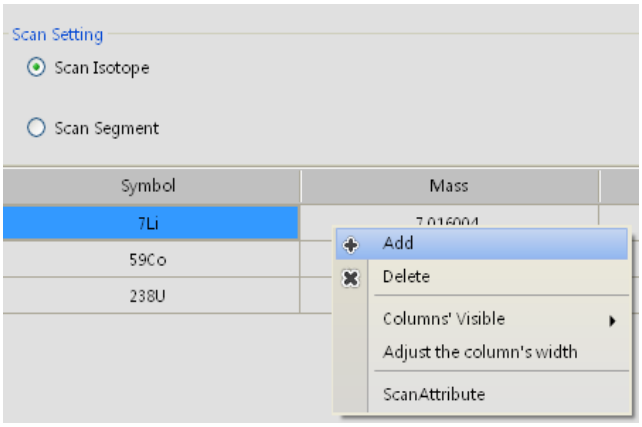


Figure-27

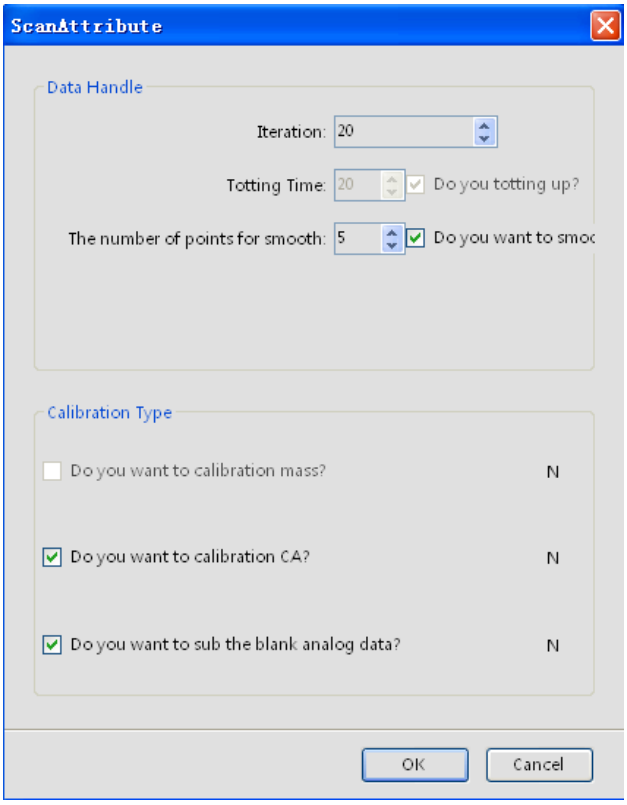


Figure-28

4) **Click**  **button, and start scanning.**

The graph will show the peak width and error between the found peak center and the calculated peak center on the y-axis against the mass on the x-axis for each mass at which a peak has been found.

Data points can be included or excluded by either clicking on the point on the graph.

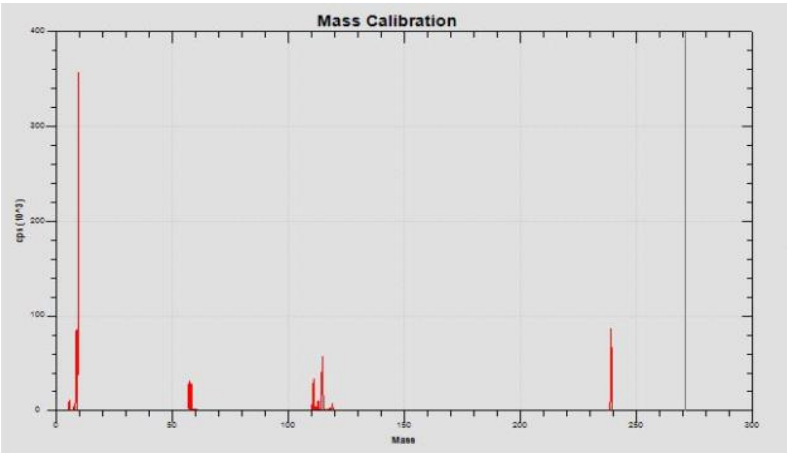


Figure-29

5) Modification of the actual value as the expected value.

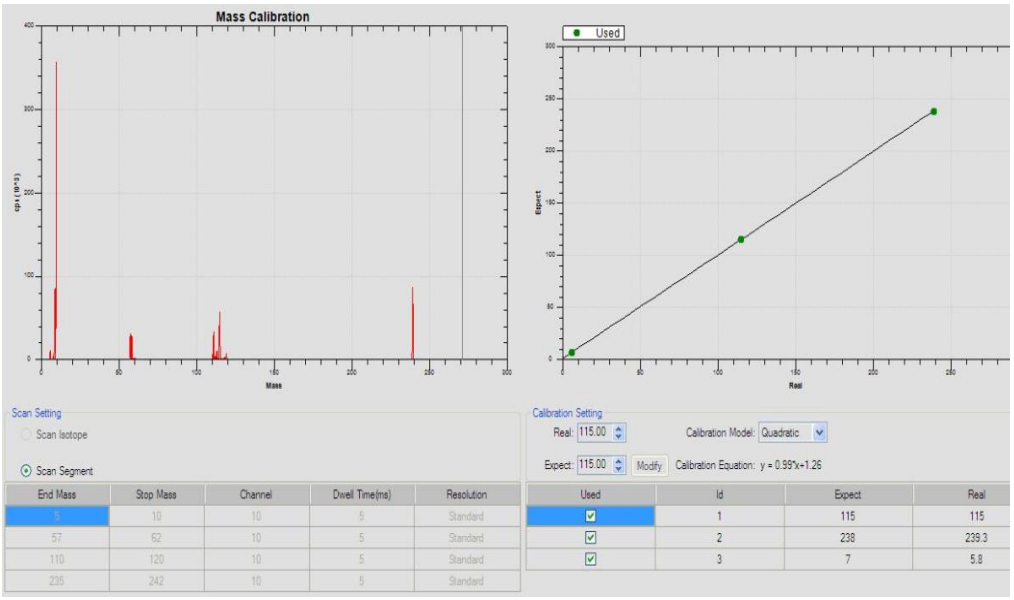


Figure-30

6.2.2 Detector Calibration

After a new detector has been installed and the automatic outgas procedure has been completed, the detector will be monitored throughout its lifetime. The Detector Monitor ringpage will show the information for the new detector.

