# ASTRUM

## HIGH RESOLUTION GLOW DISCHARGE MASS SPECTROMETER


nu instruments

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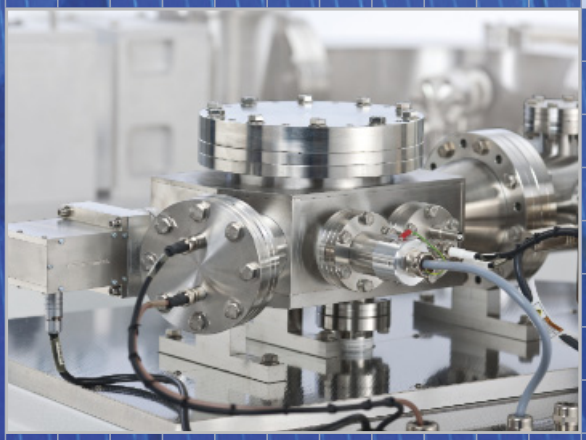
# Astrum

Glow discharge mass spectrometry (GD-MS) is recognised as one of the ultimate techniques for the characterisation of conductive and non-conductive materials. It is capable of quantifying virtually all elements from lithium to uranium, and from matrix to sub part-per-billion.

The Astrum from Nu Instruments combines a glow discharge ion source with a high resolution mass spectrometer and is a major step forward in GD-MS, from the cryo-cooled tantalum source/cell and rapid sample changeover system through to the bespoke control software. The durable construction of the instrument and proven source design give maximum uptime with minimal intervention.

## Astrum - key features

- Glow discharge source based on proven technology
- Reduced flow static discharge for maximum stability
- Tantalum cell construction for ease of cleaning
- Pin and flat sample configurations for maximum analytical flexibility
- Easy sample changeover using a unique loading probe
- Cryo-cooled source for analysis of low melting point samples and minimisation of background gases
- Double-focusing mass spectrometer, based on field proven technology
- Continuously variable high resolution capabilities from 400 to >10000 (10% valley definition)
- Faraday and ion counting multiplier for wide dynamic range
- Determination of matrix to sub-ppb elements in a single scan
- Purpose built electronics with monitoring of all instrument parameters
- Unique pumping configuration
- Bespoke software with intuitive instrument control and data analysis



