Introduction to latest LC-MS/MS technology innovations

SCIEX 7500 system and ZenoTOF 7600 system

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RUO-MKT-11-11650-C and RUO MKT-11-13113-A

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SCIEX 7500 system

SCIEX 7500 System

NEW SOFTWARE, NEW ION OPTICS, NEW SOURCE

- SCIEX 7500 system enables new levels of quantification across a large suite of sample types and workflows
- SCIEX OS software is the modern mass spectrometry software platform that transforms your samples into meaningful analytical answers

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The Turbo V ion source evolution

SCIEX 7500 System

FOR ROBUSTNESS AND RUGGEDNESS

Turbo V ion source

IonDrive Turbo V ion source

OptiFlow ion source

OptiFlow Pro ion source

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OptiFlow Pro Ion source with E Lens technology

SCIEX 7500 System

DESIGNED FOR MODULARITY

ESI

Microflow

APCI

- Maximum performance from 1 µL/min to 3 mL/min without adjustment with drop in probes and electrodes
- A versatile ion source with wide compound coverage with interchangeable ESI and APCI towers
- E Lens Technology for both micro and analytical flow for enhanced sensitivity compared to ESI alone
- Reduced user-to-user variation
- Designed with extensibility in mind

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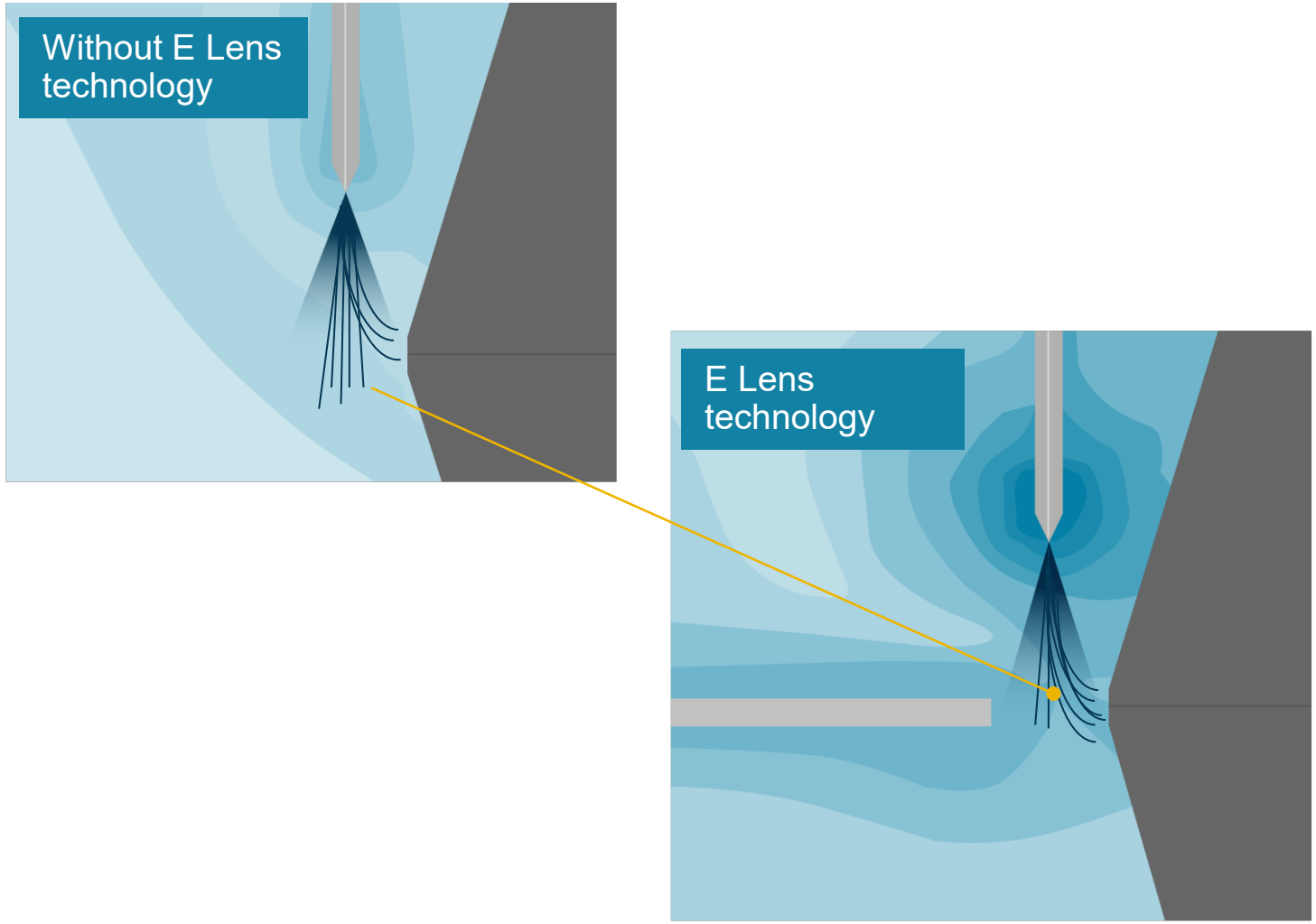
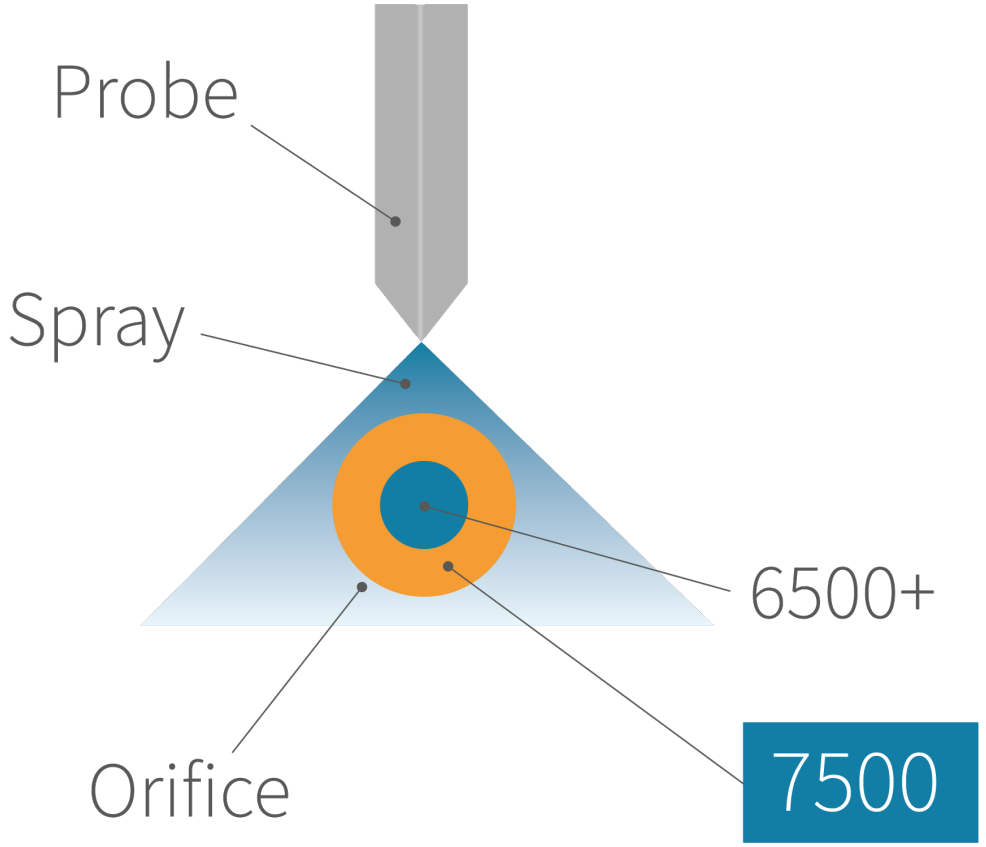
E Lens technology for greater sensitivity



- In ESI the E Lens technology drives ions towards the orifice
- The E Lens technology creates a stronger field that the droplets must traverse leading to more efficient break-up and release of ions from the droplet
- Gains in performance are up to 2-fold with the largest gains at microflow

