

VeraSpec HRQ

High Resolution Quadrupole Mass Spectrometer



PRODUCT NOTE



- Nuclear Research
- Gas Production
- Fuel Cell Development

Introducing the VeraSpec HRQ

High Resolution Quadrupole Mass Spectrometer

The VeraSpec™ HRQ delivers exceptional resolution, ion transmission and abundance sensitivity for the fine isotopic analysis of low molecular weight gases.

Isobaric compounds have different structures and make-up, but have the same nominal mass. Small, millidalton, differences in the actual mass of the ions can reveal their true composition. Many applications in gas purity, fuel cell development, and nuclear research require this level of fractional mass detail to identify and quantify low molecular weight species, but achieving this resolution in the low-mass range can be challenging.

The VeraSpec HRQ combines cutting-edge Core MS components to achieve the highest resolution to date in Extrel's VeraSpec line of high-performance mass spectrometers. Utilizing the Extrel 19 mm tri-filter quadrupole and high precision 2.9 MHz control electronics, the VeraSpec HRQ has a resolution >3000 ($M/\Delta M$) across a 1-50 Da mass range.

In addition to fractional mass analysis, the Merlin Automation™ Control Software adds unique and powerful features for full sample characterization. Merlin can scan for both positive and negative ions, and includes full control of mass-specific resolution tuning. This allows the user to define and execute a single, 50 Da scan with accurate mass and ultra-high resolution where it's needed, and nominal mass resolution at other masses. The result is an analyzer with tremendous flexibility, and the ability to measure the full composition of the sample in every scan.



Figure 1: VeraSpec HRQ

A high resolution quadrupole mass spectrometer
for the nuclear, gas production, and fuel cell industries.

Hydrogen and Helium/Deuterium Analysis

Quantifying hydrogen isotopes in the presence of helium, or detecting helium leaks in a heavy hydrogen sample, are among the most challenging low-mass applications. The ultra-high resolution of the VeraSpec HRQ can separate the accurate mass peaks of helium and dueterium to baseline. In addition, the start of the scan is completely free of on-blast (an elevated background near m/z 0) enabling the precise, accurate analysis of hydrogen at m/z 1 (Fig. 2).

