nu
AMETEK®

attom ES

High Resolution
ICP-MS

nu / AMETEK®

Attom ES

- Enhanced Sensitivity

- Enhanced Speed

- Enhanced Selectivity

- Enhanced Software

The Attom ES from Nu Instruments is a double focussing inductively coupled plasma mass spectrometer that has been purpose designed to be the ultimate tool for rapid and precise isotope ratio and quantitative analysis of trace elements in solid and liquid matrices.

The unique fast scanning techniques, coupled with a novel wide dynamic range detector system make the Attom ES a powerful analytical tool. Furthermore, the flexible high resolution slit system offers the best solution between sensitivity and resolution for unambiguous determinations in complex matrices.

Attom ES - key features

- Double focussing HR-ICP-MS with analyser and sample introduction system at ground potential

- High ionisation efficiency ICP source

- Five programmable gas flow controllers

- Easy access Peltier cooled spray chamber

- Easy connection of alternative sample introduction systems

- Enhanced sensitivity interface optimised for laser ablation and dry sample introduction

- High performance ion extraction and transfer optics

- All turbo pumped (water cooled) vacuum system

- All vacuum pumps and sensors operated at ground potential

- Low Hysteresis magnet with fast magnetic field changes

- 'FastScan' scanning technology with multiple scan modes

- Low noise discrete dynode electron multiplier

- Unique patented detector attenuation system, no analogue mode required

- Faraday detector for 12 orders of magnitude dynamic range

- Powerful and easy to use software for instrument control and data processing

Attom ES

Enhanced Sensitivity
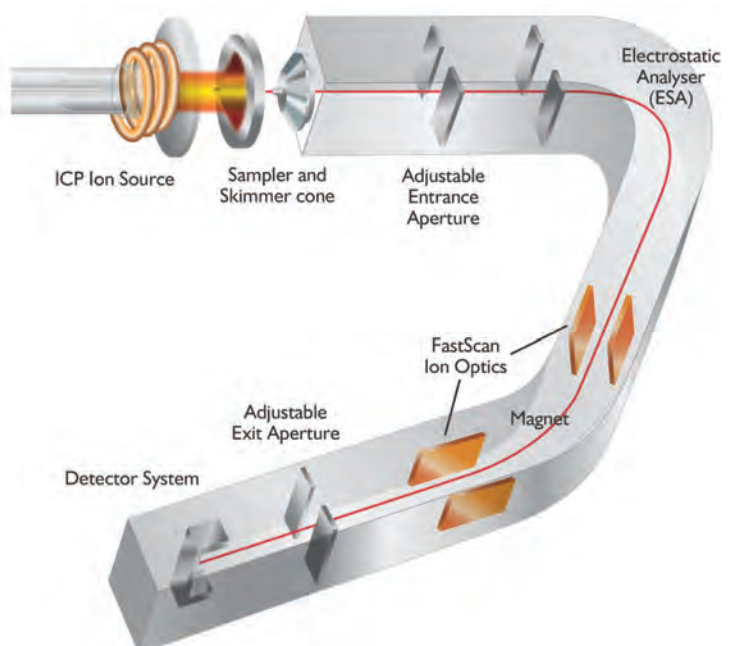High Resolution ICP Mass Spectrometer
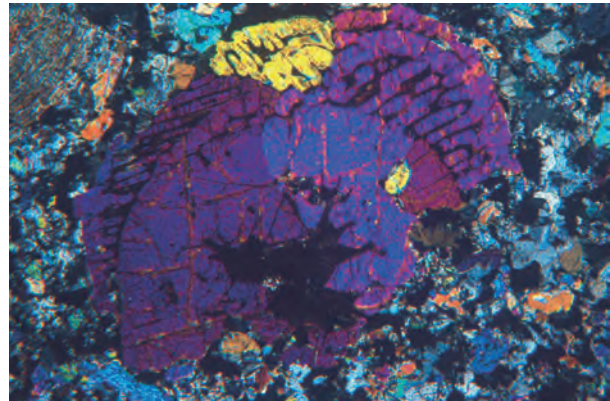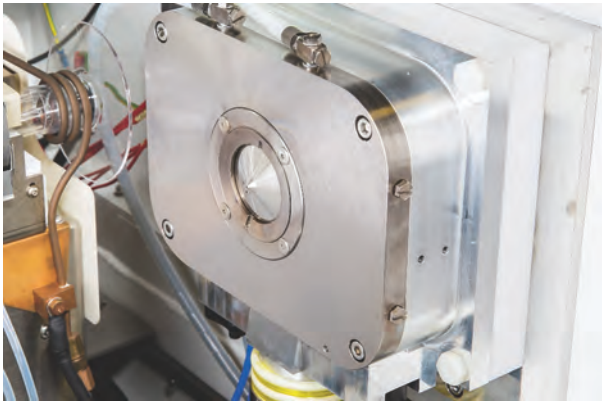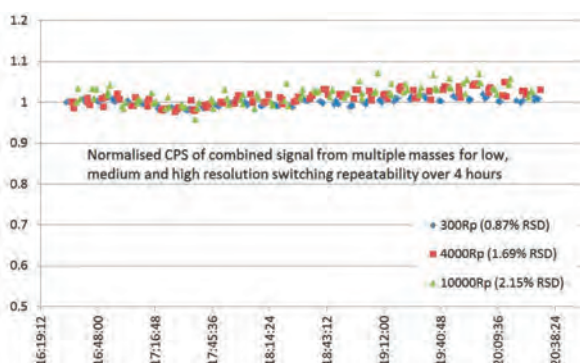
ICP Source and Sample Introduction