Enabling greater sensitivity

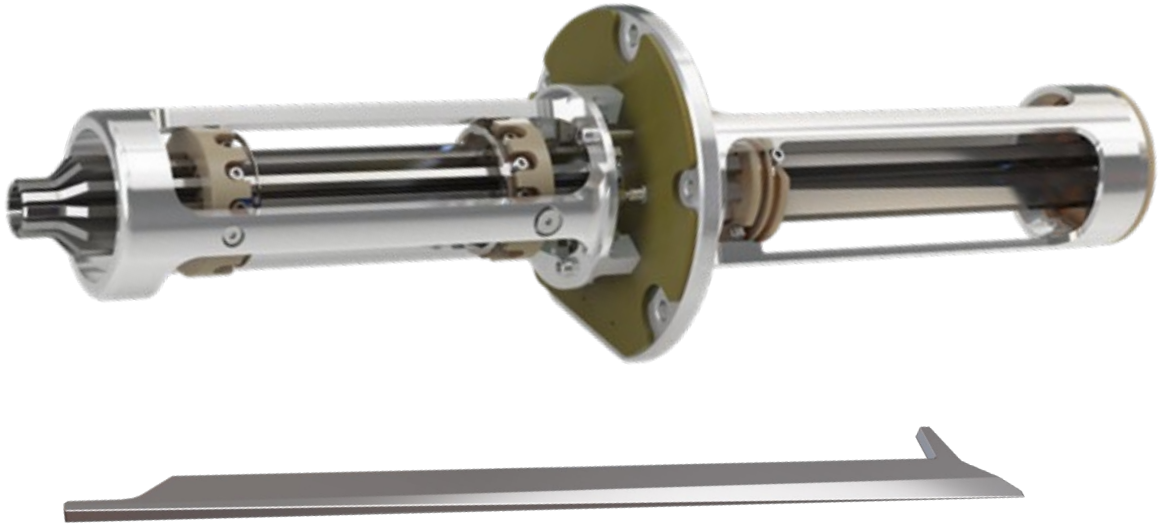
- Enabling greater sensitivity can be achieved through gains in the generation of ions, capturing and transmitting ions and detecting ions
- QTRAP 6500+ system with IonDrive technology delivered performance improvements in these key areas
- SCIEX 7500 system makes another leap forward in the capture and transmission of ions
- Sampling area of the SCIEX 7500 system orifice is 4.3x larger than the QTRAP 6500+ system orifice

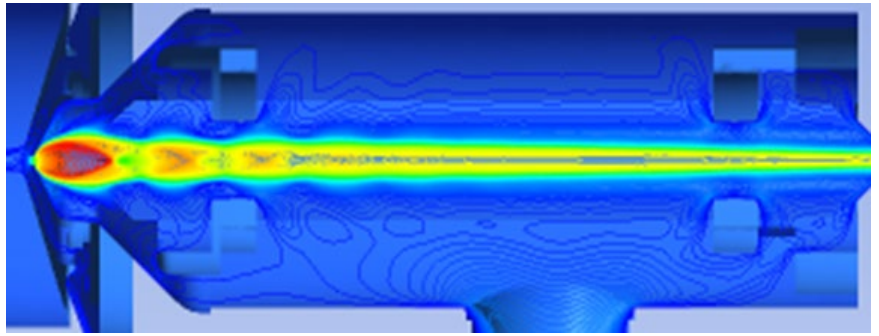


D Jet ion guide for greater sensitivity

THE D JET ION GUIDE IS A DUAL STAGE RF ION GUIDE

- The D Jet ion guide efficiently captures and transmits the ions in the high gas flow behind the orifice plate
- The tapered dodecapole geometry of the D Jet ion guide focuses the ions into the second stage QJet Ion Guide
- Gas flow for Curtain Gas™ Interface is typically 18 L/min





Roughing Pump 1 MS 120

Roughing Pump 2 MS 40

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QTRAP ready systems

SCIEX 7500 System

FUTURE PROOF YOUR LAB

- Allows users to future proof their lab's capabilities by providing an easy upgrade path to add linear ion trap scan features
- Uses LINAC electrodes on Q3 to enhance trap performance in LIT mode - in QQQ mode these electrodes are at same potential as the collar voltage and are therefore "invisible to the ions"

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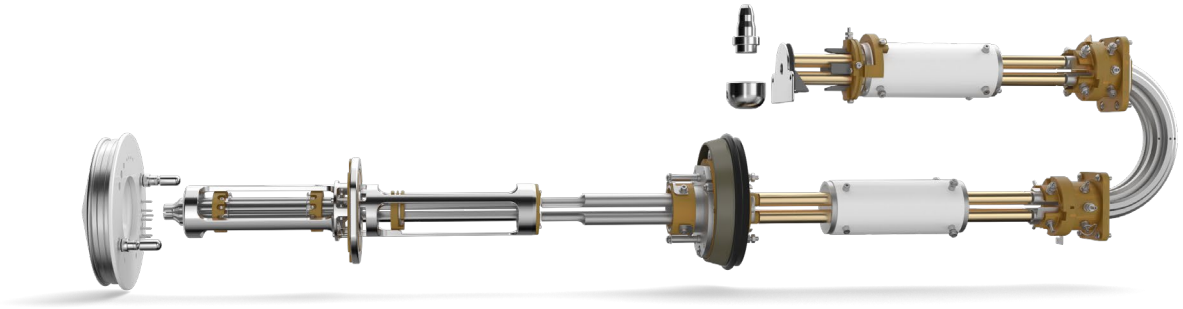
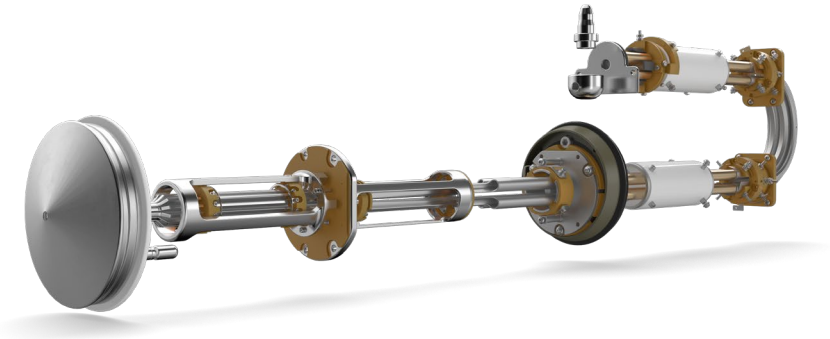
Built on a legacy of performance

SCIEX 7500 System

SCIEX 7500 SYSTEM FEATURES:

- Same rodsets as QTRAP 6500+ system, dual frequency RF drive with triple quadrupole mass range 5 – 2000 Da
- High Energy Detector system for fast polarity switching @ 5 msec and linear dynamic range up to 6 orders from LLOQ
- Curved LINAC collision cell for high speed analysis with no cross-talk
- Simplification: commonality with SCIEX platforms means no re-tuning of compound parameters CE and CXP and no DP tuning required
- QTRAP ready





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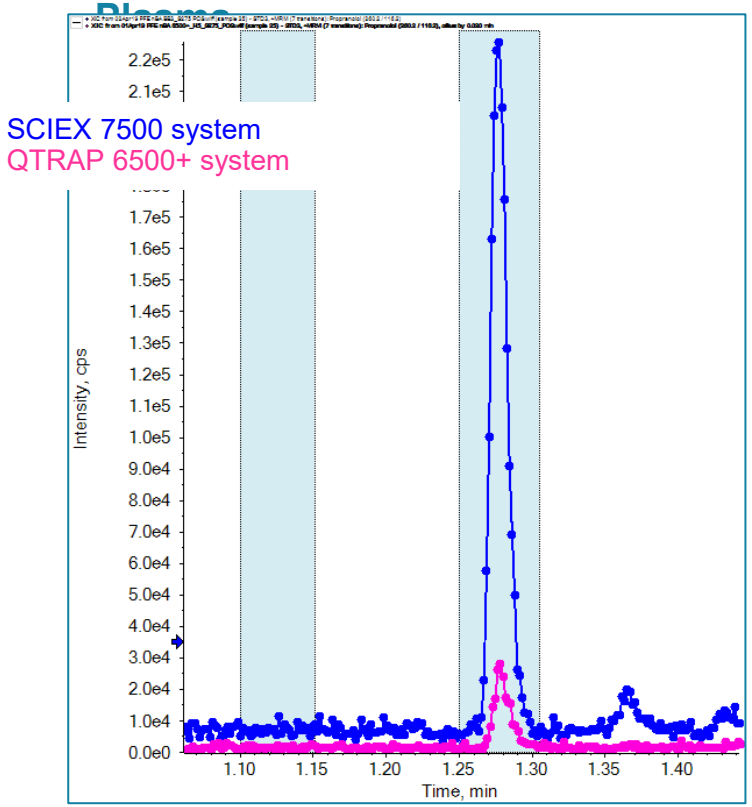
GO BEYOND with ultimate sensitivity