1) The detector calibration can be viewed in File > open > Detector Calibration.

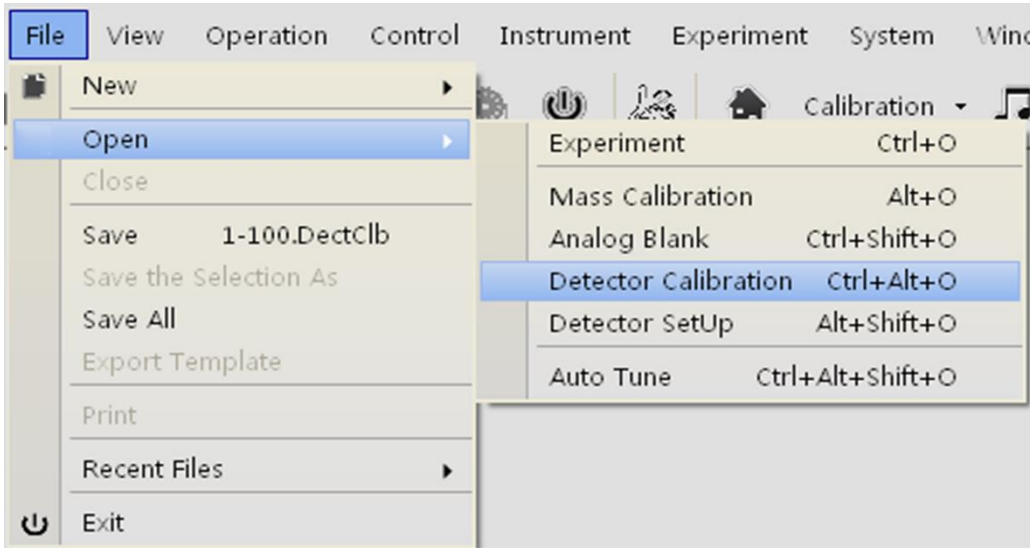


Figure-31

2) Click the right button of a mouse, to add or delete the element.
Click ScanAttribute, and select the Parameter.