The ICP source uses a proprietary solid-state 1.6KW RF generator operating at 27.12MHz. The software performs RF matching and tuning of the torch box, providing simplicity and reliability of the matching system. Five mass flow controllers are fitted, providing highly stable plasma gas control with two mass flow controllers dedicated for use with alternative sample introduction systems such as laser ablation systems.

The enhanced sensitivity (ES) interface is fitted as standard providing the highest possible laser ablation sensitivities with minimal matrix effects. Optimised cones are available for "wet" and "dry" sample introduction systems. A Peltier cooled cyclonic spray chamber with low flow nebuliser is supplied with the instrument. In addition, the Attom ES is also compatible with a range of other nebulisers, spray chambers and torch systems, providing compatibility for all sample matrices.

ICP Ion Source
Sampler and Skimmer cone
Adjustable Entrance Aperture
Electrostatic Analyser (ESA)
FastScan Ion Optics
Magnet
Adjustable Exit Aperture
Detector System

Attom ES

Enhanced Speed
Fast Analysis in all Scanning Modes

Illustration showing how the FastScan Ion Optic deflectors can be used to quickly select masses over 40% of the mass range when the magnet is parked at one mass.

Electrostatic Mass Selection

The Attom ES incorporates a unique 'FastScan' ion optics system that allows alteration of the ion trajectories within the magnet. This offers the advantage of beam deflection at constant acceleration energy and ESA voltages without inducing mass discrimination effects. Deflection of the beam by altering the acceleration voltage is a known cause of variation in mass discrimination.

By applying different voltages to the lens assembly, the entrance angle of the ion beam is altered so that it's trajectory is changed. As a result, the ion beam either remains for a shorter or longer time in the magnet section of the flight tube. An ion beam of a certain mass can therefore be deflected either to a lower or higher "apparent" mass. A mass range of up to 40% of a given mass can be covered extremely quickly.

Fast Mass Scanning

The magnet is fully laminated to allow quick mass selection with extremely low hysteresis. A new magnet control system has better than fives times faster hysteresis recovery and the ability to change the magnetic field up to twenty times faster without compromising stability. The magnet can also be used in a constant cycle mode where it can scan quickly and in a reproducible manner between the lowest and highest field positions. Combining this fast magnet scan with the unique deflector optics is the 'LinkScan' mode. LinkScan provides rapid scan speeds over the full mass range collecting data during both the up and down scans of the magnet to maximise the efficiency of data acquisition. Combining electrostatic and magnetic scan methods with the unique active deflector system allows the integration time to be maximised on each isotope selected. This technique is particularly useful for applications such as laser ablation.

Mass spectrum showing how FastScan can be used to collect data for all of the Rare Earth Elements at speeds that minimise the effects of plasma noise on the signals.

Illustration showing how the combination of continuously scanning the magnet with mass and using the FastScan deflectors can produce full mass range coverage with almost 10 scans per second and over nine orders of dynamic range.