SCIEX 7500 System

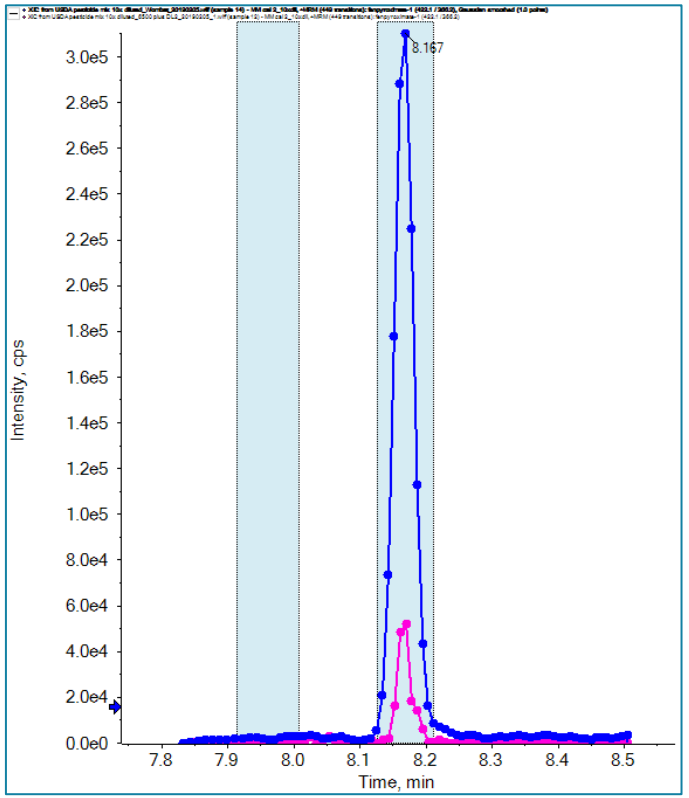
SENSITIVITY GAINS IN MATRIX SAMPLES >300 µL/MIN

Propranolol, 1 pg/mL, Rat



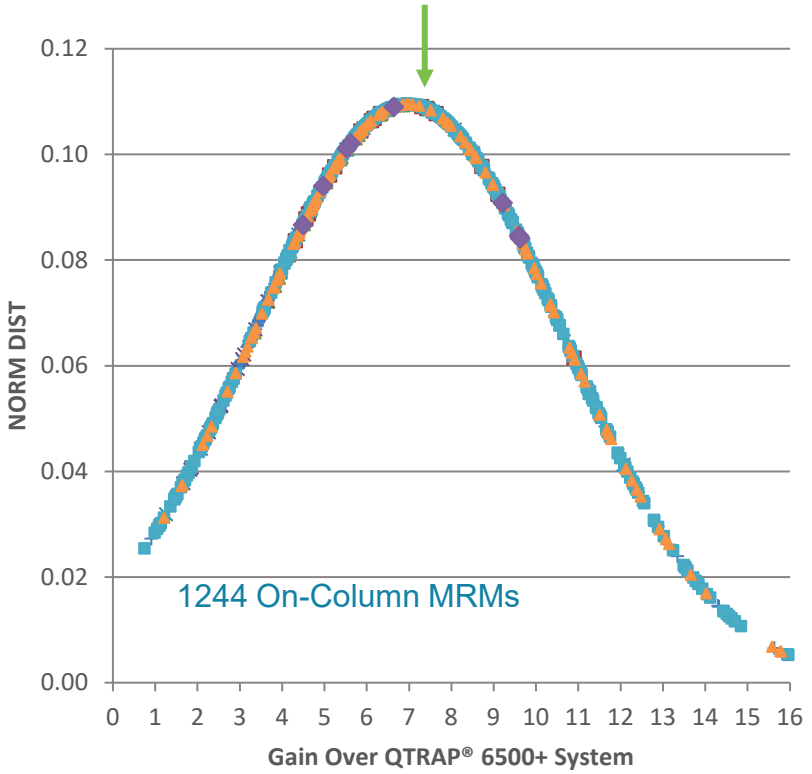
Area Gain - 9.1x
S/N Gain – 3.0x (RMS)

Fenpyroximate, Catfish



Area Gain – 8.1x
S/N Gain – 2.9x (RMS)

Average Peak Area Gain = 7.0x



1. Pesticides POS and NEG
2. Pharma small molecule POS and NEG
3. Vet drugs POS and NEG
4. Peptides

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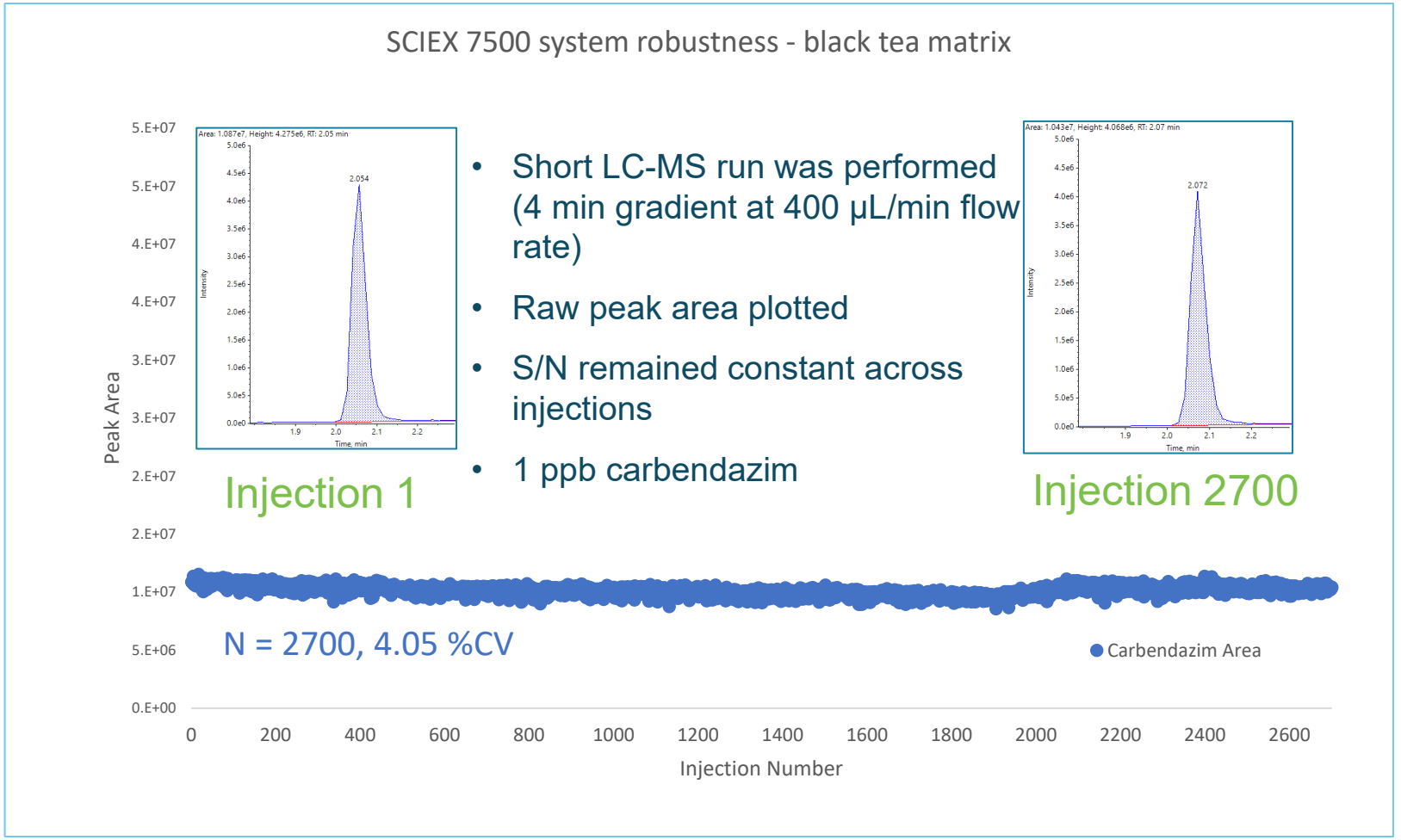
Robustness: tea matrix

