Noble

noblesse HR

Noble Gas Mass Spectrometer

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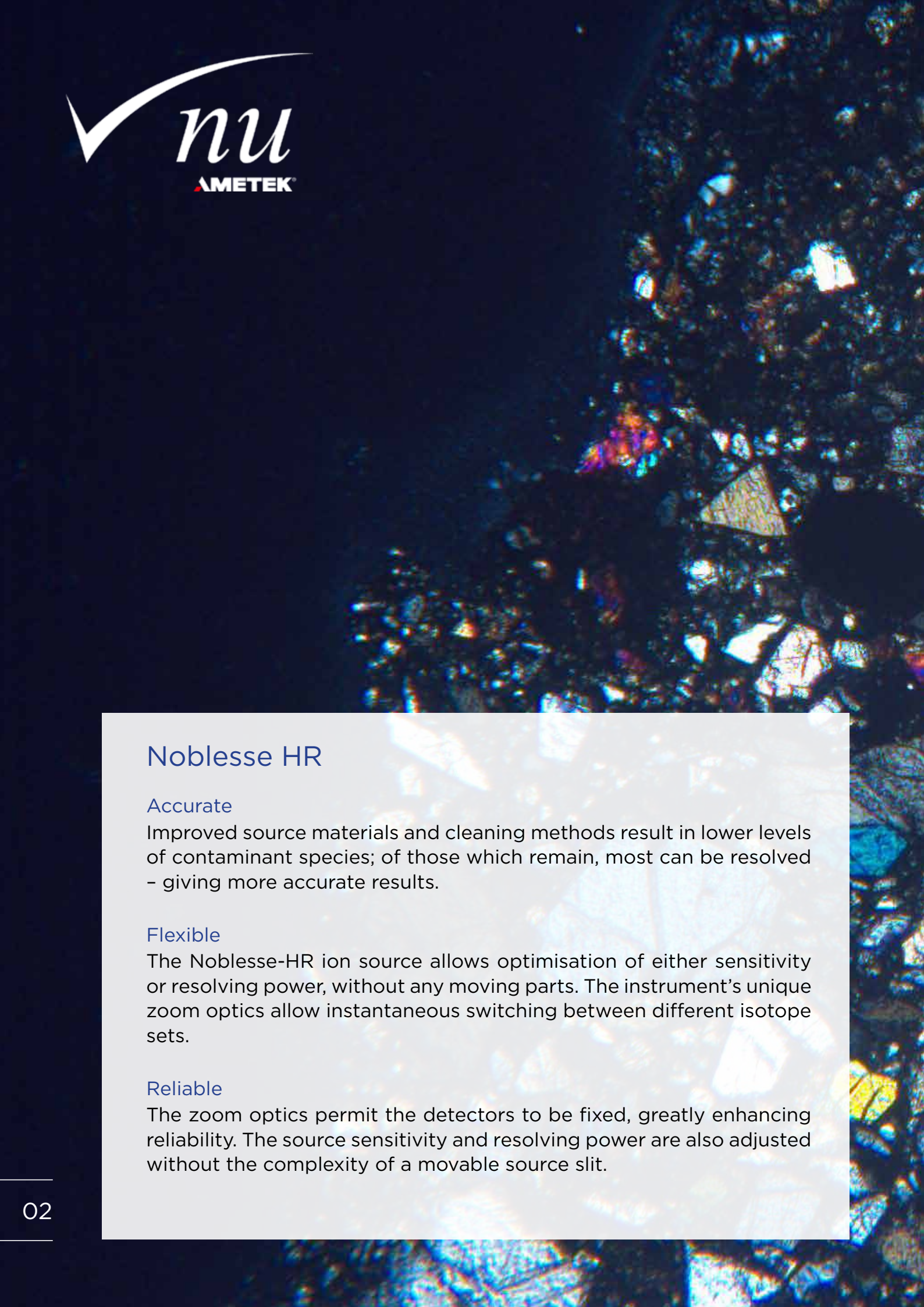

Noblesse HR

Accurate

Improved source materials and cleaning methods result in lower levels of contaminant species; of those which remain, most can be resolved – giving more accurate results.

Flexible

The Noblesse-HR ion source allows optimisation of either sensitivity or resolving power, without any moving parts. The instrument's unique zoom optics allow instantaneous switching between different isotope sets.