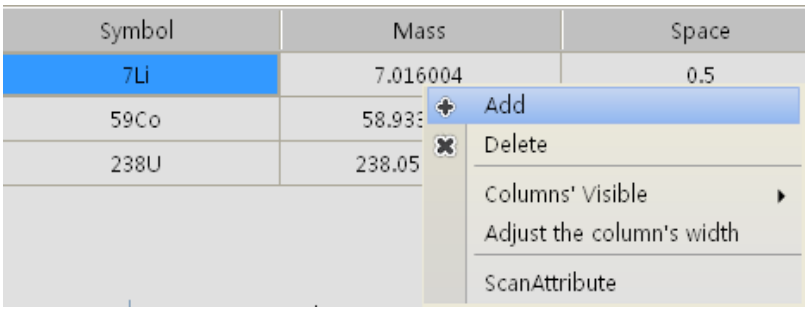


Figure-32

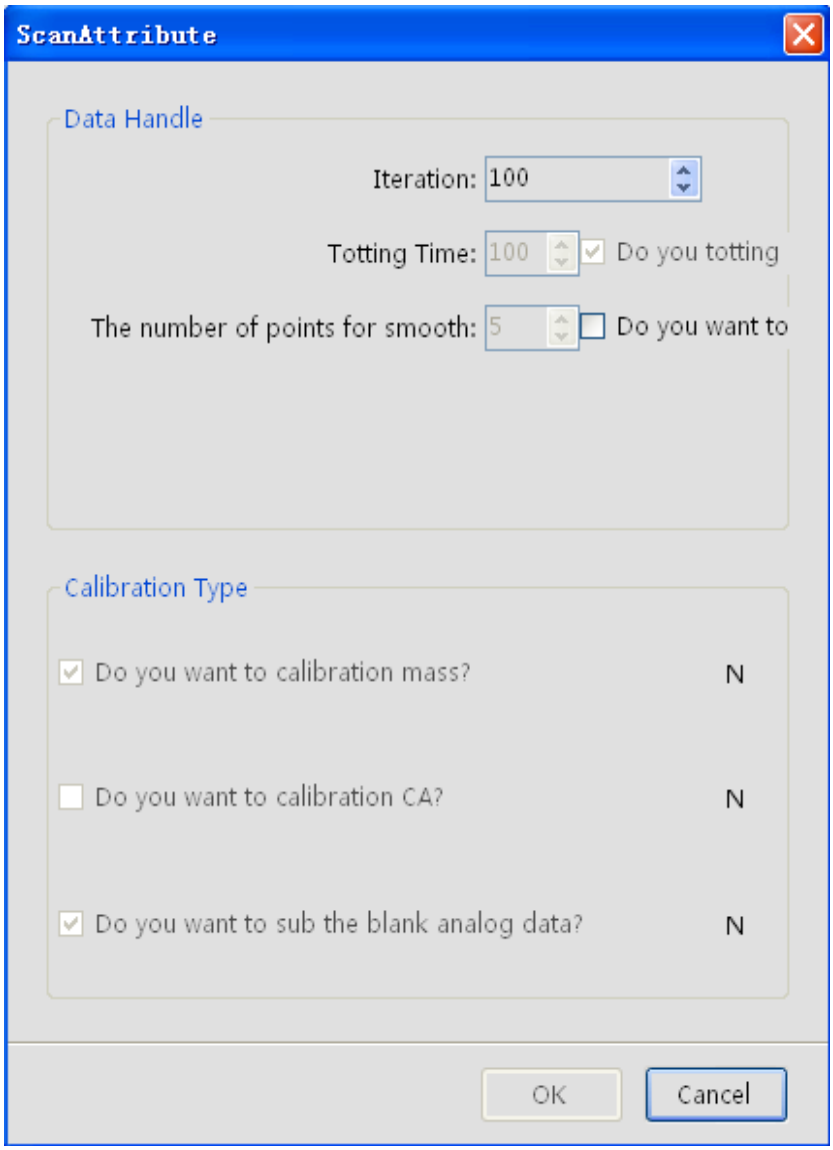


Figure-33

3) Click  button, and start scanning.

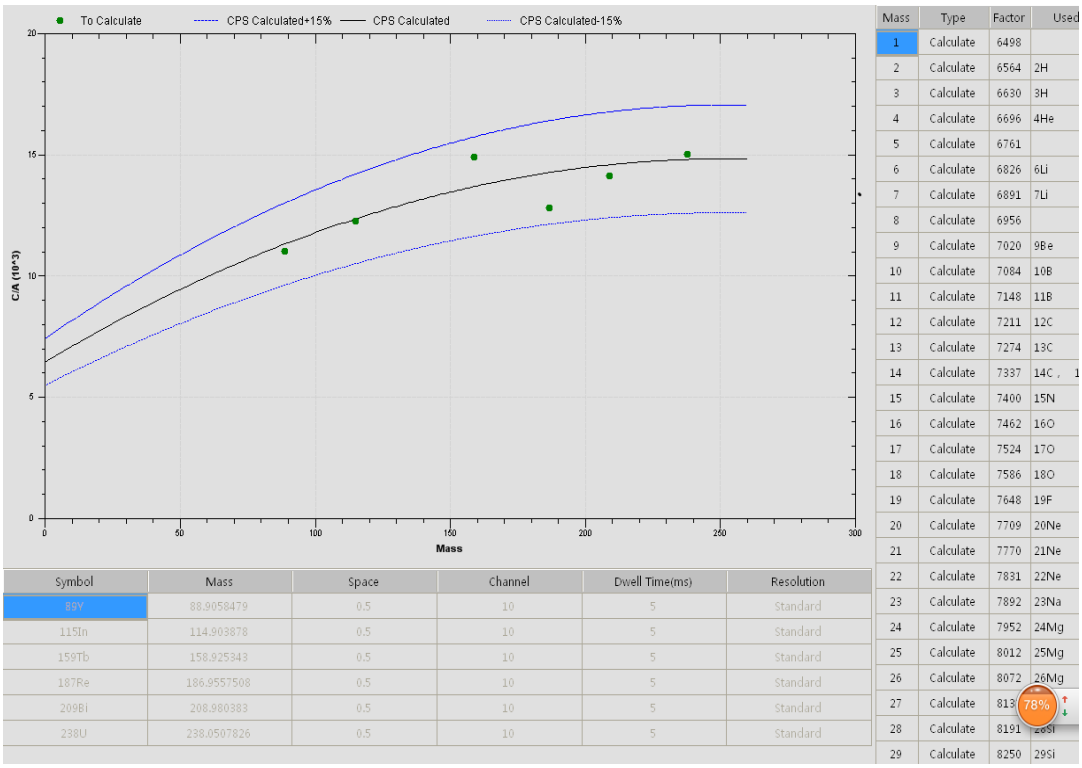


Figure-34

6.3 Sample Analysis

The objective is to set up an experiment for the analysis of standards and unknown samples. Calibration graphs will be created showing the quantitative and semi-quantitative results.

6.3.1 New Experiment Creation

1) Click on the Experiment icon to open the Experiment Wizard.