SCIEX 7500 System



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ZenoTOF 7600 system

ZenoTOF 7600 System

QUALITATIVE FLEXIBILITY COMBINED WITH QUANTITATIVE POWER

- High sensitivity MS/MS with the ZenoTOF 7600 system
- ZenoTOF 7600 system combines the flexibility of multiple fragmentation options
- SCIEX OS software provides an intuitive workflow interface for easy acquisition and data processing

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ZenoTOF 7600 system

ZenoTOF 7600 System

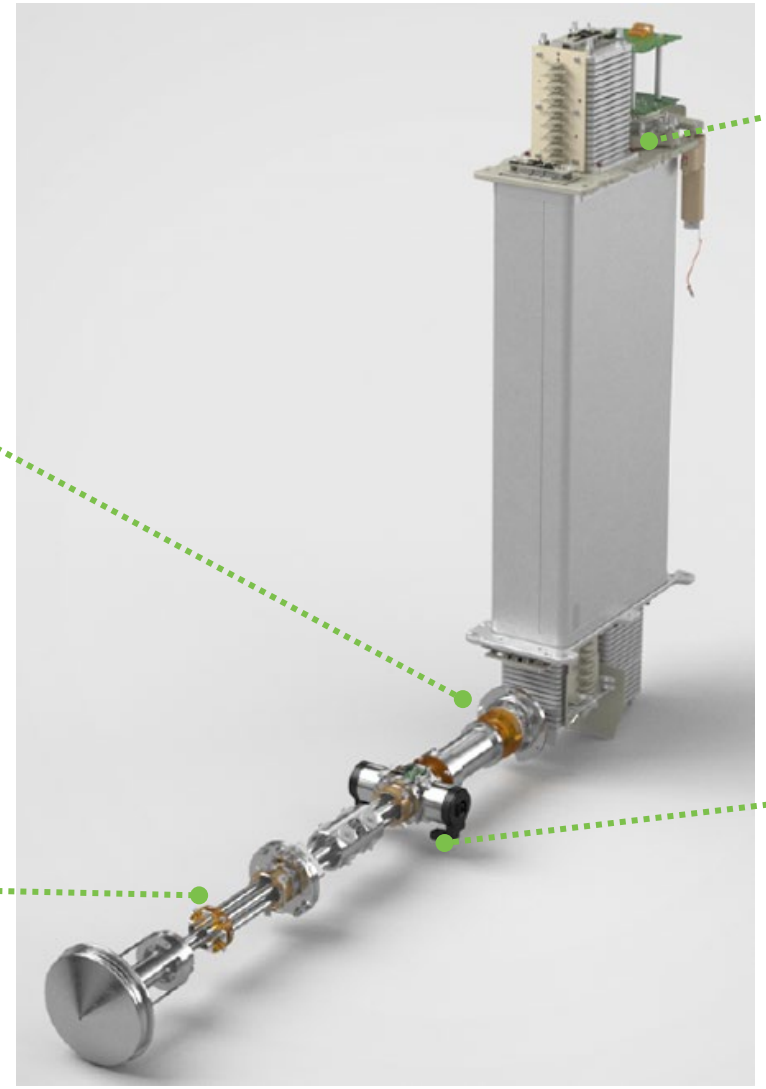
HARDWARE ADVANCEMENTS

New

Zeno trap
Improved MS/MS duty cycle gain ≥90%

New

New Q0 design for improved ion transmission and maintenance



New

Wide dynamic range

- 5GHz, 10bit ADC with 40GHz TDC timing with 25 psec detection rate. High speed pulse counting to maintain resolution and mass accuracy >130Hz and over 5 orders LDR

New

Complementary fragmentation with increased sensitivity using the EAD cell

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Electron activated dissociation (EAD Cell)

ELECTRON ENERGY TUNABLE FRAGMENTATION

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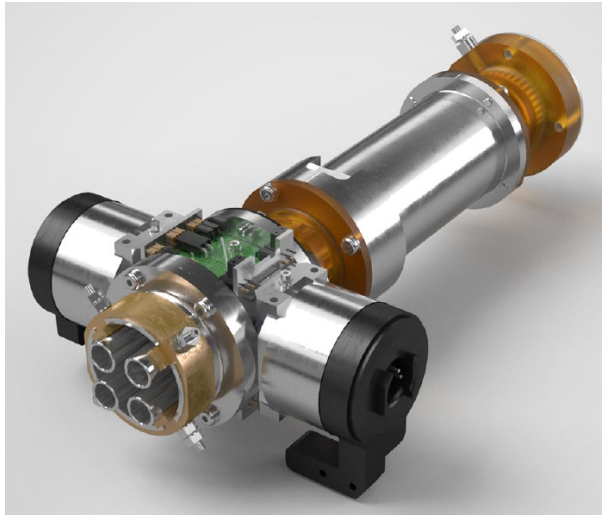
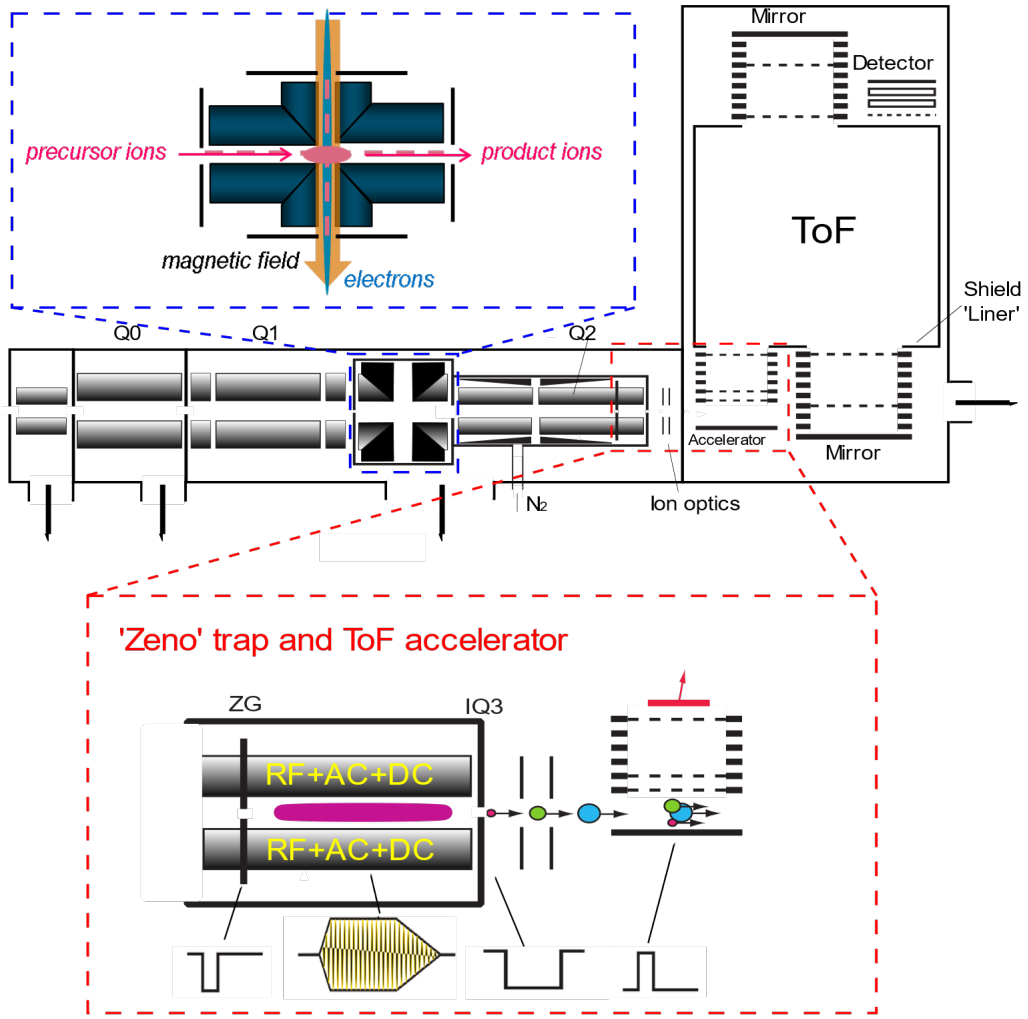
How SCIEX solves the problem?