Reliable

The zoom optics permit the detectors to be fixed, greatly enhancing reliability. The source sensitivity and resolving power are also adjusted without the complexity of a movable source slit.

Noblesse HR - key features

- High resolving power – easy resolution of all C-based interferences to Ar; demonstrated resolution of ^{36}Ar and $H^{35}Cl$
- Straightforward source filament exchange
- Capability to stop sample consumption during gas inlet – improvement in precision as less extrapolation to T_0
- Adjustable sensitivity/resolving power – one instrument can be configured to make optimal measurements of both Ne (requires high resolving power) and Xe (requires high sensitivity)
- Laminated magnet for faster peak jumping
- Zoom optics for maximum flexibility and reliability
- Collector arrays with large discrete dynode electron multipliers, for improved gain stability and lifetime
- $^{20}NeH/^{21}Ne \leq 0.3\%$ in Ne of atmospheric composition
- Fully bakeable to 300 ºC
- Optional inline valve between source and magnet – reduces volume vented to air during maintenance
- Simple control interface to user prep systems

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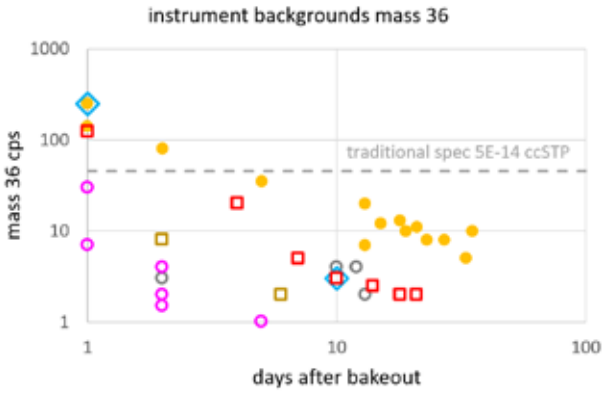
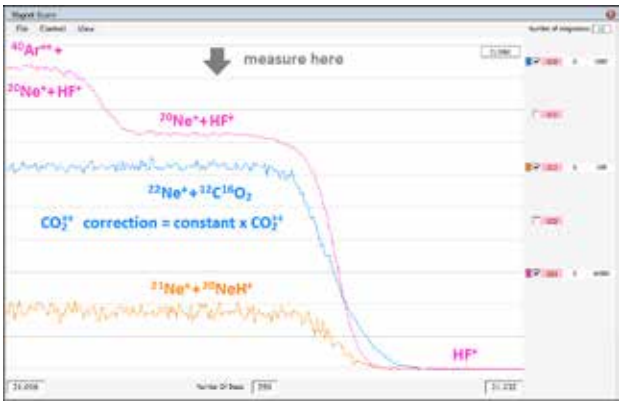


Mass 36 backgrounds after repeated venting, filament change, pump down and bakeout. $H^{35}Cl$ is included in the reported signal, but $^{12}C_3$ is easily resolved out. Each symbol represents a different filament.



Mass scans showing Ne multicollection. The measurement position is free of 40Ar2+ and 63Cu3+; any HF+ is included but is easily corrected by a short additional measurement at the foot of the peak.

Mass Spectrometer

The Noblesse HR is a single focussing mass spectrometer with a 24 cm radius, 75 degree magnet. The instrument provides good mass dispersion without excessive volume – the volume of the 5 Faraday 5 Multiplier instrument is 2900 cc including two getters (2100 cc without).

Source

The Noblesse HR employs a unique Nier type ion source, which permits adjustment between higher sensitivity and higher resolving power, without using a moveable source slit. The filament can be easily changed without removing the source and is self aligning on installation. Improvements in source materials and cleaning methods give much lower backgrounds than earlier instruments (see above figure).

Variable Dispersion Ion Optics

The Noblesse HR uses Nu Instruments' unique Zoom Optics system, which enables multi-collection of different sets of isotopes using a fixed collector array. The Zoom Optics allow 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 HR is fitted with a 20 l/s ion pump for pumpout during normal operations, whilst a 75 l/s Turbomolecular pump and dry backing pump are used to pump the instrument down from atmospheric pressure. One ion pump is fitted near the source as standard; a second can be fitted at the collector. Getters are fitted at both source and collector; both can be isolated and pumped independently, allowing activation without polluting the mass spectrometer. An optional inline valve can be fitted between the source and the magnet - this reduces the volume exposed to atmosphere during maintenance.