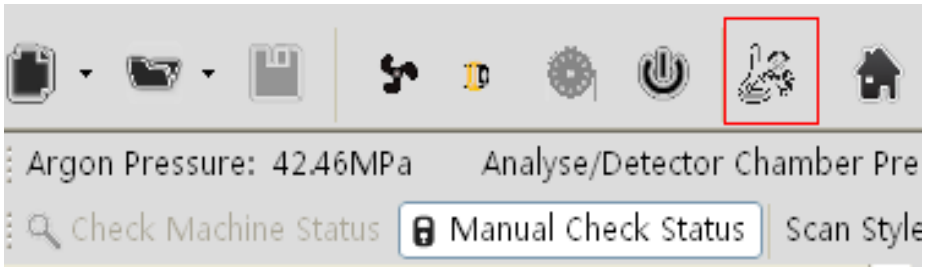


Figure-35

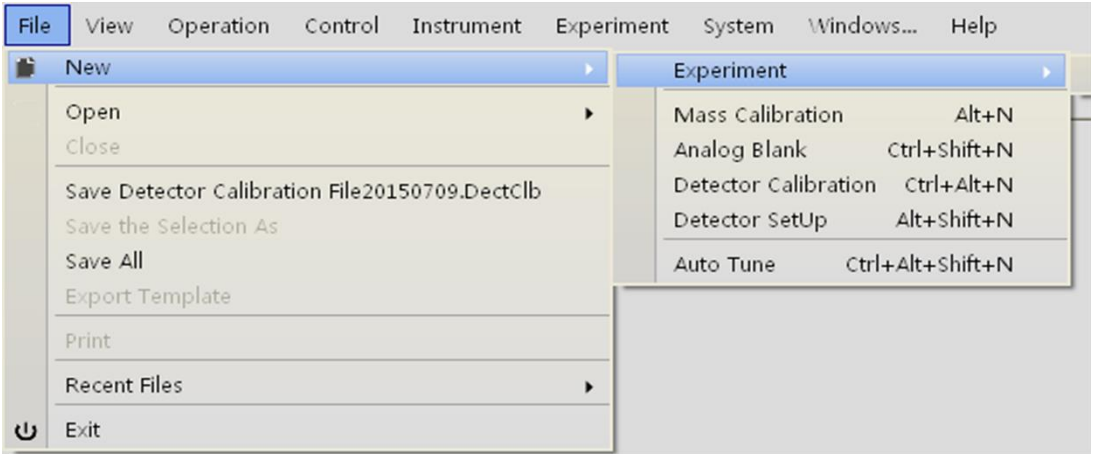


Figure-36

2) From the Experiment Wizard select Create a new blank experiment. Select the path to save the experiment file.

6.3.2 Experiment Setup

In the selected new experiment double click the Method icon, then click on the Editor in the Setup page to select the correct configuration.

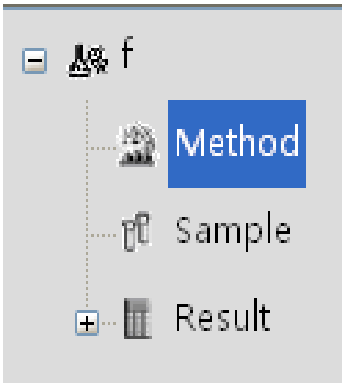


Figure-37

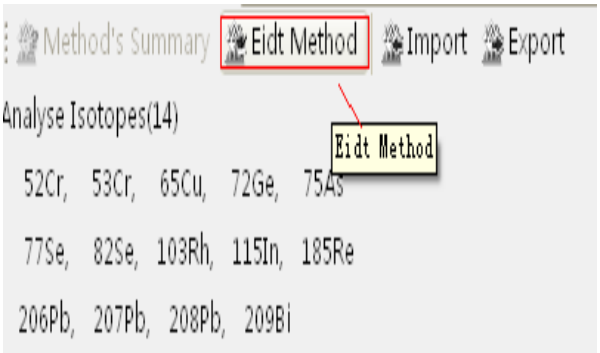


Figure-38

6.3.3 Acquisition Element

Select the test isotopes.

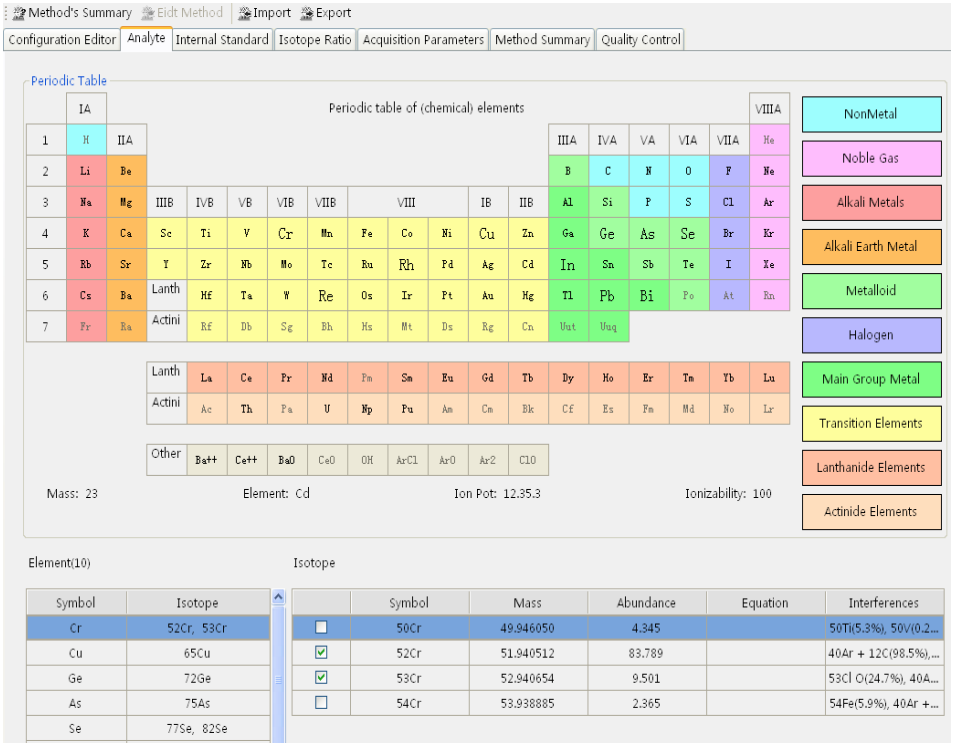


Figure-39

6.3.4 Internal Standard Selection

In the Setup menu click on Internal Standards to select internal standards for the experiment.