INTEGRATED MS/MS ASSEMBLY WITH ELECTRON ACTIVATED DISSOCIATION (EAD)





- EAD cell for electron based fragmentation
- Zeno trap for enhancement of low abundant fragment ions

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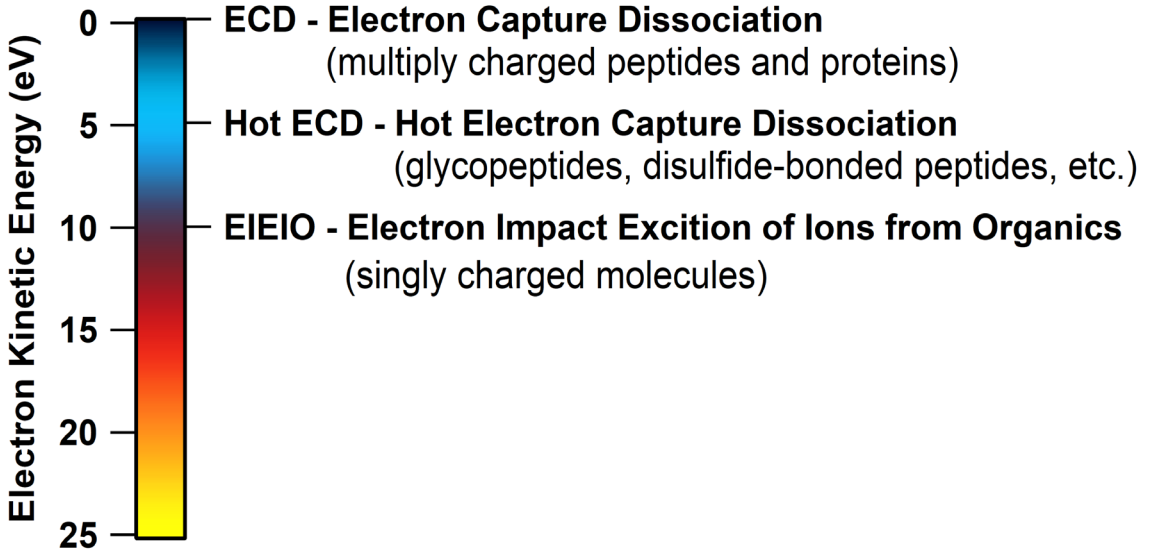
Electron activated dissociation (EAD)

- Free electrons are captured by ions and form a radical state which then fragments
  - Electrons introduced with different energies will induce fragmentation in different molecule types

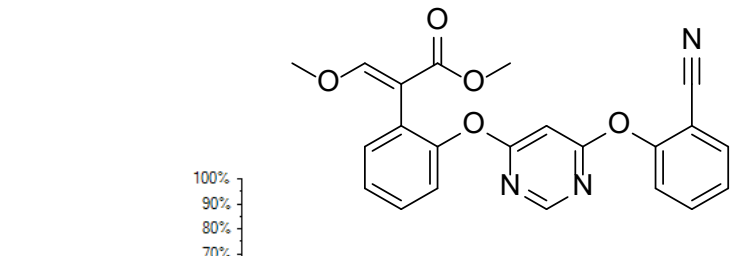


T. Baba *et al. Anal.Chem*. 2014

EAD for contaminant identification

ZenoTOF 7600 System

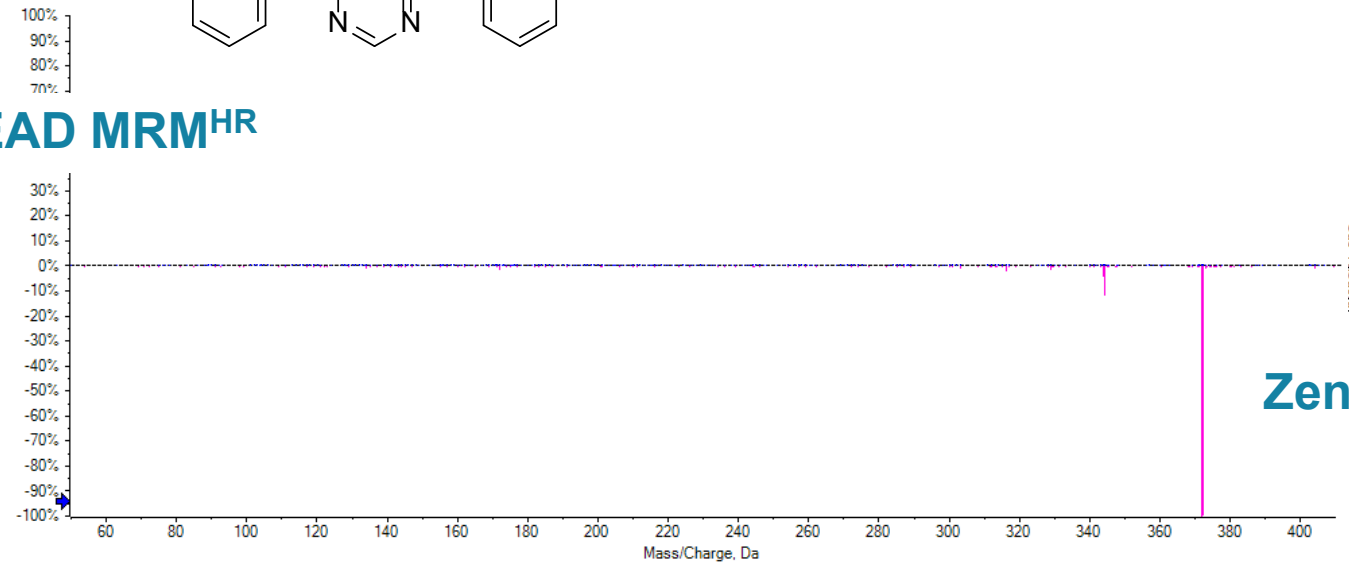
IMPROVED SPECIFICITY FOR LIBRARY MATCHING AND ION RATIOS



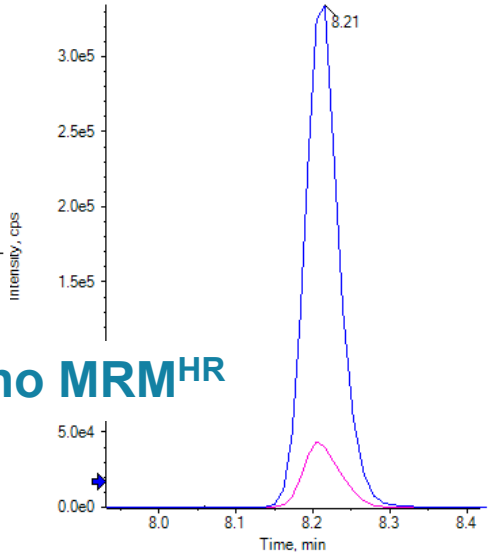
Azoxystrobin

Fungicide

Zeno EAD MRM^{HR}



Zeno MRM^{HR}



- Zeno EAD MS/MS spectrum via MRM^{HR} contains >200 peaks
  - KE = 10 eV

- CID MS/MS spectrum typically contains only two peaks
  - CE = 35 V

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Zeno trap

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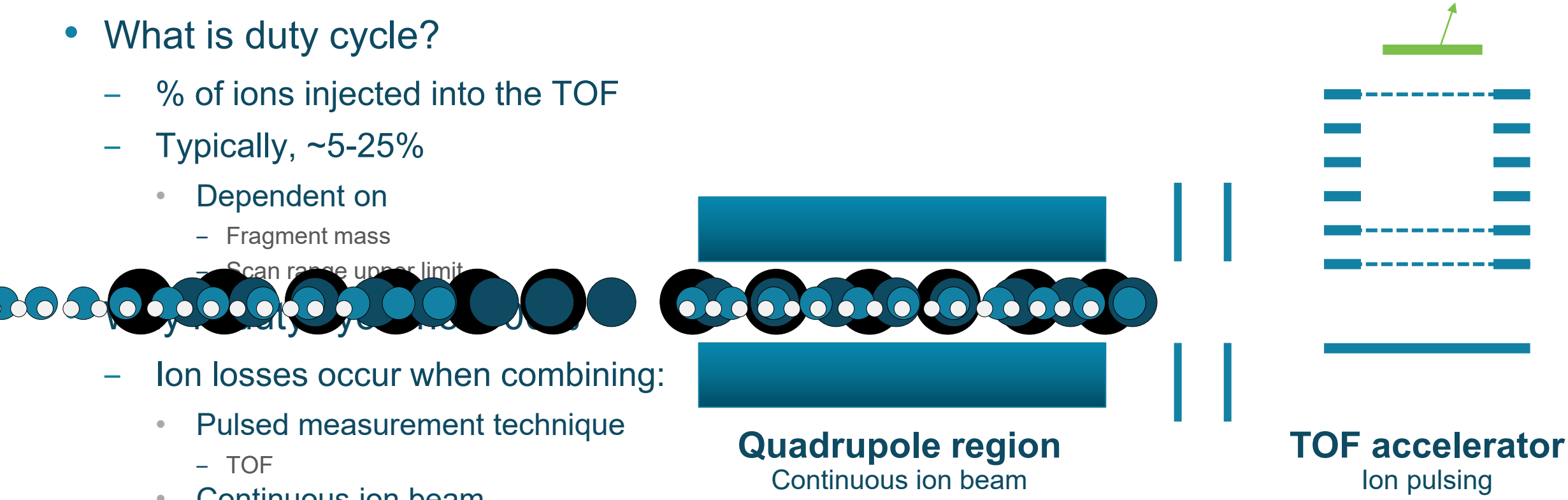
What is duty cycle?