Noblesse HR

Versatile Collector Options

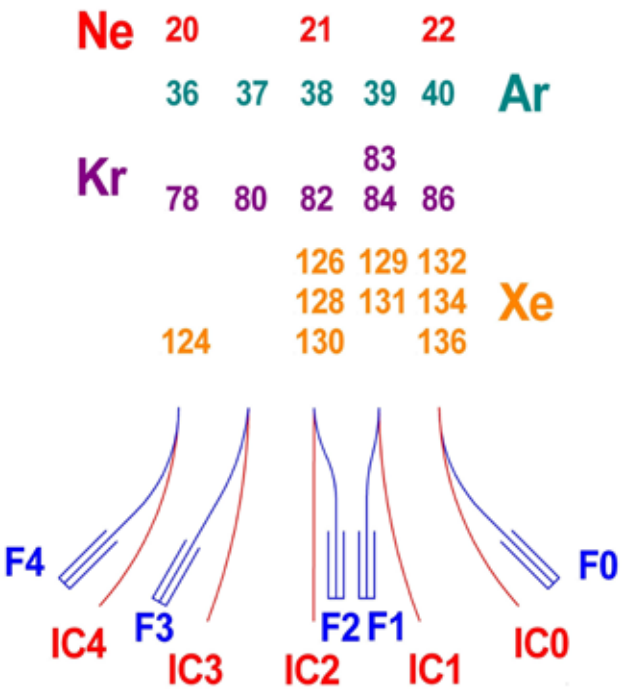
5 Faraday 5 Multiplier collector

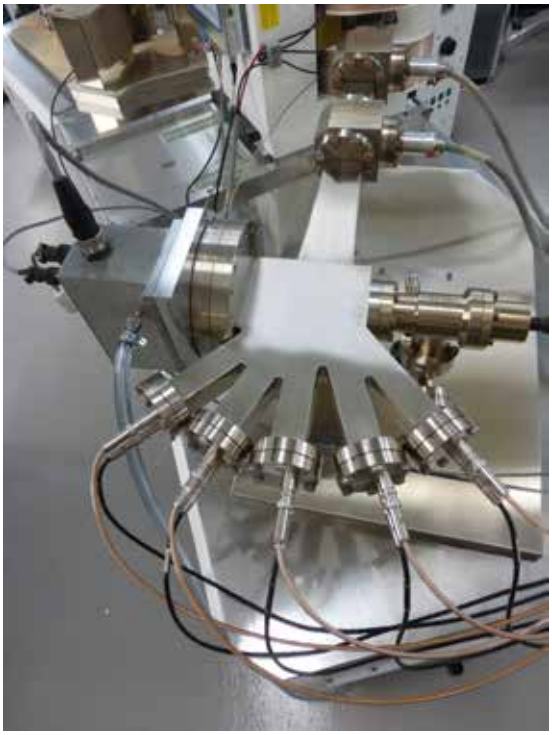
Fixed collectors, together with zoom optics, enable multicollection of isotope sets shown below.

Full multicollection is possible for Ne and Ar; Kr measured in 2 steps; Xe in 3 steps. He can be measured by peak jumping – this works well as most time is spent on the minor ^{3}He peak.

Full sized multipliers give enhanced stability and lifetime.

Each channel is switchable between Faraday and Multiplier to give maximum dynamic range. This also enables multiplier multicollection of all five Ar isotopes - for example, for small spot size, laser ablation studies.