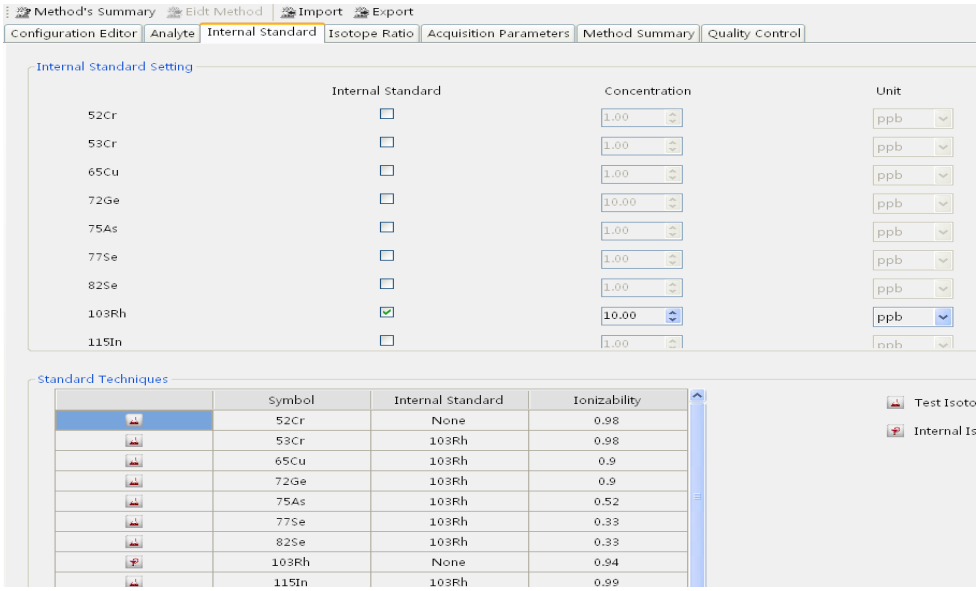


Figure-40

6.3.5 Select the Relevant Parameter

Set the relevant parameter. If different settings are used, the relevant instrument settings should be ticked in each experiment.

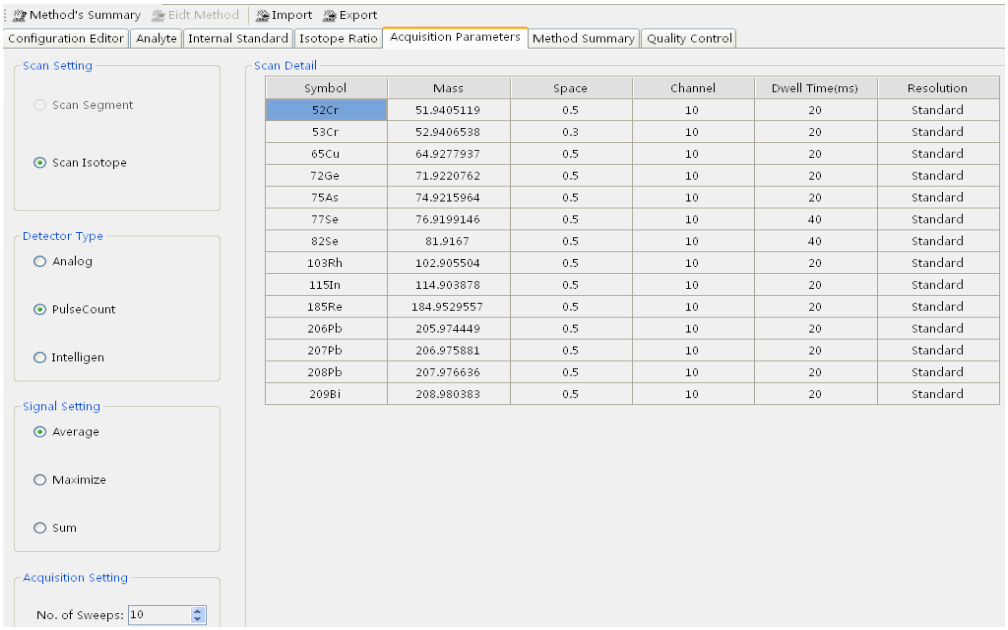


Figure-41

6.3.6 Calibration Method Setup

Click on the drop-down arrow next to each analyte to display the dropdown list. Select the calibration method of choice as shown below for each analyte.

For the internal standard analytes select None in the method column. By selecting None, a concentration file and calibration will not be assigned to these analytes.

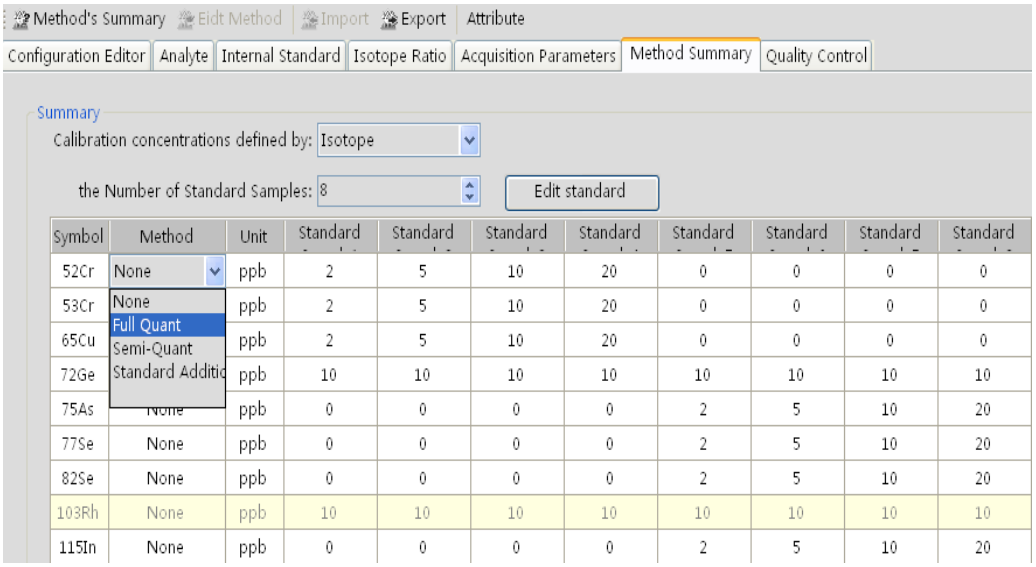


Figure-42

6.3.7 Creating a Sample List

Define the Blanks, Standards, and Unknowns using the drop-down list as shown. Select the number of survey runs and main runs as shown.