Enhanced Selectivity
High Resolution

Graph showing the reproducibility of ion signal when switching resolutions during a batch of samples.
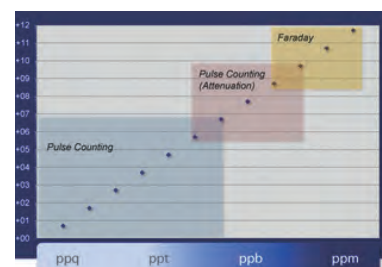

Nu Quant can use automated valley integration with baseline correction to fully make use of the High Resolution capability.

High Resolution

For all ICP-MS instruments, the avoidance and removal of interferences is a constant requirement. The use of a patented double focussing magnetic sector mass spectrometer offers the great benefit of physical separation between the mass of an analyte ion and that of an interference, this unambiguous method of measuring the signal makes the technique robust and trustworthy for developing methods of analysis in a research or routine laboratory. The Attom ES[1] uses vertical fixed slit assemblies to provide flexible resolutions from 300 to >10000. These slits are fully computer controlled and the slit parameters for different resolutions can be stored and accessed from within the operating software. The resolution can be optimised for specific applications and sensitivity does not have to be compromised at the expense of over-resolution. The use of vertical slits also ensures a longer lifetime between slit changes as fresh portions of the same slit width can be used as the ion beam erodes the material. The independent control of source and collector slits also allow pseudo resolution to be used for isotope ratios where there are interferences.

Detector System

The Attom ES uses a unique combination of detector modes to give a wide dynamic range and good linearity across the different modes. A standard discrete dynode electron multiplier is used for high sensitivity with only a few counts per minute background. However, for larger ion beam sizes, rather than using the 'analogue' mode of the electron multiplier, the beam is deflected through a grid of micro-machined holes which automatically attenuates the beam by a pre-determined factor. The time taken to

Graph showing the reproducibility of ion signal when switching resolutions during a batch of samples.

deflect the beam is of the order of tens of microseconds. The attenuation factor is extremely stable and, once calibrated, the system does not need to make regular recalibrations.

This unique system extends the dynamic range of the pulse-counting multiplier to 9 orders of magnitude and is linear across the whole range with measurement times as low as $200\mu s$ per isotope (10us for single particle mode). For signals even greater than this, a faraday detector option is available which will extend the dynamic range of the detection system to 12 orders.

1 – Technical Note NA11: Innovation in the use of fixed slits to overcome the issues of slit lifetime and lack of application flexibility

Attom ES

Enhanced Software
AttoLab Instrument Control

The Attom ES software suite includes AttoLab to provide full control of all instrument parameters. An intuitive working platform allows easy and efficient instrument tuning, parameter storage, sample analysis set up and data measurement.

AttoLab intelligently determines the optimum way to group isotopes in a method to take the best advantage of the wide deflector scan regions for a particular resolution setting. Different methods can then be tied together in a batch file. So for any sample, different resolutions can be used to unambiguously determine each isotope resolved from interferences.

AttoLab has a comprehensive user interface, providing the analyst with all the information needed to control the instrument, set up methods, calibrate and collect data.

The AttoLab Batch Editor provides the flexibility to acquire data for multiple methods on any sample within the run.

Enhanced Software
Nu Quant for Isotope Ratios
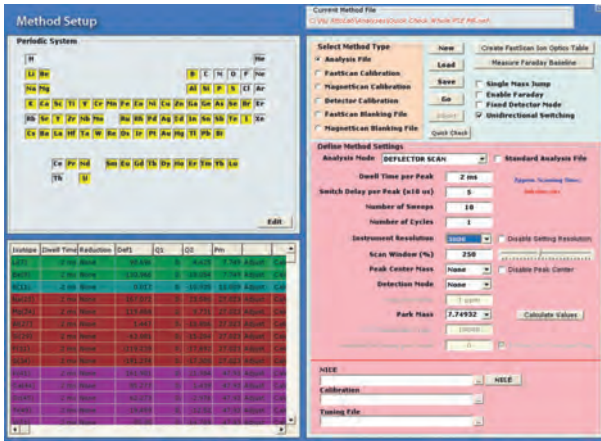
AttoLab's Method Editor provides the optimum capability for data acquisition for isotope ratios, high resolution quantitative analysis or fast time resolved analysis using a variety of scan methods.