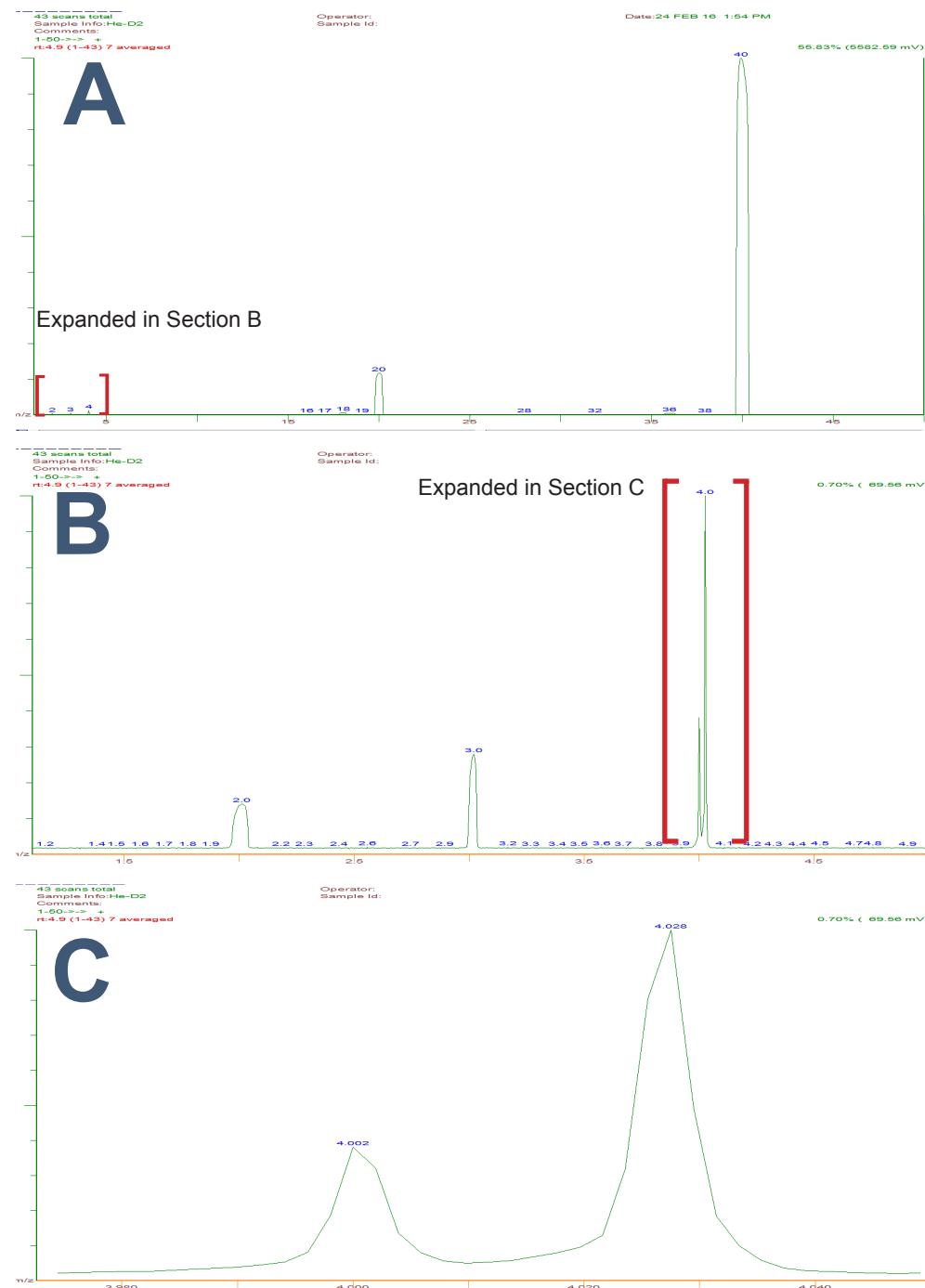


Figure 2: The VeraSpec HRQ was used to analyze a mixture of argon, helium, and deuterium. The three images above depict portions of the same scan, displayed with increasing resolution to show the level of detail within the data set.

- The full scan from m/z 0.5-50 shows the mass spectrum of the sample. For the majority of the scan, including m/z 20 and 40 where argon appears, the analyzer was set for unit resolution to allow maximum ion transmission and sensitivity.
- At m/z 5 and below however, the resolution was increased to completely separate the peaks of the low mass molecules.
- Helium and deuterium both have a nominal mass of 4 Da, but the VeraSpec HRQ provides the complete separation and accurate mass of the two compounds in this sample.

Exceptional Abundance Sensitivity

Abundance sensitivity is the ratio of signal produced by a peak at its highest point to the amount of signal it produces at a point +/- 1 Da on the mass range. Excellent abundance sensitivity is necessary to measure a trace component at an analytical mass that occurs within 1 Da of a major peak in the spectrum of the bulk gas. Ultra-high resolution gives the VeraSpec HRQ an abundance sensitivity of better than 10^6 . In the analysis of a helium sample, the peak from ${}^3\text{He}$ can be clearly distinguished from ${}^4\text{He}$ despite the concentration of the larger isotope being over 500,000 times greater (Fig. 3).