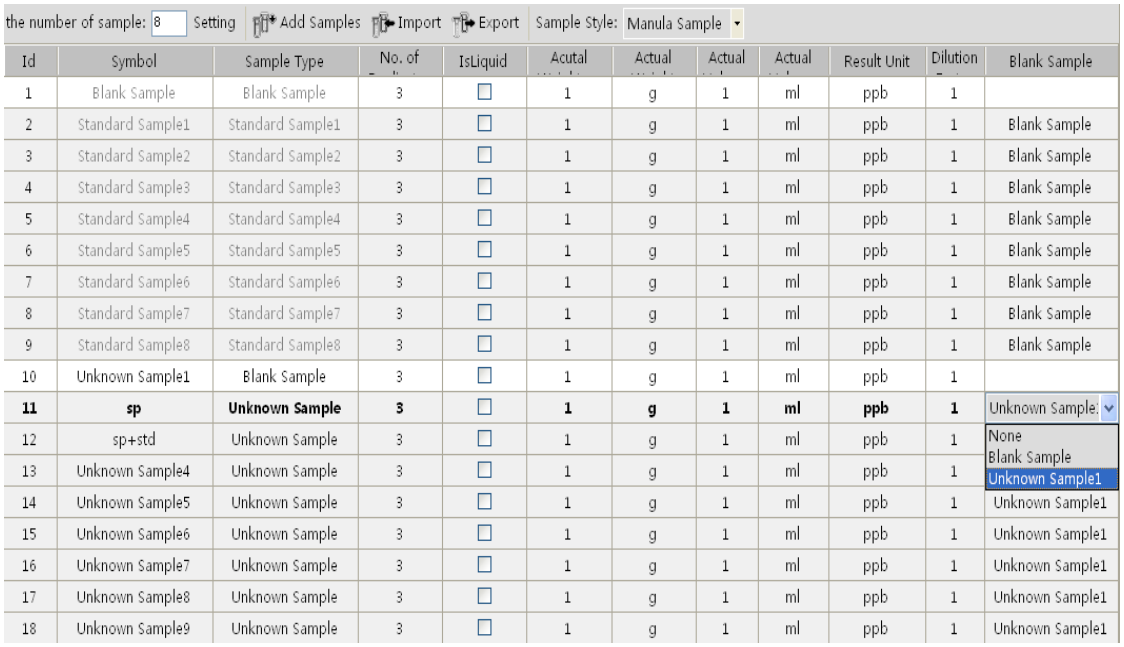


Figure-43

6.3.8 View Data Acquisition and Spectra

1) Click on the Scan  button to start the acquisition.
2) After the survey run is completed, the results can be viewed.

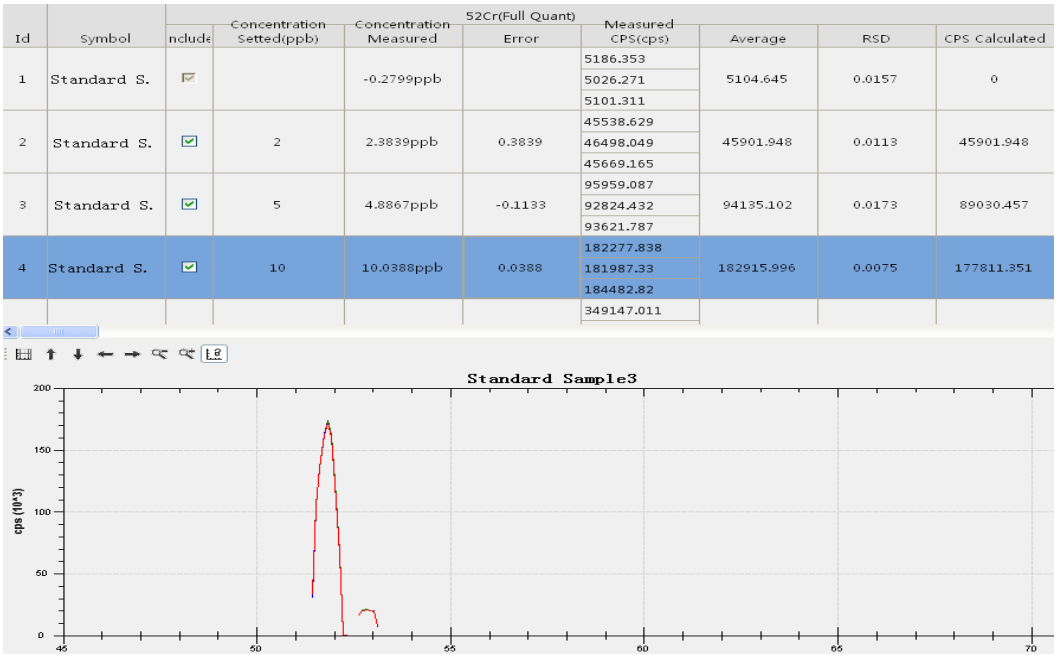


Figure-44

3) Go to Results > element. Double-click the isotope. There will be the isotope spectrum (that is, survey and stability run to enlarge the menu).

