nu instruments

Nu Plasma II
Multi-Collector ICP-MS

Nu Plasma 1700
Multi-Collector ICP-MS

Nu TIMS
Thermal Ionisation MS

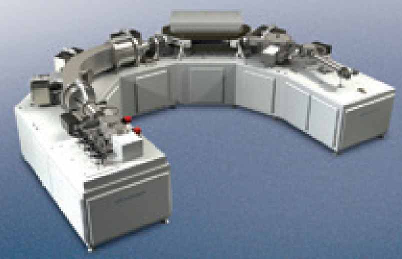
Attom
High Resolution ICP-MS

Astrum
Glow Discharge MS

Evolution
HR Gas Analysis MS

Noblesse
Noble Gas MS

Panorama
HR Stable Isotope Ratio MS



Horizon
Stable Isotope Ratio MS

Perspective
Stable Isotope Ratio MS

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Noblesse

NOBLE GAS MASS SPECTROMETER

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Noblesse

The five noble gases are trace elements whose diverse applications in geo- and cosmochemistry are out of all proportion to their low terrestrial abundance. Over the last decade, Nu Instruments' Noblesse multi-collector mass spectrometer has established a solid track record in analysis of all the noble gases. The Noblesse has been used successfully for applications as diverse as Ar-Ar dating, studies of noble gases from the Earth's mantle, and measurement of krypton and xenon in solar wind samples returned by NASA's *Genesis* mission.

A range of collector arrays are available. The collectors are fixed, yet due to the instrument's unique, patented, variable dispersion Zoom lens system, instantaneous switching is possible between different sets of isotopes.

Noblesse - key features

- High efficiency Nier source
- Multi-collector options – many developed in collaboration with users
- Minimal internal volumes
- Total 'dry' pumping technology
- Unique electrostatic Zoom Optics (patented) – fixed collector array, no moving parts, increased reliability
- Simple source filament change
- State of the art, purpose built electronics
- Fully bakeable to 300 deg C
- Intuitive control software operating under Windows
- Optional sample preparation systems available
- Lifetime technical support

NOBLE GAS MASS SPECTROMETER

Mass Spectrometer

The Noblesse is a single focussing mass spectrometer using a 24 cm radius, 75 degree magnet. The instrument provides good mass dispersion without excessive volume – the volume of the popular 1 Faraday – 3 Multiplier array is ~1550 cc (without getters).

Source

The Noblesse employs a Nier type ionisation source, which features both excellent efficiency and a high trap/emission current ratio. The filament can be replaced easily without removing the source, and is self-aligning on installation.

Variable Dispersion Ion Optics

The Noblesse uses Nu Instruments' unique and patented Zoom Optics system, which enables multi-collection of different sets of isotopes using a fixed collector array. The Zoom Optics allows the dispersion to be changed instantaneously – even during an analysis – whilst use of a fixed array reduces volumes and greatly increases reliability. The Zoom lenses also perform fine focussing of the ion beam, making adjustable magnet pole pieces a thing of the past.

Vacuum system

The Noblesse is fitted with a 20 l/s ion pump for pump out during normal operation, whilst a 75 l/s Turbomolecular pump and dry backing pump are used to pump the instrument down from atmospheric pressure. The pneumatic valve to the source end ion pump is software controlled. A pneumatic inlet valve is available as an option, for use with an automatic gas preparation system. The instrument is fitted with a getter adjacent to the source; a getter or ion pump can be fitted at the collector. Both getters can be isolated and pumped independently, allowing activation without polluting the mass spectrometer.

VERSATILE COLLECTOR OPTIONS

Detection Systems

A key feature of Noblesse is the wide range of collector arrays which are offered. These have evolved over the last 10 years, many of them being developed in response to customer demand for specific applications.