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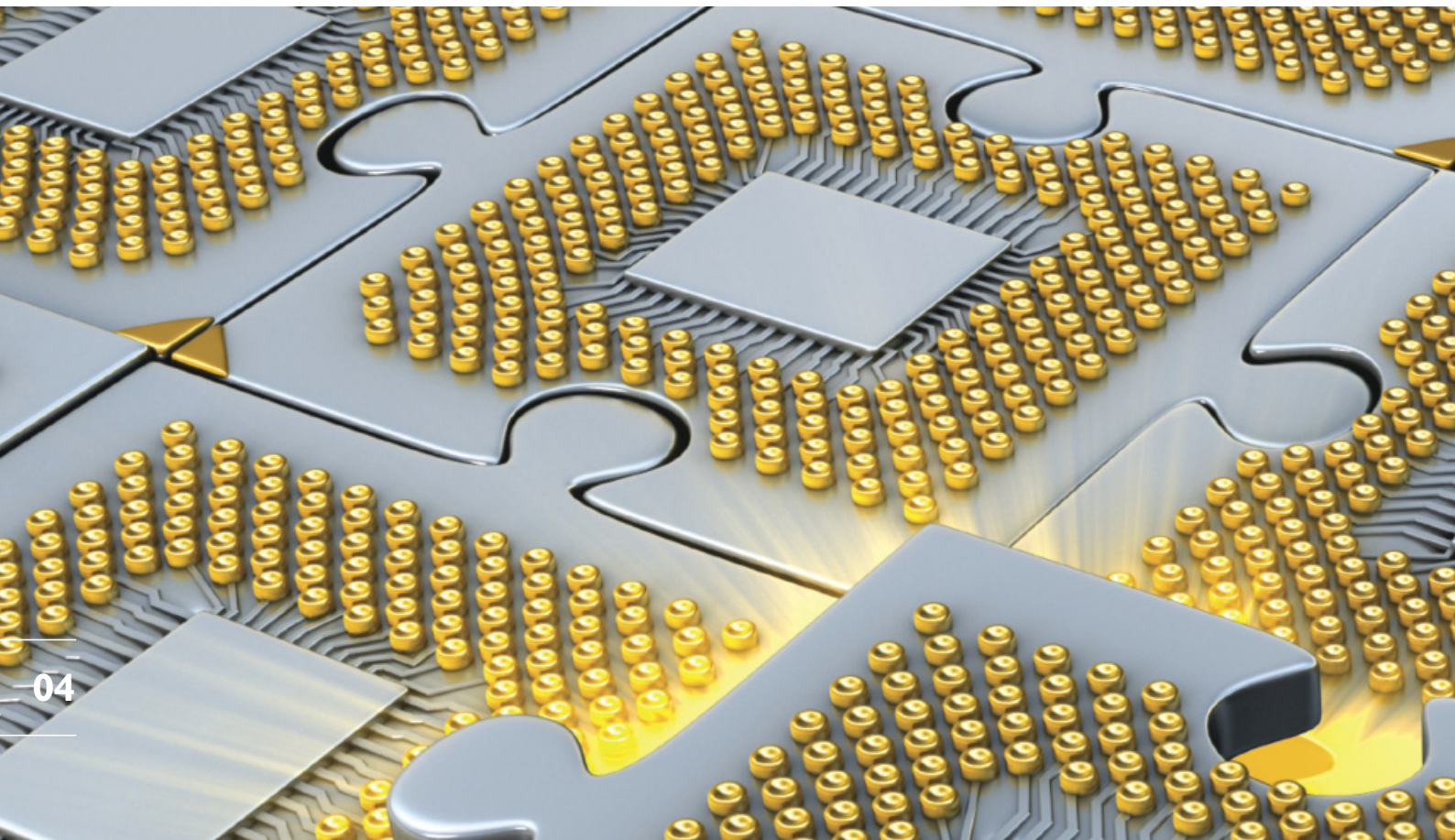
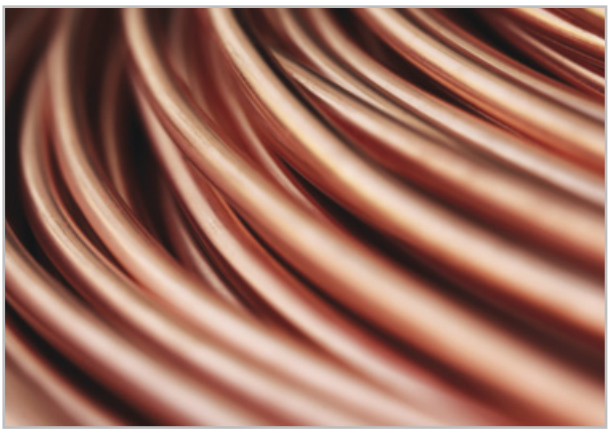
## THE ASTRUM IS DESIGNED TO TEST HIGH PURITY MATERIALS WITH THE BEST DETECTION LIMITS

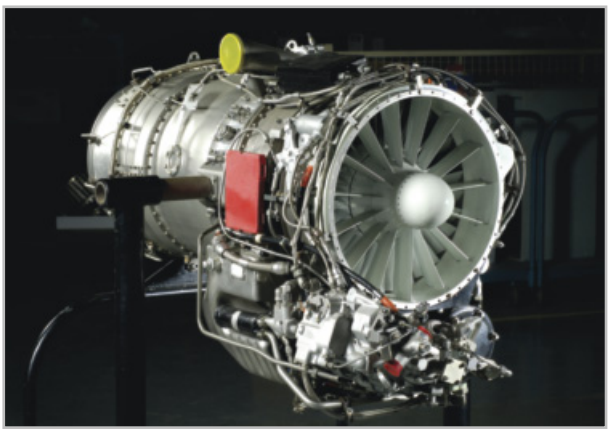
The primary application of the Astrum GD-MS is the characterisation of high purity material whether it be nickel superalloys  for the aerospace industry, copper and silicon for the semiconductor industry, or gallium for the ever-developing LED business.