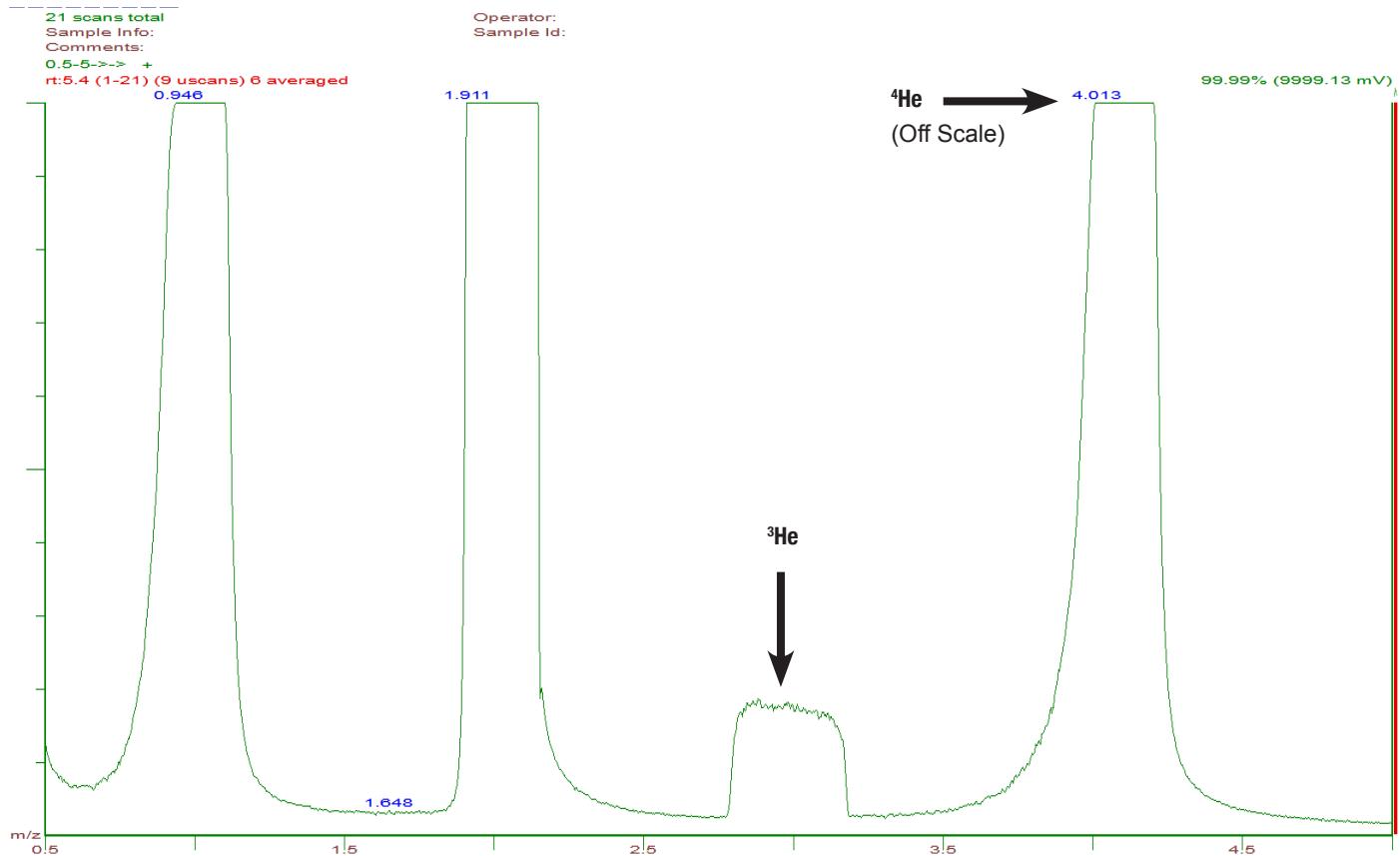


Figure 3: A scan from m/z 0.5 to 5 showing the natural helium isotope ${}^3\text{He}$ in a UHP helium sample. ${}^3\text{He}$ is only 2ppm relative to ${}^4\text{He}$, but the small peak is clearly visible, because the VeraSpec HRQ has an abundance sensitivity of 10^6 .

The Extrel “Complete System” Advantage

The VeraSpec family of quadrupole mass spectrometers is the result of decades of collaboration between Extrel and their research, academic, and industrial customers. Each VeraSpec analyzer is a turn-key solution, letting you focus on your work instead of on building an analyzer.