The most popular configuration remains the versatile **1 Faraday, 3 Multiplier (1F3M, offset Faraday)** option. With a collector slit separation of ~5% of mass, multicollection is possible at all the noble gases except helium. Helium may be measured easily by switching between ^{3}He on a multiplier and ^{4}He on the Faraday, whilst the unique use of a laminated magnet ensures fast and accurate peak jumping. Given that the error in most ^{3}He/^{4}He ratios is dominated overwhelmingly by counting statistics on ^{3}He, the time required for the ^{4}He measurement is small. Unique micro filters are fitted to enhance the abundance sensitivity for studies of trace isotopes such as ^{3}He. At the high mass position, one can deflect the beam between the Faraday and multiplier, useful for isotopes – such as ^{40}Ar – which show a wide range in signal size.

The **1F3M (direct Faraday)** array was developed primarily for an Ar-Ar samples. It allows simultaneous measurement of the most important Ar isotopes (masses 36, 37, 39 and 40) with ^{40}Ar on a Faraday.

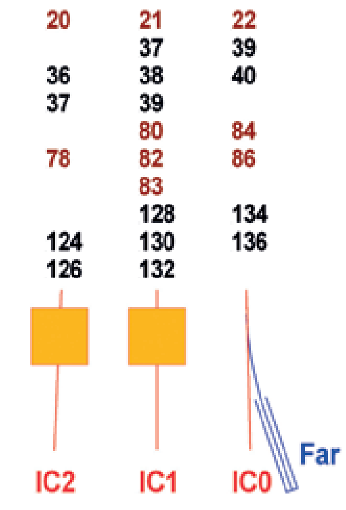
The **1F4M** array was developed for very small Ar-Ar samples, with ^{40}Ar on an ion counter. Again, masses 36, 37, 39 and 40 are all measured simultaneously.

The **6F4M** array was developed for Ar, Kr, and Xe. All five Ar isotopes can be measured simultaneously, either all on Faradays, or with ^{40}Ar on a Faraday and the rest on ion counters. Kr is measured in three steps and Xe in four steps.

The **3F4M** array was developed for both nitrogen and the noble gases. For Ar-Ar work, masses 36, 38, 39 and 40 are measured simultaneously, with mass 40 switchable between a Faraday and a multiplier. Also, all nine Xe isotopes can be measured in just three steps.

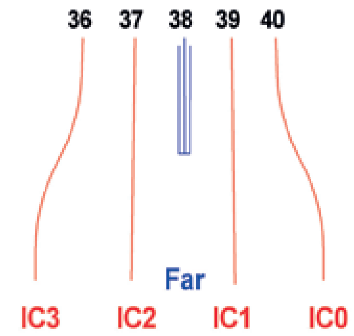
All Faraday detectors employ 10^{11} ohm resistors as standard, with 55V amplifiers, providing enhanced dynamic range over earlier systems. Other resistor values are available on request. Full size discrete dynode multipliers are employed, providing maximum stability and lifetime. Over-limit protection is provided, preventing beam entry into the multipliers should the count rate become too high.

COLLECTOR OPTIONS - EXAMPLES

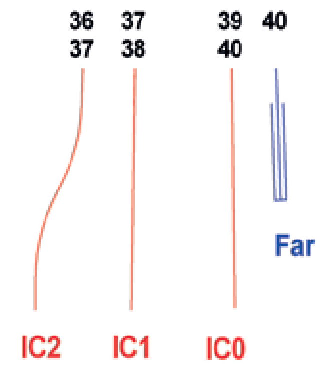


1F3M, offset Faraday

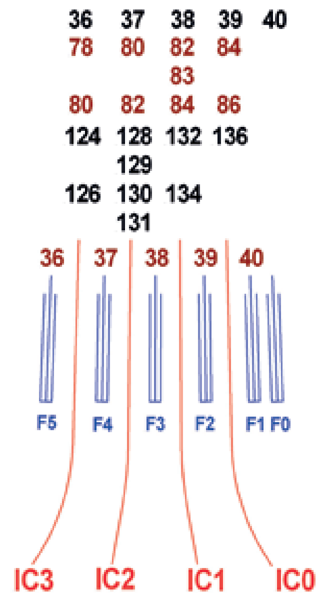
microfilter, to improve abundance sensitivity