### Semiconductor Industry

There is a burgeoning interest in the use of HR GD-MS for semiconductor materials such as silicon and sapphire. This is driven not just by the semiconductor industry but also by the demand for solar cell silicon, wherein the purity of the silicon has a direct correlation with the solar cell performance.
Production of virtually all electronic, optical and electro-optical devices requires high-purity semiconductors. The electrical properties of these semiconductors are dependent on the impurities present in them and only extreme low levels of impurities are permitted in these metals to guarantee the performance of the end product such as microprocessors and other micro devices. GD-MS also helps in bulk survey analysis of these semiconductors to identify the amount of impurities even at the trace and ultra-trace levels.







## Pure Metal Industry

In large scale production of metals and alloys the total trace impurity is not well controlled. However, in order to control its mechanical, chemical and electrical properties, controlled doping with trace elements and purification to reduce the presence of unwanted materials is required. GD-MS helps in identifying the impurities in the finished product, thereby ensuring the quality and performance of the system where these metals are used.

## Alloy Industry

Alloys and Super Alloys are the key materials for the manufacturing of high performance machinery such as turbines. As these types of machinery often work under very high temperature and pressure, even a slight change in composition of the trace elements can have undesirable results. GD-MS is ideal in identifying these elemental compositions in the product to ensure the best performance of the system.

Contract laboratories use GD-MS analysis for materials characterisation and the Astrum design has been greatly influenced by their requirements. In some cases these can be the most demanding users, with regular changes in sample matrix and sample quality. The Astrum is the benchmark for achieving the best data quality with the lowest detection limits and running costs.

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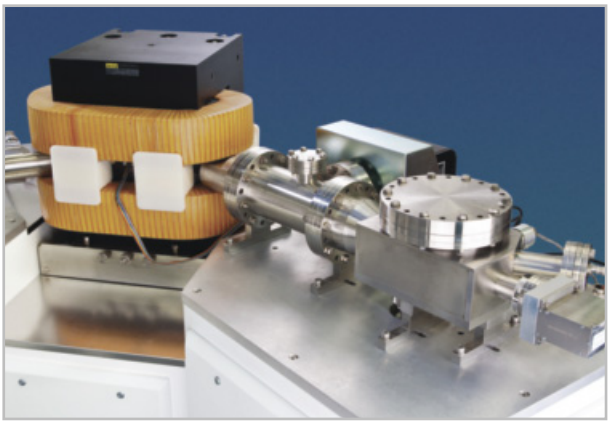
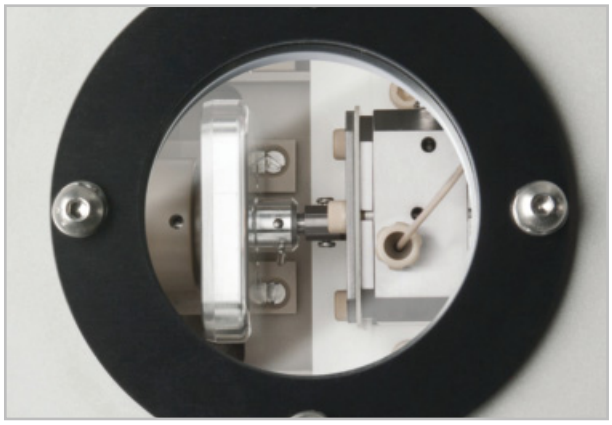
## HIGH RESOLUTION GLOW DISCHARGE MASS SPECTROMETER





## Mass Spectrometer

The Astrum is a double focusing instrument with both an electrostatic and a magnetic sector. This is necessary to allow the instrument sufficient resolution to separate analyte species from interfering molecular species. It is based on a tried and tested layout to produce high resolution and high ion transmission. Its sensitivity, ease of calibration, flexibility and robustness to analyse a wide variety of sample types and matrices makes it ideal for trace elemental analysis. The magnet is laminated and able to switch between masses rapidly and accurately.

## High Resolution Capability

The high resolution system employed by the Astrum is of a continuously adjustable slit mechanism. It allows the best combination of resolution and sensitivity, avoiding over-resolution at the expense of sensitivity. The low resolution (10% valley) of the Astrum is 400, and high resolution >10,000 can be achieved. A typical resolution setting chosen by many analysts is 4,000.

