



Enabling faster MRM while maintaining instrument robustness

David M. Cox, Yang Kang, Ian Moore, Holly Lee, and Michael Deng
SCIEX, Canada

Monitoring many MRM transitions and high sample throughput is vital for maintaining safety and quality in several fields of study. Assays with many MRM transitions can screen not just for expected compounds but also for compounds that are less likely to be observed. Analyzing many samples in a row from complex and dirty matrices without having unplanned maintenance is crucial for delivering timely results.

Fig. 1: **The SCIEX 7500+ system** has an enhanced Q0 region that improves robustness by filtering away ions above the mass cutoff for the analysis method. Ions of interest are subsequently accelerated along the ion path to exit Q0.

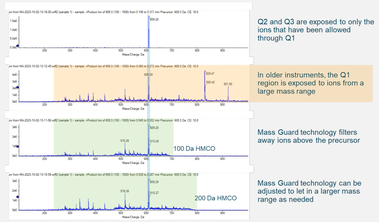

Fig. 2: **Q0 mass transmission windows**. In an MRM or product ion scan, the only ions that reach Q2, Q3 and the detector are ions that have been allowed through Q1. The range of ions entering Q1 can be quite large, including well beyond the mass range we ever scan with Q1. These ions can contaminate the lens elements up to and including Q1. For each MRM transition, the instrument now filters away ions larger than the precursor mass of interest (a high mass cut-off, HMCO), thus preventing contamination.

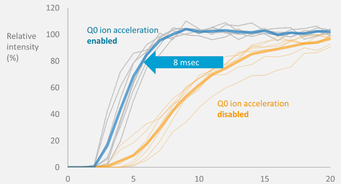

Fig. 3: **Q0 ion transmission speed.** Ions larger than the precursor mass of the current MRM transition are being filtered away. However, this could be an issue if ions for the next MRM transition are also filtered away, and there isn't enough time to re-establish the ion beam. To address this, ion acceleration was introduced to the Q0 region. This figure shows the benefit of Q0 ion acceleration on the time to detect ions transiting from Q0 to the detector. This experiment was performed under challenging conditions with high mass ions, without fragmentation and at varying Q0 pressures. With Q0 ion acceleration enabled, the transit time was significantly reduced.

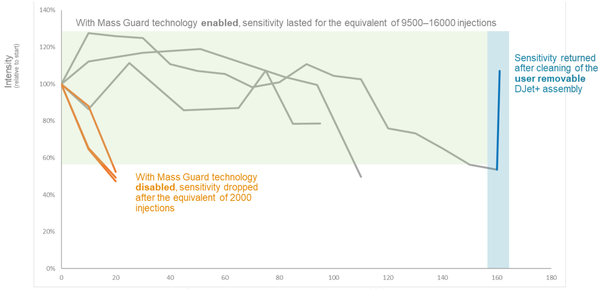

Fig. 4: **An accelerated contamination protocol** was used to compare how long an instrument could acquire samples. A solution of tea/arugula extract was directly infused. After every 10-15 mL of infusion, the intensity of reserpine tuning solution was evaluated. The protocol was stopped when sensitivity dropped below 50%. This protocol eliminates the complexity of LC column and other interactions for testing the robustness of the instrument. This protocol was repeated on multiple instruments. With Mass Guard technology **disabled**, the instruments required maintenance after the infusion of 20 mL of sample. With Mass Guard technology **enabled**, instruments lasted for up to 160 mL of infusion. Sensitivity was regained after cleaning only the parts that are user removable, such as the DJet+ assembly.

An **enhanced Q0** region **removes high mass ions** before they can contaminate Q1, while also enabling **faster ion transmission**. This improves how long the instrument can run samples and increases the number of MRM/sec.

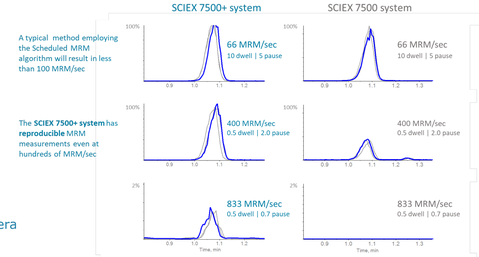

Fig. 5: **MRM/second**. MRM for several compounds were acquired at various dwell and pause times. Shown here are extracted ion chromatograms for methamphetamine. Three replicates were acquired for each condition. In a typical method employing the Scheduled MRM algorithm, 66 MRM/sec (10 msec dwell, 5 msec pause) is easily achievable. Whether using a SCIEX 7500 system or SCIEX 7500+ system, the full signal strength is available for screening or quantifying at these dwell/pause times. If pause time is not sufficient to establish the full MRM ion flux, a reduction or elimination of signal will occur. As scheduling windows sizes are increased, or if more compounds are added to method, or if the length of the LC gradient is reduced… these all require faster cycle times, and therefore more MRM/sec. The SCIEX 7500+ system has significantly better signal strength at higher MRM/sec due to the acceleration of ions in the Q0 region and improved electronic components in other parts of the ion path.

To receive a copy of this poster:
- Scan the code with your phone camera
- Complete the form

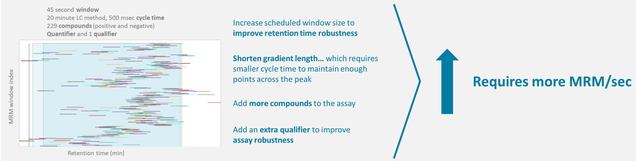

Fig. 6: **A typical pesticide screening MRM assay** includes many compounds with scheduled acquisition windows and a target cycle time appropriate for the LC gradient length. Improvements to this method (listed above) all require, or benefit from, the ability run more MRM/sec.

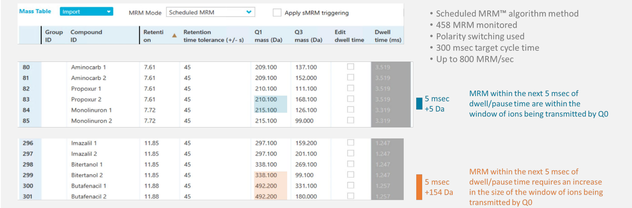

Fig. 7: **A pesticide screening MRM assay was performed with the target cycle time decreased**. For each MRM, the enhanced Q0 region filtered away ions larger than the precursor and accelerated the precursor ions toward Q1. In most cases, the next MRM to be acquired was either within the current window of mass transmission in Q0 or there was enough dwell/pause time to achieve full transmission. However, in the densest regions of acquisition, there were cases in which the next MRM to be acquired was outside the current window of mass transmission in Q0 and there was not enough time to establish full transmission. In these cases, the software automatically adjusted the size of the mass transmission window in Q0 to include the precursor for the next MRM.

REFERENCES

1 Bradley B. Schneider, Yang Kang, Leigh Bedford, Ian Moore, Mircea Guna, Chang Liu, and James Hager. Mass spectrometer robustness improvement with a quadrupole ion guide bandpass filter. ASMS 2022
2 Mike Morrison. How to create a better research poster in less time (#betterposter Generation 2) [Internet]. 2020 [cited April 23, 2024]. Available from: https://www.youtube.com/watch?v=SYk29tnxASs

TRADEMARKS/LICENSING