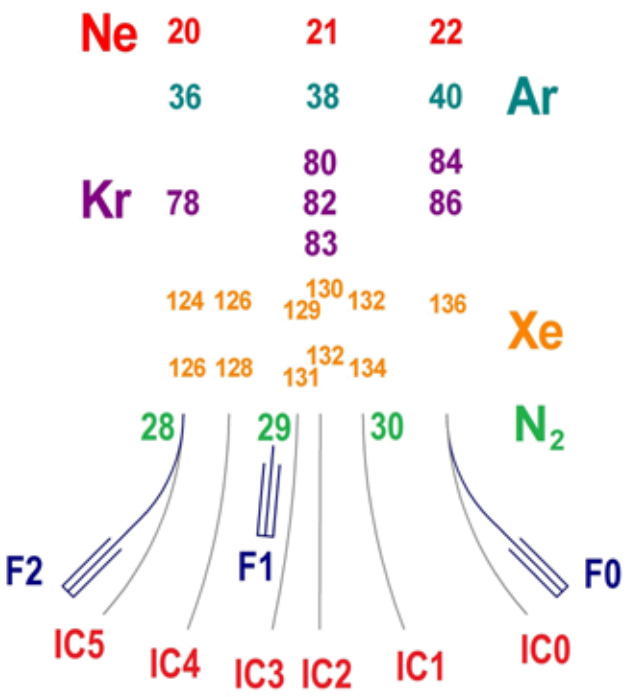


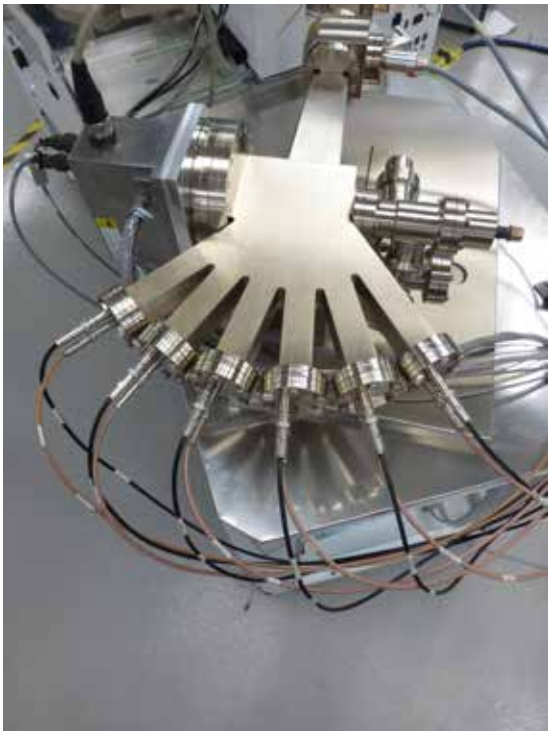
3 Faraday 6 Multiplier collector

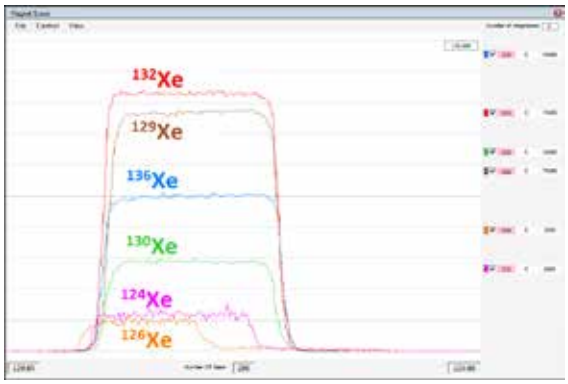
Six full size multipliers enable measurement of all isotopes of Xe in just two steps (shown below).

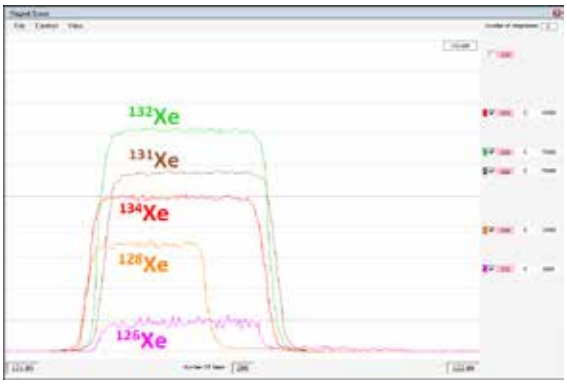
Masses 126 and 132 are measured on both steps.

This configuration also enables N_2 multicollection.