- **Design:** Each application demands specific capabilities. Preconfigured, proven Extrel components can be quickly and easily incorporated into a mass spectrometer tailored to the job at hand.
- **Integration:** Precision alignment, in-vacuum wiring, and system control can be complex issues. Extrel analyzers are engineered with function and maintainability in mind, reducing cost and saving time down the road.
- **Validation:** Full functionality and system stability are confirmed and documented prior to leaving the factory.
- **Support:** A qualified Extrel technician will install the instrument, verifying factory-run performance for optimum operation. Extrel technical support ensures that experts who know your analyzer will be available for assistance during the entire life of the system.

Application Specific Customization

The VeraSpec HRQ system offers flexible inlet options for seamless sample integration:

- Conflat flange or VCR fittings for gas purity and leak-proof sample introduction, UHV operation, and assurance of safety in a demanding environment
- VCR fittings with toggle and metering valves for calibration and sample gases
- Load-lock style chamber for connecting to a furnace, glove box, or other outgassing samples
- Custom designed inlets available

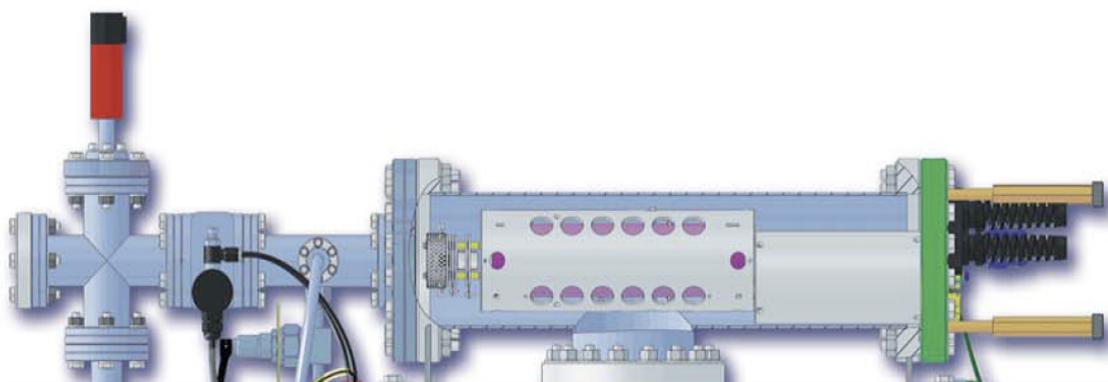


Figure 4: A cutaway view of the probe in a VeraSpec HRQ with a pumped gas inlet.

VeraSpec HRQ System Specifications

Table 1: VeraSpec HRQ Mass Range Options

| Mass Range | Quadrupole Mass Filter | Operating Frequency | Relative Transmission | Resolution (M/ Δ M FWHM) | General Sensitivity (mA/Torr) |
|------------|-----------------------------|---------------------|-----------------------|---------------------------------|-------------------------------|
| 1-50 | 19 mm (3/4 inch) tri-filter | 2.9 MHz | 75% | 3000 | 4 |
| 1-120 | 19 mm (3/4 inch) tri-filter | 2.1 MHz | 65% | 2500 | 3 |

Installation Requirements:

- Recommended Power Supply:
 - (2) 120 VAC, 50/60 Hz, 15 Amp circuit
 - (2) 220 VAC, 50/60 Hz, 15 Amp circuit
- Ambient Temperature:
 - 55° F to 80° F (13° C to 27° C)
- Relative Humidity: 0-90% non-condensing
- Analyzer Weight: 200-250 lbs (90-115 kg)
- Analyzer Dimensions:
 - Height: 42.9" (109 cm)
 - Depth: 40.0" (102 cm)
 - Width: 23.1" (59 cm)

Merlin Automation Data System Software:

- Instrument Control: PC connected via USB or Ethernet
- Analysis Mode:
 - Scan Mode
 - Single Ion Monitoring (SIM)
- External Communications:
 - Ethernet, digital I/O, analog I/O, OPC

Exceptional Worldwide Service and Support: For over 50 years, Extrel has been committed to providing the highest quality support services for thousands of instruments installed worldwide. Factory trained and certified personnel are available to provide industry-leading support to our customers at every stage of their analytical process.



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