## Low Running Cost

The Astrum has relatively low running costs in comparison to other instruments in the market. The sample cell does not require regular cleaning due to minimal memory effects as the cryo-cooling removes residual gases. The robust source construction does not get worn easily, reducing the need for frequent replacement.

# THE ASTRUM SOURCE: ROBUST & FLEXIBLE CONSTRUCTION

### Reduced Memory Effect

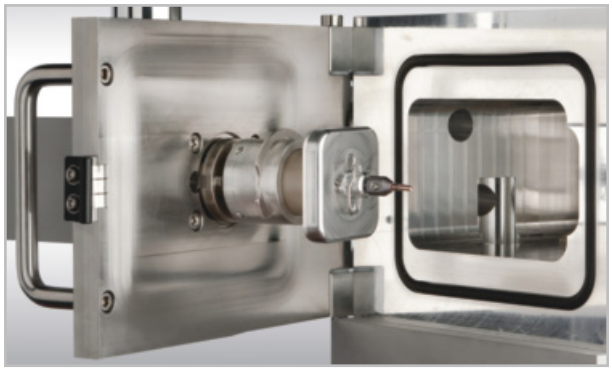
The glow discharge source in the Astrum is engineered from tantalum. It is designed to minimise memory and backgrounds whilst maintaining a design that is easy to remove and clean.

### No Residual Gases

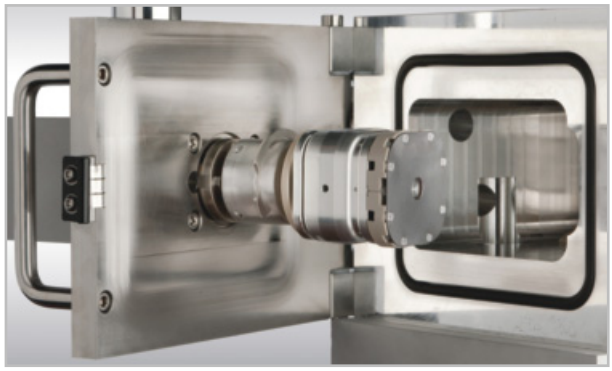
The Astrum uses Cryogenic cooling which achieves better background than other methods such as Peltier cooling. The analysis of high purity materials by GD-MS is made difficult by the presence of molecular gases that interfere with the analyte peaks, potentially causing erroneous measurements. Whilst high resolution is capable of isolating some of these gas peaks, others cannot easily be resolved. Cooling the sample and glow discharge cell with cryogenic gases removes residual gases and significantly reduces undesirable species from the spectrum. Furthermore, cryo-cooling makes the analysis of low melting point materials (such as gallium) significantly easier.

### Pin & Flat Sample Cell Holders

The Astrum is supplied with both pin and flat sample holders to allow for a wide range of samples including unfinished/ finished materials, powders and irregular shapes. Samples are easy to remove and refit using the unique loading probe. Both types of sample holder are machined from tantalum for ease of cleaning and to minimise cross-contamination between samples.

