In practice, the RF and DC control voltages to the quadrupole are both decremental over time so as to scan a sequential range of m/z ions (highest to lowest m/z). Scanning starts at a predetermined m/z and both voltages then decrement at a predetermined rate (i.e. the scanning speed) until the final predetermined m/z is achieved (i.e. the scan range). At each decrement, the RF and DC tuning ratio must be carefully matched. If the DC is too high, the quadrupole will attenuate the desired m/z ions. If the DC is too low, the quadrupole will not effectively attenuate unwanted m/z ions in resolution. The DC in each quadrupole is typically matched to that of the RF (see the “Standard Response” curve in Figure 1). The RF and DC scan rates, matching the RF and DC response is no longer sufficient due to the decreasing mass resolution through the quadrupole becomes longer than the time between scan decrement steps.

Agilent’s patented Quadrupole Fast Scan Technology provides the ability to dynamically scan the DC response relative to the RF during the settling time of each scan. The DC is referenced to the RF so that when the “RF” “speeds” the quadrupole field, no ions already in transit are able to pass through the quadrupole assembly without their abundance being attenuated by each successive scan decrement step. At the end of the settling time, the matched RF and DC ratio is restored to preserve resolution of the mass peak.

Isotopic Fidelity at Ultra-fast Scan Speeds

The observed isotope distribution for sulfachloropyridazine obtained from UHPLC chromatographic data at ultra-fast scan speeds with fast polarity switching using the UPHLC separation shown in Figure 5. The observed isotope distribution demonstrated excellent agreement with theoretical values (Figure 6).

Conclusions

- Patented Agilent quadrupole fast scan technology improves ion transmission at scan speeds up to 15K Da/sec.
- Ion response resolution was maintained at ultra-fast scan speeds with UPLC chromatographic data using quadrupole fast scan technology with the new linear phase FIR filter.
- Ultra-fast scanning with fast polarity switching enabled the collection of ten positive and ten negative scans across sub-1 second peaks from m/z 259 to 1,259 at 15K Da/sec (Figure 5).

Figures and Tables

- Figure 1: A new proprietary linear phase FIR filter demonstrated improved signal quality and resolution when compared with a Gaussian filter at 15K Da/sec scan speeds.
- The observed isotope distribution demonstrated excellent agreement with theoretical values.
- Ultra-fast scanning with fast polarity switching enabled the collection of ten positive and ten negative scans across sub-1 second peaks from m/z 259 to 1,259 at 15K Da/sec scan speeds.

Results and Discussion

Ultra-fast Scan Speed Performance

When profile data was collected at 15 KDa/sec scan speeds with the Gaussian filter, isotopes could not be resolved, and full width at half maximum (FWHM) for the peaks ranged from 0.77 to 0.82 (Figure 4a). The new linear phase FIR filter was then compared with standard Gaussian filtering to improve its effective resolution at 15K Da/sec scan speeds.

With profile data was collected at 15 KDa/sec scan speeds with the Gaussian filter, isotopes could not be resolved, and full width at half maximum (FWHM) for the peaks ranged from 0.77 to 0.82 (Figure 4a). The new linear phase FIR filter was then compared with standard Gaussian filtering to improve its effective resolution at 15K Da/sec scan speeds.