AttoLab includes tools for Time Resolved Analysis (TRA)[2] to benefit from the hardware designed for fast data acquisition. The data can be collected in real time and simultaneously processed using NICE. The data reduced by both NICE and the TRA is displayed with full statistics in both tabular and graphical presentation.

Time Resolved Analysis is simple and powerful.

Nu Instruments' class leading isotope ratio software with the Nu Instruments Calculations Editor (NICE) is further enhanced in Nu Quant with tools for users to define exactly how the isotope ratio measurements need to be made to follow their own laboratory practices. Nu Quant NICE scripts can be used on whole batches of samples at once. With the flexibility for simple cycle by cycle ratios or complete customisation of signal processing with user defined rules for when to report data or not.

Nu Quant with NICE scripts allow for simple isotope ratios on whole batches of samples or sophisticated data processing rules to be applied with ease.

2 – *Application Note NA10: Attolab TRA software for accessory integration and data handling*

Attom ES

Enhanced Software
Nu Quant for Elemental Analysis

ICP-MS is a technique which can generate a lot of data very quickly. Reviewing the quality of the calibration, checking for interferences, monitoring the recovery of the internal standards and checking the reproducibility of measuring the same sample multiple times are common tasks for the analyst running a batch of samples. Nu Quant is a quantitative data processing package designed by Nu Instruments to dramatically reduce the workload of the analyst by automating much of the task of reviewing the data and providing comprehensive editing tools with an audit trail to give the best confidence in any results reported.
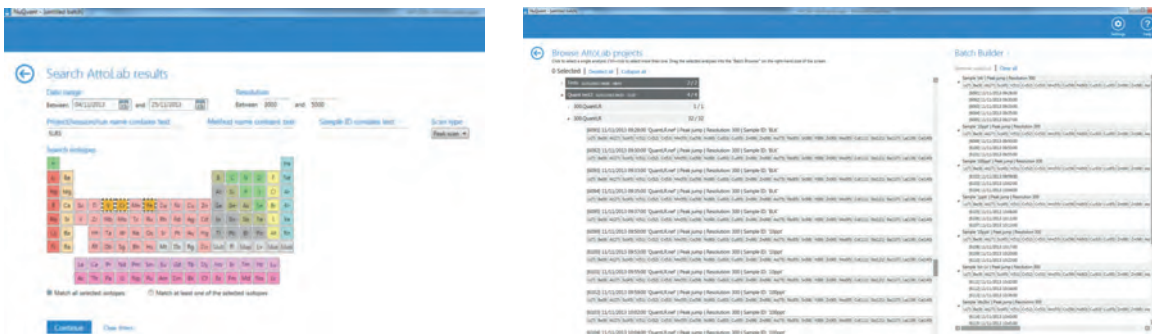
Nu Quant provides a comprehensive and searchable index of data from the Attom ES to ease information management.