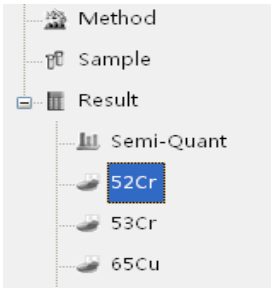


Figure-45

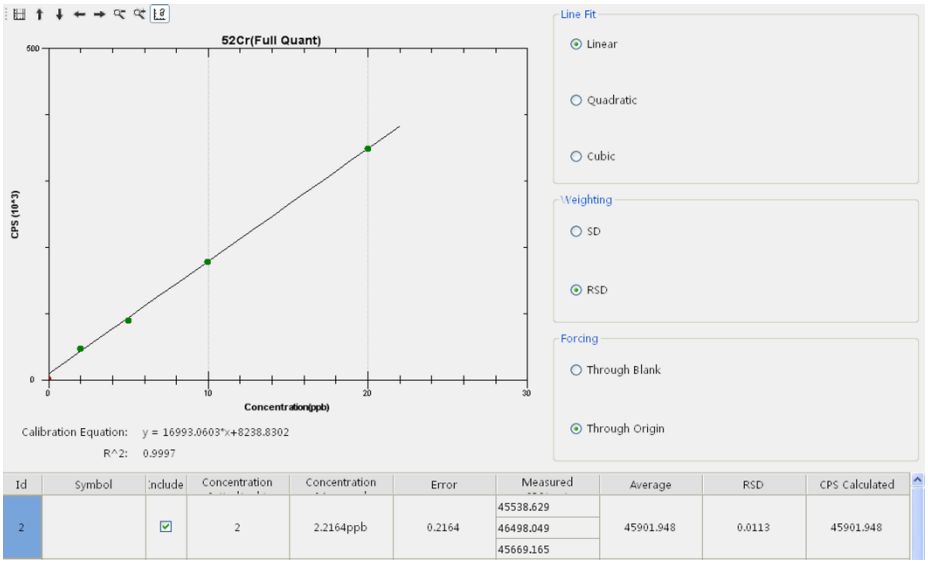


Figure-46

6.3.9 Printing Report

This is set up in File> Print.

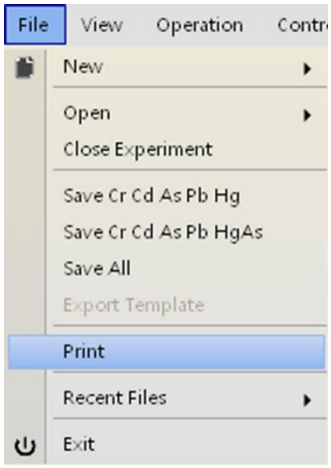


Figure-47

7. Maintenance

This chapter contains general maintenance instructions for the ICP-MS. If the user follows these instructions, the user will obtain the best possible performance with the instrument. ICP-MS is a precision instrument that will yield high performance for a long time if it is properly and regularly maintained. You will be taken step by step through all aspects of routine maintenance.

Caution:

Take care to wipe up any spillages that occur when handling acids or organic solvents near the instrument. Otherwise, the enamel coating may corrode. Before using any cleaning or decontamination methods except those specified by the manufacturer, the user should check together with the manufacturer that the proposed method will not damage the equipment.

Warning:

Pay particular attention to the area inside the torch box where the sample introduction glassware is mounted. As acids tarnish the surface finish, wipe up spills. Wear protective gloves while doing this! If for any reason, the user wants to clean the instrument panels, use a diluted soap solution and paper towels to wipe down the panels.

7.1 Peristaltic pump tubing

The condition of the peristaltic pump tubing can affect the stability of the ion beam. Therefore, the peristaltic pump tubing should be replaced regularly: For a typical 40-hour working week, it is recommended to replace it weekly.

1) Remove the sample uptake tube from the sample and drain the sample introduction glassware and all tubing. Stop the peristaltic pump by using Accessories Control.
2) Wipe the surface of the peristaltic pump rollers and tension arms with a dry cloth to remove any dust.
3) Replace the sample uptake tubing.
4) Attach the tension arms. Ensure that the tubes are fitted for the correct sample and drain flow direction when the peristaltic pump is operating.
5) Switch the peristaltic pump on. Check that the sample is being taken up into the instrument and being drained efficiently.

Note: Do not over-tighten, as this would reduce the tubing lifetime!

7.2 Removing Glassware

Removal and cleaning of ICP glassware and fittings is carried out to reduce blank levels for isotopes which tend to accumulate on the glassware.

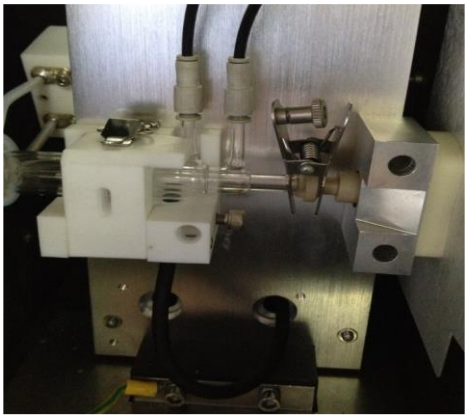


Figure-48

1) Switch the ICP-MS off, into Vacuum ready. Drain the complete sample introduction system.
2) Release the push-fit connector on the nebulizer gas line.
3) Lift the slider that holds the Peltier cooler in place around the impact bead spray chamber and place it into the higher rest position. Gently remove the spray chamber from the ICP-MS.
4) Release the two push-fit connectors that supply the coolant and auxiliary gases to the torch. Release the metal clip on the PTFE block that holds the torch in place. Slide the transfer tube backward away from the torch and gently pull the torch clear of the block and coil.