… AND WHY IS DUTY CYCLE IMPORTANT?

- What is duty cycle?
  - % of ions injected into the TOF
  - Typically, ~5-25%
    - Dependent on
      - Fragment mass
      - Scan range upper limit
  - Ion losses occur when combining:
    - Pulsed measurement technique
      - TOF
    - Continuous ion beam
      - Quadrupole



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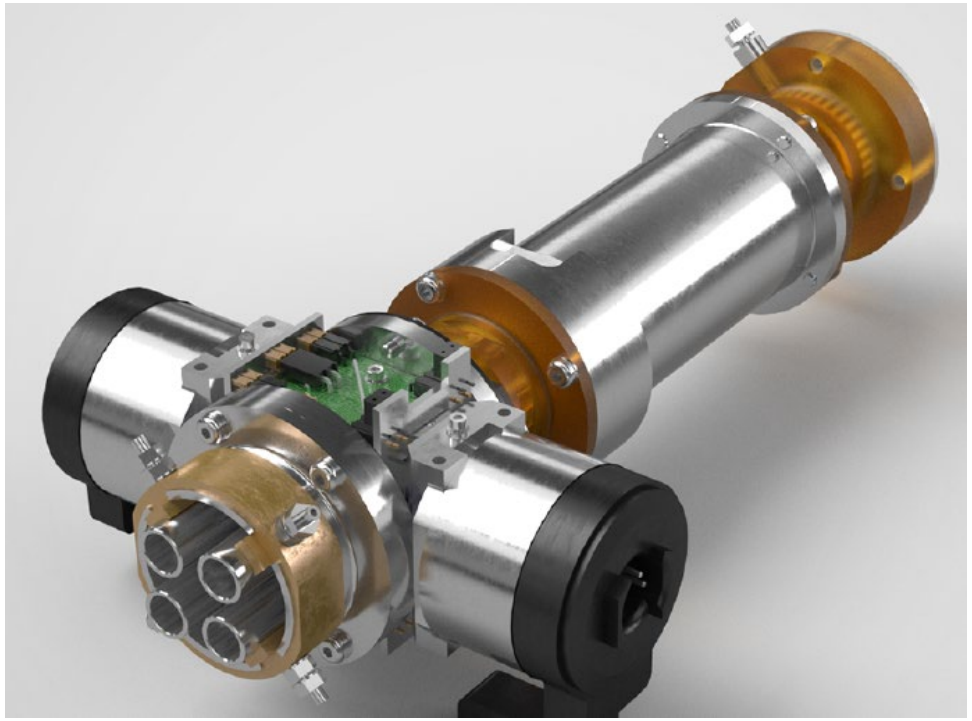
How does SCIEX solve the problem?

ZenoTOF 7600 System

ZENO TRAP DELIVERS FULL MASS RANGE TO ACCELERATOR ELECTRODE



- The Zeno trap addresses the duty cycle problems with QTOFs
  - Improves MS/MS sensitivity across the entire mass range
  - ≥ 90% of all ions injected into TOF region
- Improved sensitivity means
  - Lower LOQs
  - Lower sample loading
  - Improved MS/MS spectral quality
    - Improved structural elucidation / Met ID
    - Greater quality for low level metabolites
- Zeno trap capacity ~ $7e^6$ ions

J. Am. Soc. Mass Spectrom. (2017) **28**: 2143-2150)

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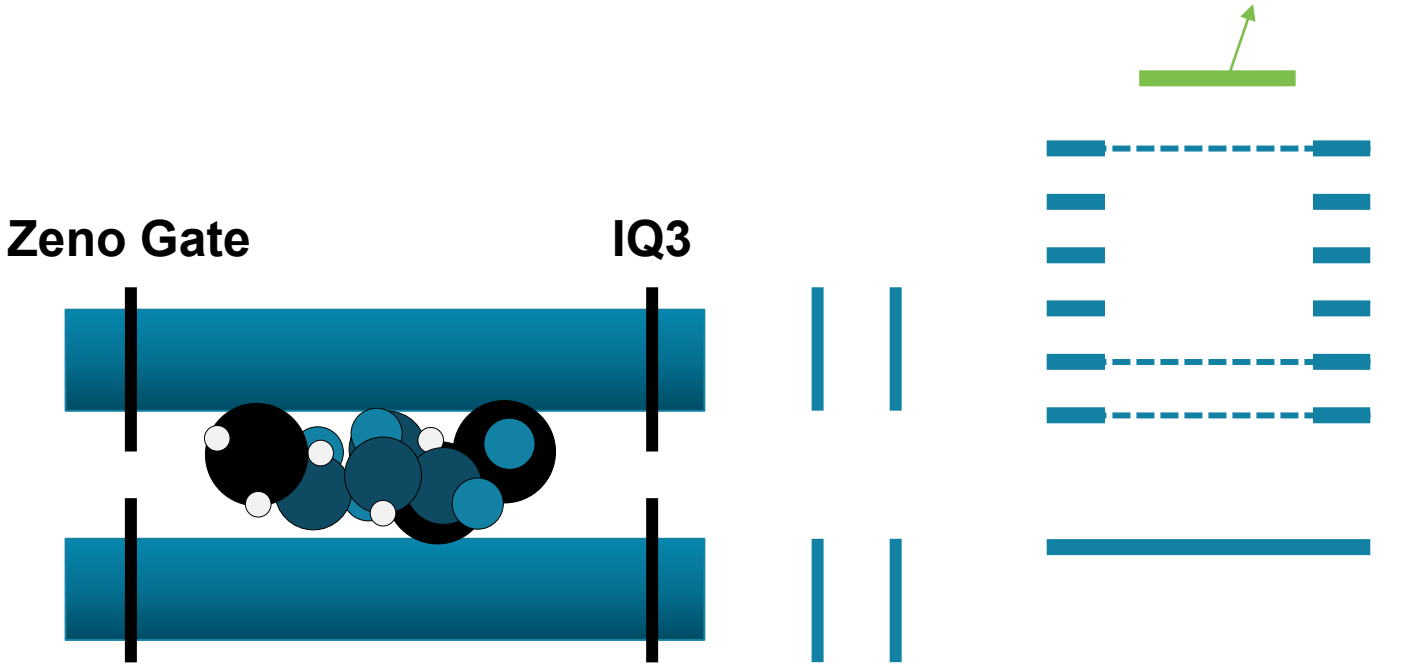
Zeno trap

FOR SENSITIVITY GAINS IN MS/MS

- The Zeno trap provides control of the ion beam from the collision cell into the accelerator
- Ions are gated then released in a mass dependent manner
  - Higher m/z ions are released first then followed by lower m/z ions
  - All ions now arrive in the accelerator at the same time and location