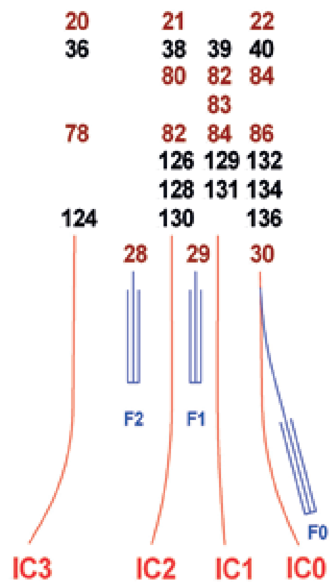
1F4M



1F3M, direct Faraday



6F4M



3F4M

INTEGRATED SAMPLE PREPARATION SYSTEM

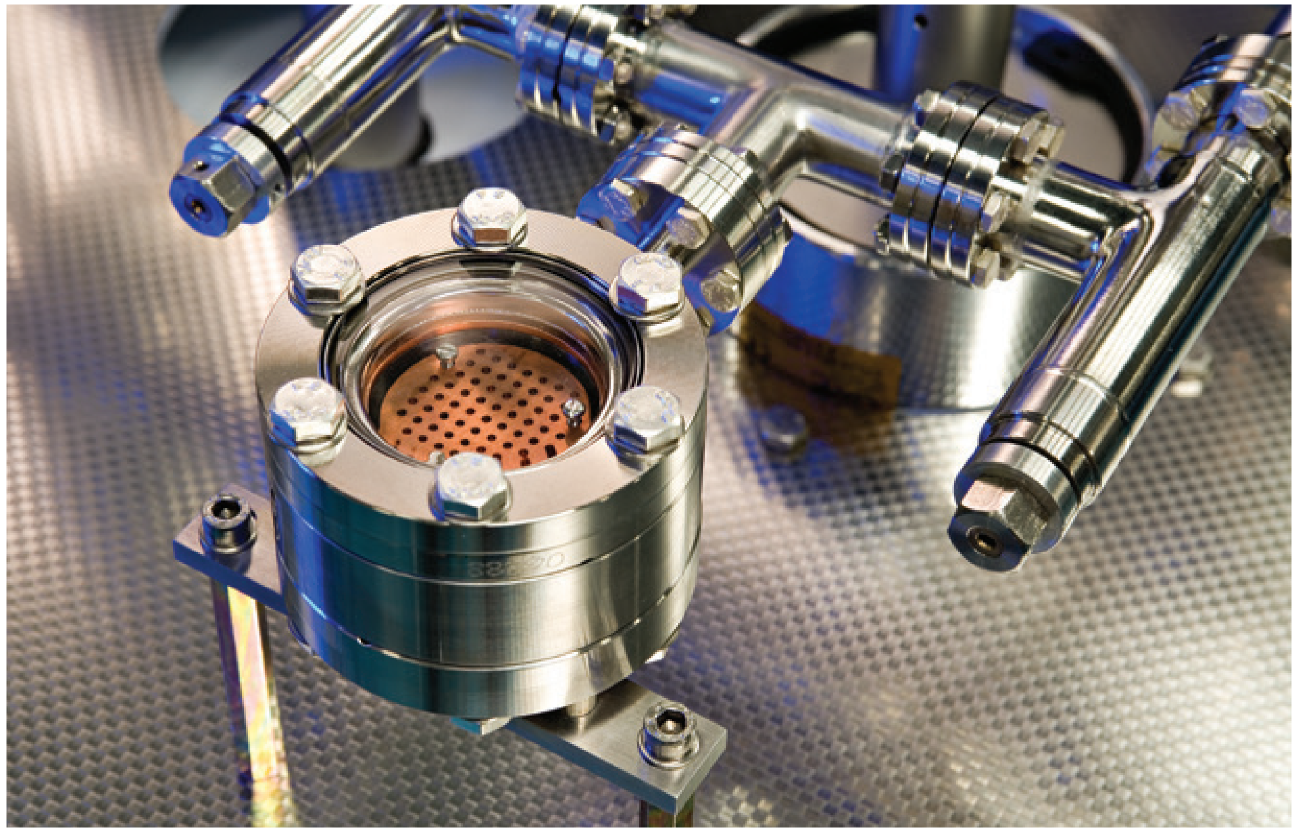
Sample Preparation System

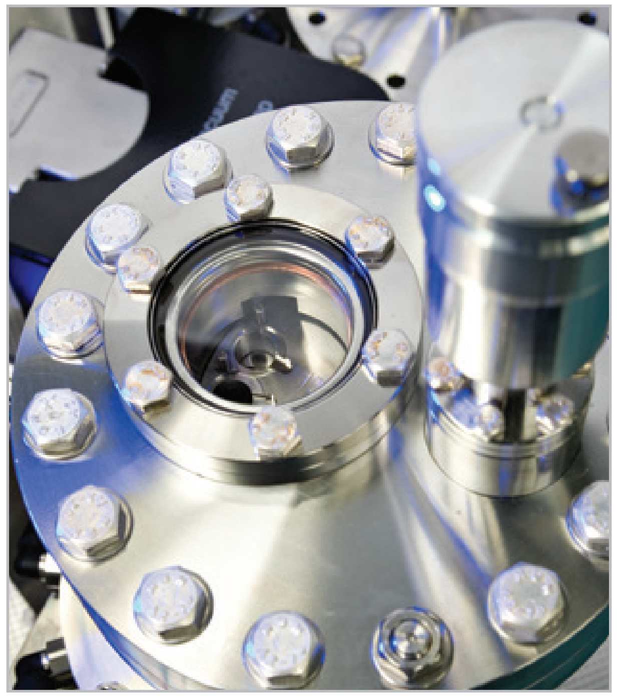
Nu Instruments offer an all metal sample preparation system for connection to the Noble gas mass spectrometer, either for use by itself, or as an interface between the user's systems and the mass spectrometer inlet. The complete manifold system is manufactured to rigorous UHV standards, and has been designed to have the smallest possible volume, whilst maintaining reasonable gas conductance, so as to ensure the lowest possible blank levels for the analyses.

The system includes two calibration gas reservoirs, each fitted with a pipette with auto valves, to enable known quantities of reference gas to be admitted into the mass spectrometer.