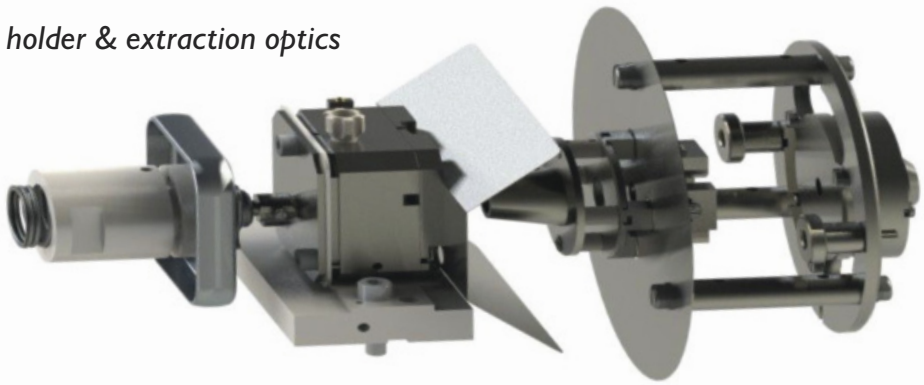


*Pin sample holder*



*Flat sample holder*

*Pin sample holder & extraction optics*



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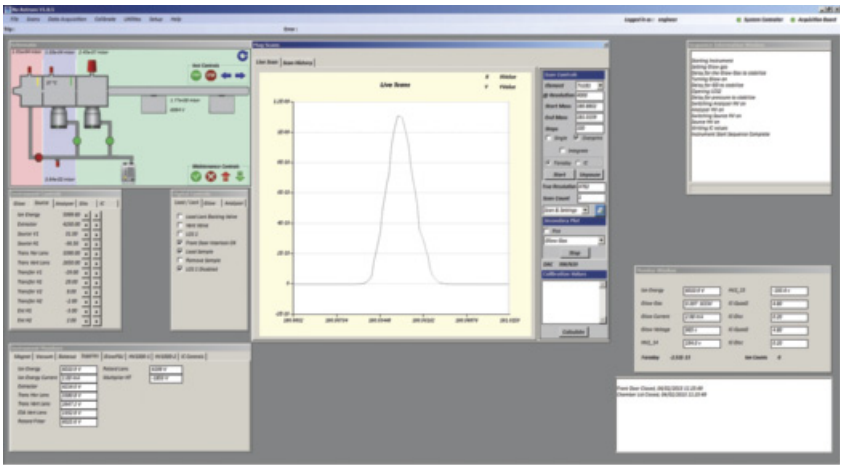
## BESPOKE SOFTWARE SUITE WITH INTUITIVE CONTROL AND ANALYSIS

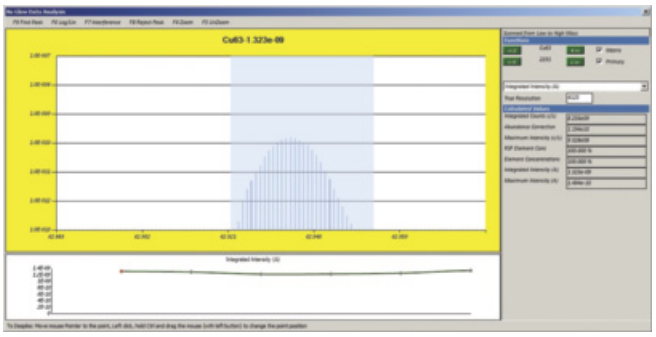
### Detector system



GD-MS is a universal technique in that matrix elements (up to 100%), trace elements (to sub ppb level) and everything in between is analysed in the same scan. To cover this extremely wide dynamic range, the Astrum uses both an ion counting detector and a Faraday detector. The ion counting detector is a full-size electron multiplier that has been designed for longevity, good linearity and low background count rates. The Faraday detector is of a fast charge-coupled design with proven long lifetime and connected to a high stability pre-amplifier. Switching between the two detectors is fully automated within the Astrum control software. Scan windows are colour coded to allow the analyst instant identification of which detector has been used for each analyte.

### Electronics and software

The Astrum uses a state-of-the-art suite of electronics, with fully automated monitoring of all instrument parameters and the status of each power supply. The control software was designed in conjunction with GD-MS users to provide them the control and flexibility that they require. Data is extremely easy to interpret and can readily be exported for off-line processing. Furthermore, upgrades to the software are supplied free of charge for the lifetime of the instrument.