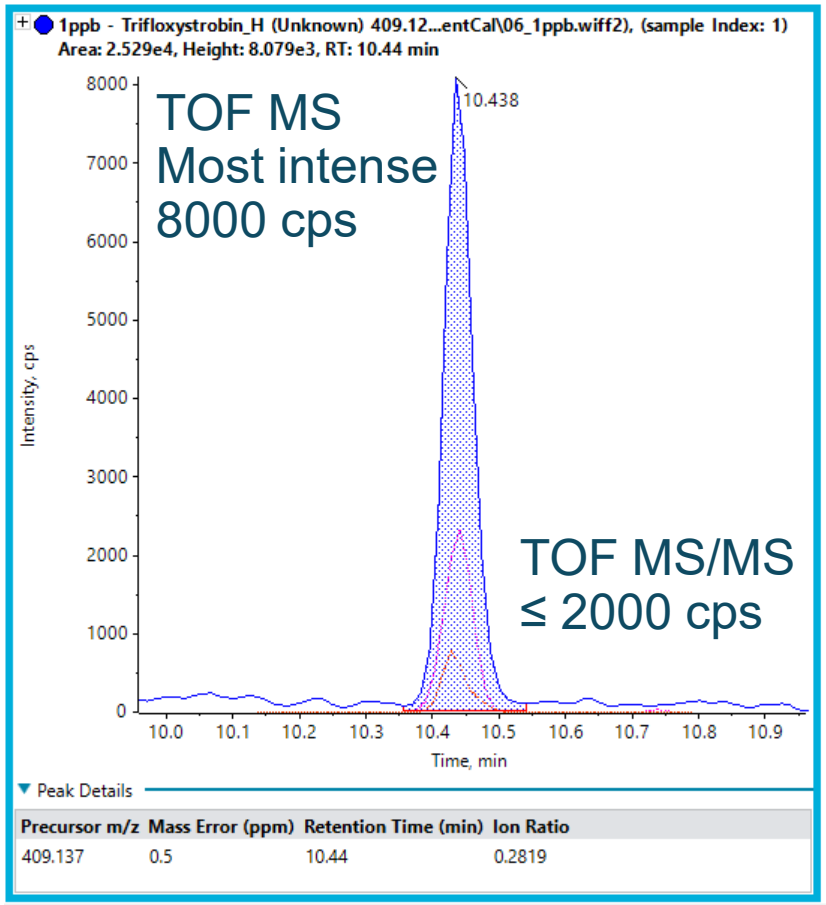
Quadrupole region
Continuous ion beam

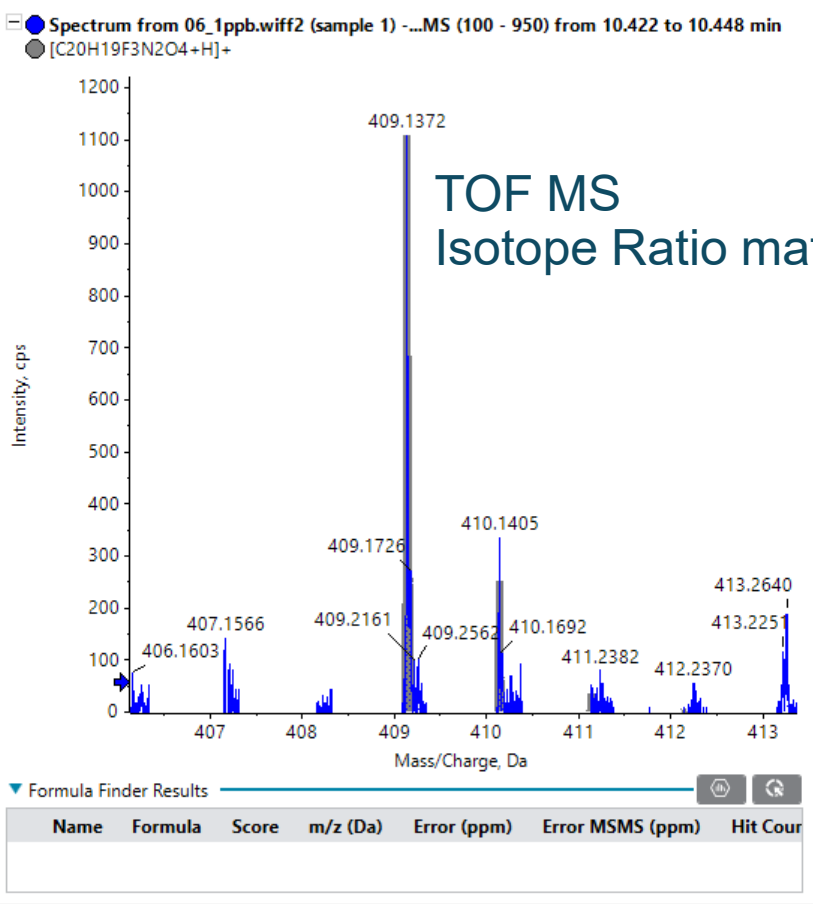
TOF accelerator
Ion Pulsing

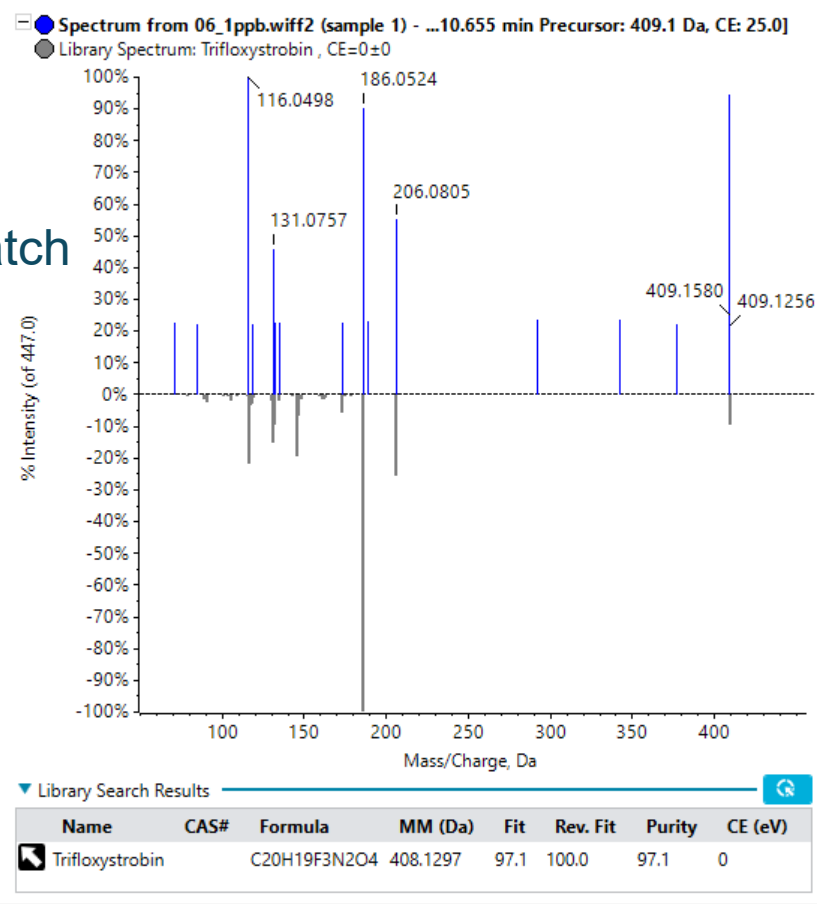
Data comparison: trifloxystrobin 1 ppb

ZenoTOF 7600 System

MRM^{HR} – ZENO TRAP DEACTIVATED







Mass error = 0.5 ppm

Library Score
Purity = 97%

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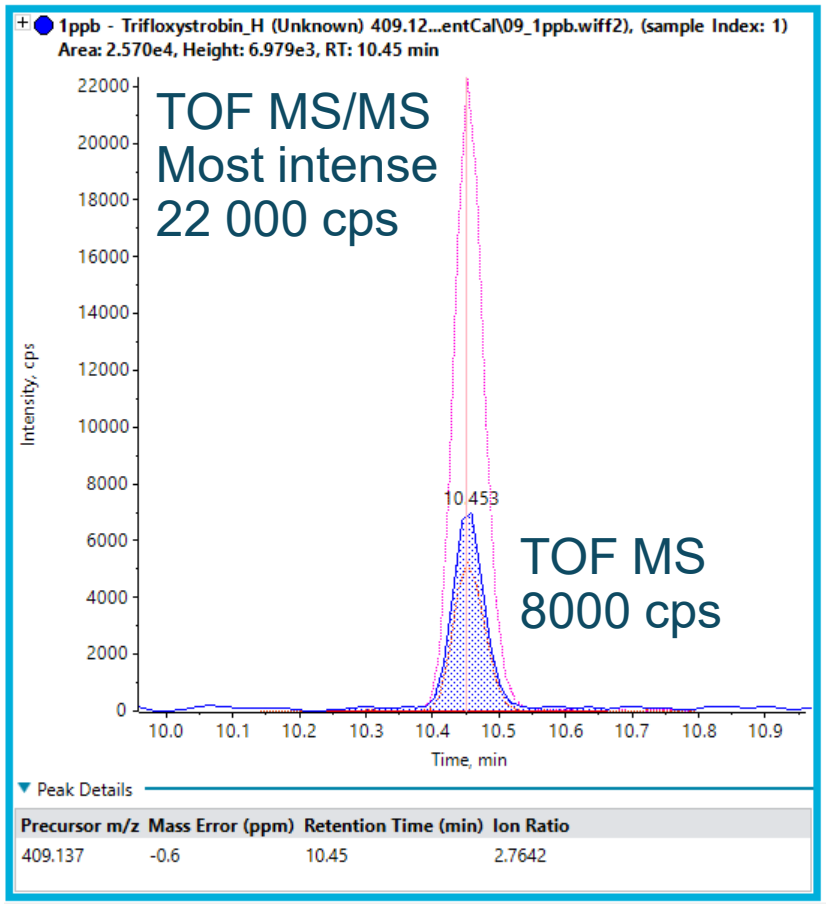