Automatic valves are provided to the ion pump, and to the furnace section. A dedicated getter is provided adjacent to the furnace, to enable "dirty" samples to be processed prior to opening the valve to the main manifold section. An additional getter is provided on the manifold near the ion pump.

A sample cell is provided, for the user to integrate with their own laser system.





Resistance Furnace

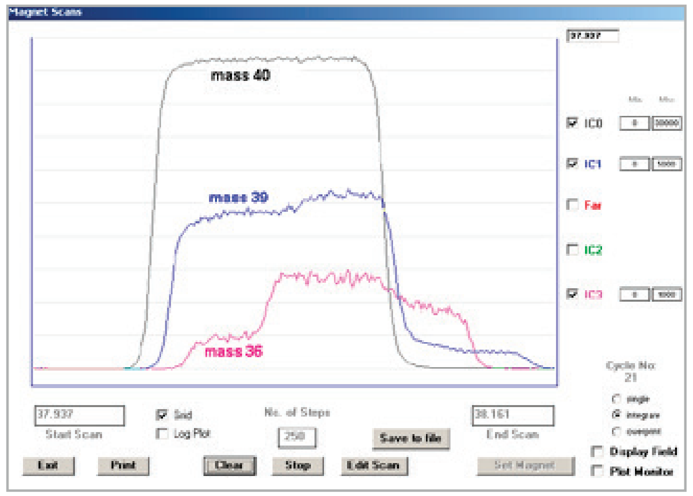
The furnace consists of a central tantalum crucible, heated by a split tantalum resistive element. This is then surrounded by a series of heat shields and the whole assembly is placed inside a water-cooled chamber, which is pumped independently from the main sample introduction line, with a dedicated high vacuum and backing pump. A water chiller unit is included in the package.

A disposable tantalum inner liner is used to contain the dropped samples in the furnace, and hence minimise chemical reactions with the tantalum crucible, thus maximising its lifetime.