Nu Quant provides the tools to create processing batches from samples acquired at any time, allowing the mixing of certain acquisition conditions for the ultimate flexibility.
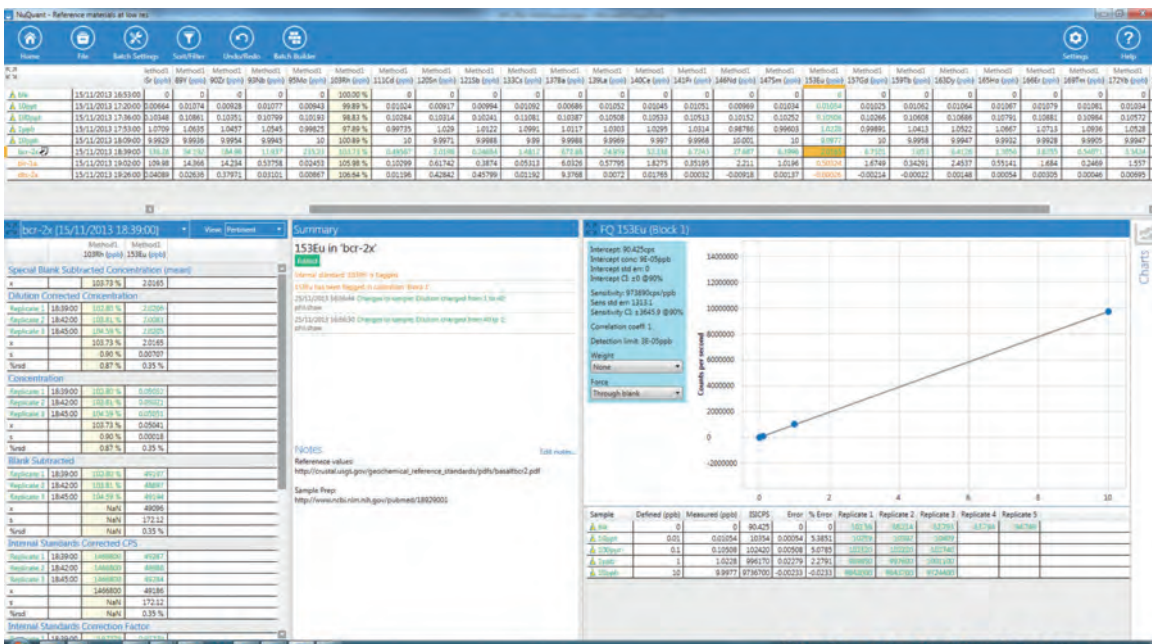
Nu Quant has a "Dashboard" interface providing a clear view of the top level results.
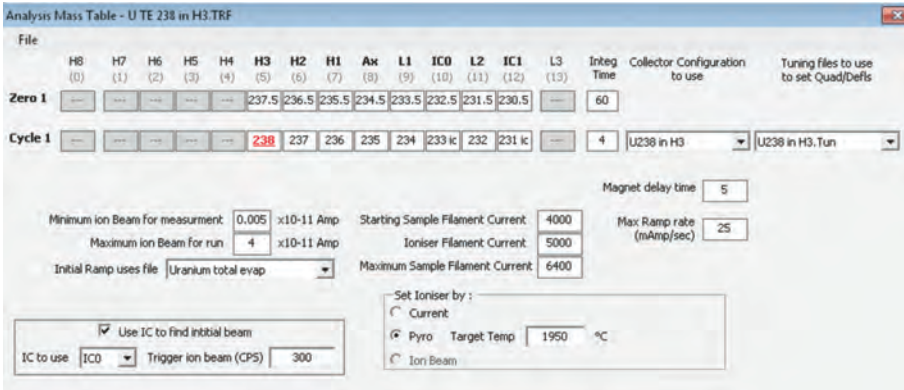
The Nu Quant "Dashboard" can show all calibrations as flagged thumbnails with a detailed and colour coded editable view of the full calibration information.
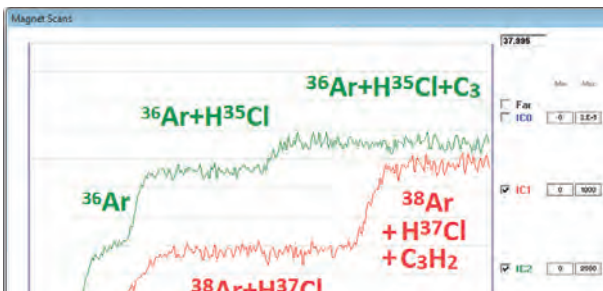
Nu Quant provides a fully detailed view of all of the calculation steps taken to reach a result, along with an audit trail of changes made for any single result and whether any edits make a consequential change to other results.

Nu Quant can display all of the spectra for an isotope or sample as thumbnails which are flagged to show when attention is required from the analyst due to peak location and resolution.
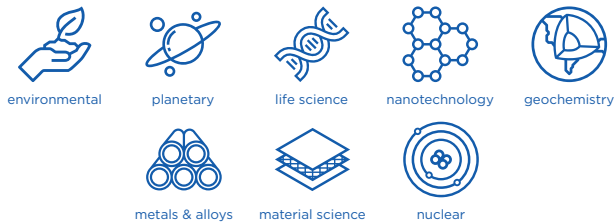

Nu Quant provides a simple tool for the user to define the initial calibration conditions and quality tests for the calibration or individual samples to provide the flagging on the "Dashboard".

attom ES

Innovators in
Mass Spectrometry

High Resolution ICP-MS

environmental planetary life science nanotechnology geochemistry

metals & alloys material science nuclear

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Innovators in Mass Spectrometry. We deliver cutting-edge science and technology solutions, and offer our customers unparalleled support and maintenance service through the comprehensive **AMECARE** PERFORMANCE SERVICES program.

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