7.3 Cleaning Glassware

Warning: When handling the corrosive acids required to perform the cleaning procedure described below, take the following precautions: Wear protective clothing. Use acid-resistant laboratory gloves and glasses. The user must be aware of all safety procedures in case of spillage or exposure to skin or eyes before commencing the cleaning. The acid cleaning of the glassware should take place in a fume hood.

1) The torch, chamber, transfer tube, and nebulizer may be cleaned by soaking them in a laboratory glassware cleaner for 30 min. Raising the temperature will speed up the process.
2) Rinse at least three times with deionized water. Insert the impact bead spray chamber in 10-20% Analar grade nitric acid. Leave it there until the glassware is required for use. For a thorough cleaning, the soaking period should exceed 6 h. Alternatively, items can be cleaned in less than 1 h with an ultrasonic bath and the same cleaning solution.
3) Before re-installing the glassware, remove it from the nitric acid and wash it at least three times in fresh deionized water. Finally, allow it to air dry completely. If any components are to be stored for some time before use, they should be placed in metal-free sealed plastic bags.
4) Inspect the tip of the nebulizer using a magnifying glass. If the tip appears damaged in any way, it should be replaced. Damaged nebulizers can give rise to poor stability and sample transport efficiencies.

7.4 Nebulizer Maintenance

ICP-MS is supplied with a glass concentric type nebulizer. With use, these nebulizers may become blocked. A blockage is typically caused by particulate matter present either in the supply gas or in the sample. To prevent nebulizer blockage, follow the general rules below:

1) Filter the supply gas by installing a low-impedance gas filter inline. This prevents particulate matter present in the gas or gas lines from lodging in the nebulizer.
2) Filter the sample. This is recommended provided that the solid material present in the sample is not of analytical importance. Typically, the nebulizer will not lose efficiency when analyzing samples containing small particle size matter because the design of the sample capillary is sufficiently robust for the analysis of such samples.
3) Rinse the nebulizer. If the nozzle is coated in crystalline deposits, soaking in dilute nitric acid (2%) is sufficient.

7.5 Cleaning Cones

The condition of the cones affects sensitivity, blank levels, and the magnitude of signals from some background species (particularly oxide species). The actual intervals at which cleaning is required depend on the analytical workload and the nature of the samples being analyzed (particularly the level of dissolved solids in the samples being aspirated).

Note: The cones are manufactured to high precision from pure nickel and should be handled with care, particularly the skimmer. The tip of the skimmer cone is fragile and as such is easily damaged.

1) Open the torch box door to release the clip between the torch box turret and the interface region. Push the torch box enclosure away from the rest of the instrument to reveal the interface region.
2) Using the sample cone tool provided, unscrew the locking collar holding the sampler in place.
   Note: Should the sample cone be stuck, carefully insert a small flat screwdriver into the edge of the sampler to gently prize it away from the interface front plate. If the graphite gasket is damaged, it should be replaced.
3) Inspect the sample cone for excessive wear around the orifice. Replace, if necessary.
4) To clean the sample and skimmer cones, place them in an ultrasonic bath in ~5% Decon 90 (or similar laboratory detergent) for approximately 15 min. Rinse with deionized water, then ultrasonic for 15 min. with deionized water. Dry carefully with a non-fiber shedding laboratory wipe, or leave to air dry.
5) If further cleaning is required (that is, if performance expectations cannot be met), clean the front and rear surfaces of the sample cone by gently rubbing from the center outwards with an abrasive pad.
   Caution: Do not rub abrasive material over the tip of the cones! Their edges must be sharp and regular.
6) The skimmer cone is less mechanically robust than the sample cone (particularly at the tip). The edges of the cone must be sharp and regular. If there is evidence of damage to the tip, it should be replaced.

The procedure for removal is as follows:

- Remove the skimmer cone through the sample cone hole in the front plate (by inserting the recessed cone tool and aligning the two lugs in the cone tool on the outer edge of the cone surface; then turning counterclockwise, it will be held in place magnetically).
- Inspect the skimmer and reject it, if damage is apparent.

7) Reassemble the interface in reverse order. Ensure that the skimmer is seated properly and that the front plate and sample cone seals are in position and clean. Tighten the sample and skimmer cones finger-tight to give a good thermal and vacuum seal. Move the torch box back into position and close the torch box door.
Caution: Be careful to push the torch box enclosure into position with the door open to avoid damage to the interlock key!

8. Accessories

Standard Accessories

S. No	Accessory Name
1	Glove Box
2	PC Cable
3	Reducing Valve
4	Bellows
5	Radial Spring Clamp
6	Sealing Ring
7	PU Tube
8	Peristaltic Pump Head Hose
9	Polyurethane Hose
10	Peristaltic Pump Tubing
11	Exhaust Pipe
12	Ethernet Cable
13	Mechanical Pump
14	Vacuum Clamp
15	Plastic Box
16	Allen Wrench
17	Ball Allen Wrench
18	Double-Ended Wrench
19	Adjustable Wrench
20	Flat-Blade Screwdriver
21	Tweezers
22	Phillips-Screwdriver
23	Cooling Water Tank
24	Flash Storage

Optional Accessories

S. No	Accessory Name
1	Collision Pool Components
2	Autosampler