Samples are introduced using a low volume carousel, which permits sequential dispensing of samples. A window enables the samples to be viewed during heating, as well as enabling the temperature to be monitored independently via the use of a (user supplied) optical pyrometer, if required.

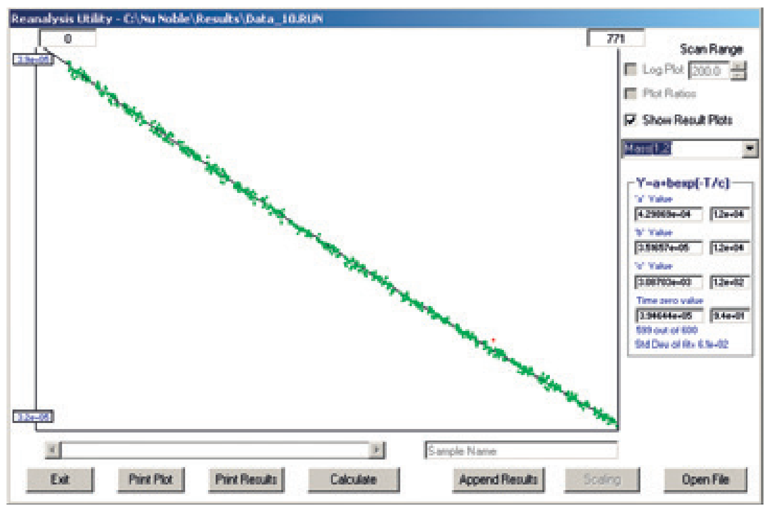
The temperature of the furnace is monitored using a W/W-Re thermocouple, and controlled using a dedicated controller, interfaced to a PC. A number of different heating profiles may be stored for use in different experiments.

USER FRIENDLY AND INTUITIVE SOFTWARE



Mass scans window

The Noblesse comes with feature rich, powerful, yet easy to use software that provides the user with all the tools required for analysis of the noble gases. All instrument parameters are controlled from the software. The data analysis package includes curve fitting and extrapolation to time zero, for either amounts versus time or ratios versus time – and including rigorous error propagation. Data acquisition runs are simple to set up and it is also possible to construct batch of runs for a series of samples. The software may also be used to control the Nu Instruments sample preparation system and furnace. Additional digital outputs are available for the control of user-supplied valves.



Data reduction, showing curve fitting

The standard Nu Instruments Calculation Editor (NICE) software provides user-definable data reduction functions. Both raw and calculated data are available for each sample run along with full logging of instrument settings. Data can be analysed on or off-line and can be easily exported for further analysis to third party software packages. Upgrades are available free of charge for the lifetime of instrument.

NOBLESSE – SELECTED PUBLICATIONS

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Noble gas isotopes in hydrothermal volcanic fluids of La Soufrière volcano, Guadeloupe, Lesser Antilles arc. L. Ruzié, M. Moreira, O. Crispi, Chemical Geology, 304-305, 158-165 (2012)

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Early differentiation and volatile accretion recorded in deep-mantle neon and xenon. Sujoy Mukhopadhyay, Nature, 486, 101-106 (2012)

The heavy noble gas composition of the depleted MORB mantle (DMM) and its implications for the preservation of heterogeneities in the mantle. Jonathan M. Tucker, Sujoy Mukhopadhyay, Jean-Guy Schilling, Earth and Planetary Science Letters, 355-356, 244–254 (2012)

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Astronomically calibrated $^{40}Ar/^{39}Ar$ age for the Toba supereruption and global synchronization of late Quaternary records. Michael Storey, Richard G. Roberts and Mokhtar Saidin. Proceedings of the National Academy of Sciences of the United States of America, 109, 18684-18688 (2012)

Measuring the Isotopic composition of Solar Wind Noble Gases. Alex Meshik, Charles Hohenberg, Olga Pravdivtseva and Donald Burnett, in Exploring the Solar Wind, Dr Marian Lazar (Ed) ISBN: 978-953-51—339-4, Intech, available from http://www.intechopen.com/books/exploring-the-solar-wind/measuring-the-isotopic-composition-of-solar-wind-noble-gases (2012)