Noblesse HR

Integrated Sample Preparation System

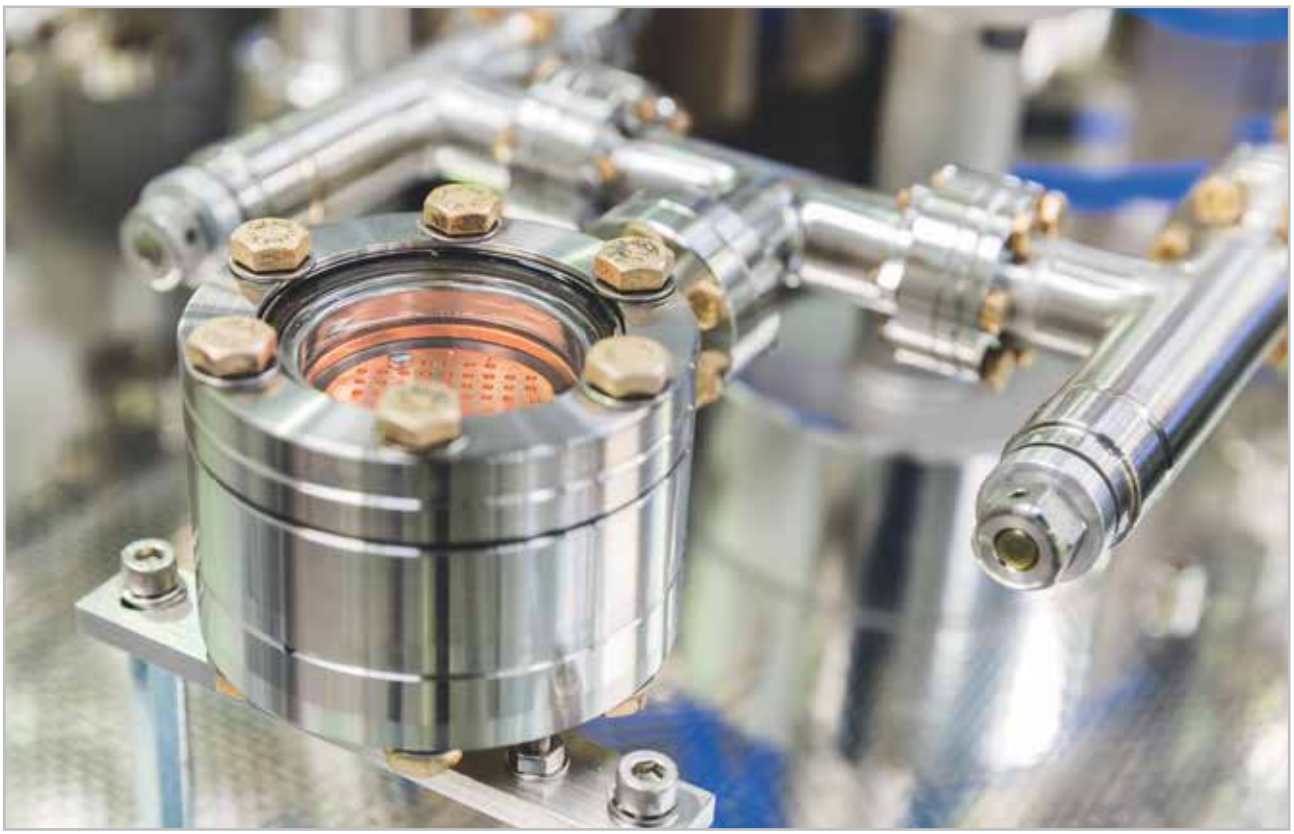
Sample Preparation System

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.

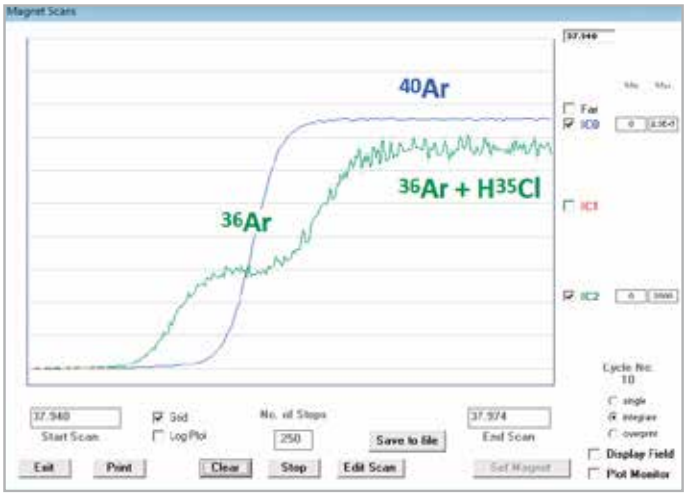
samples are introduced using a low volume carousel, which permits sequential dispensing of samples. A window enables the samples to be viewed during heating, as well as enabling the temperature to be monitored independently via the use of a (user supplied) optical pyrometer, if required.

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.