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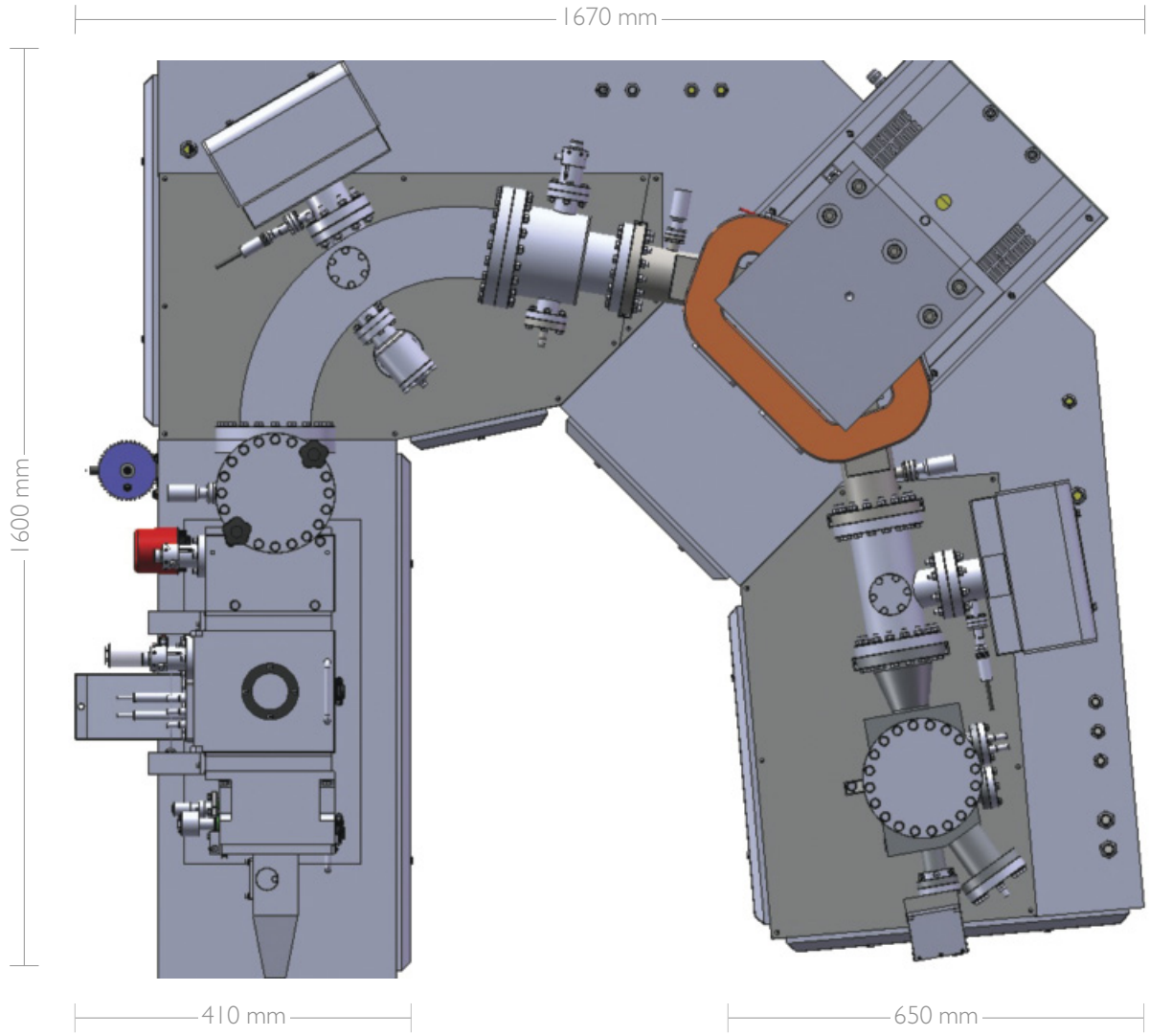


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|---|---|
| Width: | 1,670mm |
| Depth: | 1,600mm |
| Power requirements: | 230V, 50/60Hz, 16A<br>(transformer supplied for sites with alternate voltage) |
| Water chiller: | Supplied (500W), for cooling turbomolecular pumps |
| Heat loading: | 1.5-2kW during normal operation |
| Vacuum pump exhaust: | 12mm I/D flexible tubing |
| Temperature range: | 20-24°C |
| Humidity: | Below 70% |
| Gas supplies required: | Argon (99.9995%) and compressed air |
| Cryo-cooling: | 120-200 litres capacity dewar recommended |
| Communications: | Instrument PC can be connected to the internet for service support |
| Matrix current (sensitivity): | $>5x10^{-10}$ amps at RP>4,000 using total Cu signal |
| Operating analyser pressure: | $<2x10^{-7}$ mbar under full gas load |

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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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