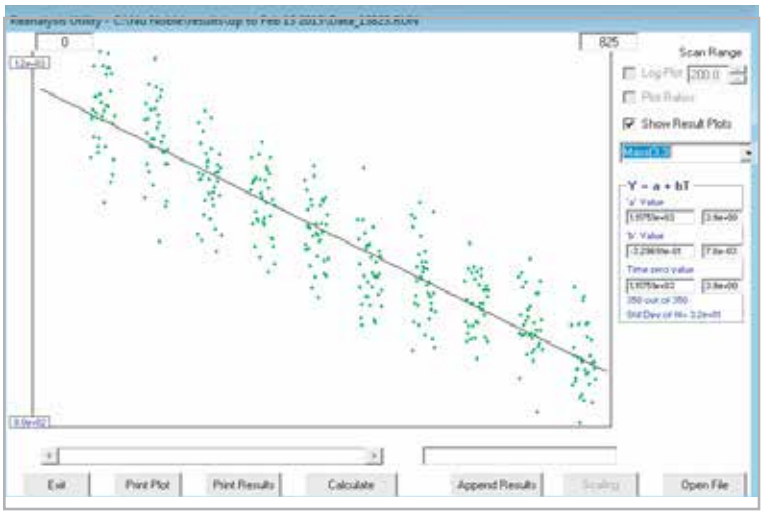
Noblesse HR

User Friendly and Intuitive Software

The Noblesse HR comes with 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 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.



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.

Selected Publications

C J Warren, S C Sherlock, S P Kelley. Interpreting high pressure phengite $^{40}Ar/^{39}Ar$ laser probe ages: an example from Saih Hatat, NE Oman. Contributions to Mineralogy and Petrology, DOI 10.1007/s00410-010-0576-1 (2010).

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C J Campisano, E C Kirk, K E B Townsend and A L Deino. Geochronological and Taxonomic revisions of the Middle Eocene Whistler Squat Quarry (Devil's Graveyard Formation, Texas) and Implications for the Early Uintan in Trans-Pecos Texas. PloS one 9 (7), e101516 (2014).

Brad Singer, Brian Jicha, Daniel Condon, Alexandra S Macho, Kenneth A Hoffman, Joseph Dierkhising, Maxwell C Brown, Joshua M Feinberg, Tesfaye Kidane. Precise ages of the Reunion event and Huckleberry Ridge excursion: Episodic Clustering of geomagnetic instabilities and the dynamics of flow within the outer core. Earth and Planetary Science Letters (405), 25-38 (2014).

D Kellett and N Joyce. Analytical details of single- and multicollection 40Ar/39Ar measurements for conventional step-heating and total-fusion age calculation using the Nu Noblesse at the Geological Survey of Canada. Geological Survey of Canada, Technical Note 8 (2014)

Bastian Baecker. Primordial and other noble gases in micrometeorites. Doctoral Thesis, Ruprecht-Karls-Universität, Heidelberg (2014).

Stephanie Flude, Alison M Halton, Simon P Kelley, Sarah P Sherlock and James Schwanetal, Observation of centimetre-scale argon diffusion in alkali feldspars: implications for $^{40}Ar/^{39}Ar$ thermochronology. Geological Society, London, Special Publications, 378 pp. 265–275 (2014).

Cameron M Mercer, Kelsey E Young, John R Weirich, Kip V Hodges, Bradley L Jolliff, Jo-Anne Wartho, Matthijs C van Soest. Refining lunar impact chronology through high spatial resolution $^{40}Ar/^{39}Ar$ dating of impact melts. Sci. Adv. 2015; 1; e1400050 (2015).

E N DiMaggio, C J Campisano, J Rowan, G Dupont-Nivet, A L Deino, F Bibi, M E Lewis, A Souron, L Werdelin, K E Reed and J R Arrowsmith. A Rare late Pliocene Fossiliferous Sedimentary Record and the Environmental Context of the early Homo from Afar, Ethiopia. Science Express, 5 March 2015 / 10.1126/science.aaa1415 (2015).

J M Saxton, A method for measurement of ^{36}Ar without $H^{35}Cl$ interference. Chemical Geology, 409, 112-117 (2015).

J M Saxton, The $^{21}Ne/^{20}Ne$ ratio of atmospheric neon†, J. Anal. At. Spectrom.,35, 943, (2020).

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Innovators in Mass Spectrometry

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