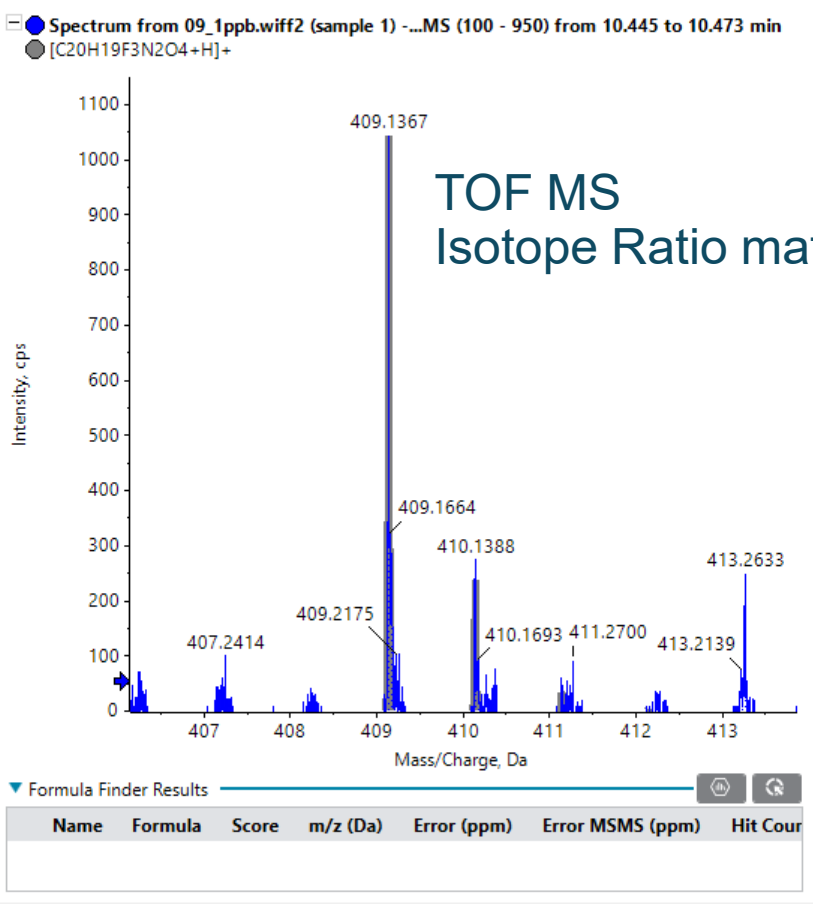
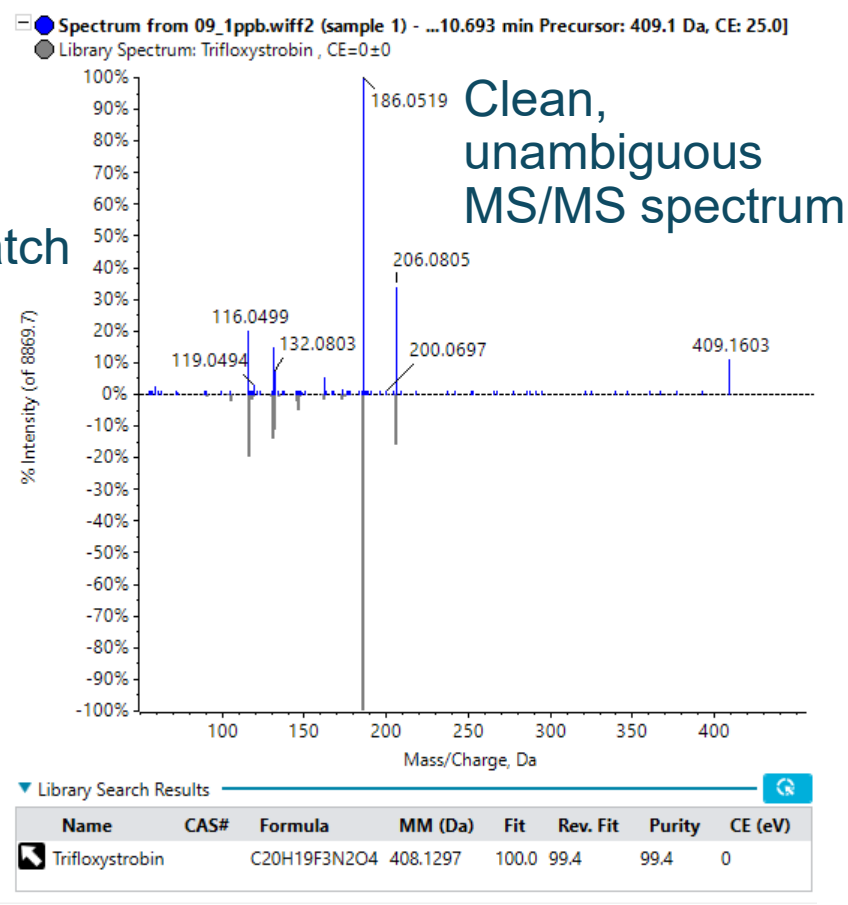
Data comparison – trifloxystrobin 1 ppb

ZenoTOF 7600 System

MRM^{HR} – ZENO TRAP ACTIVATED







Mass error = -0.6 ppm

Library Score
Purity = 99.4%

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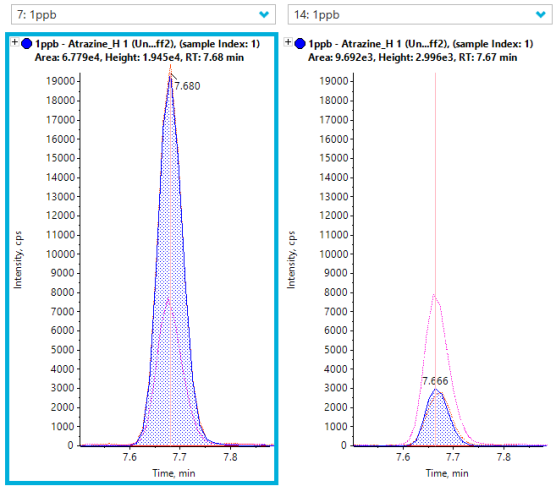
Gains depend on fragment m/z

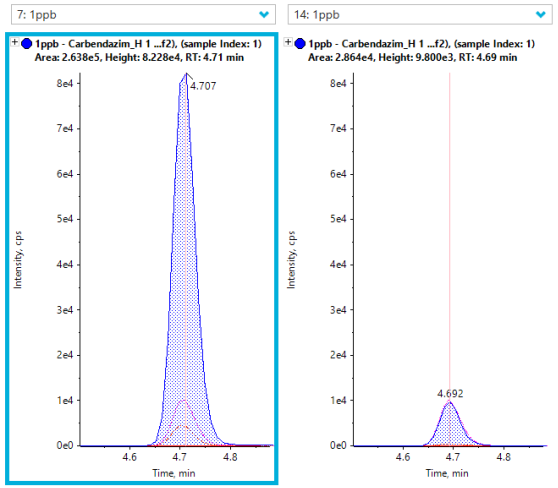
ZenoTOF 7600 System

1 PPB STANDARD: LEFT – ZENO TRAP ON, RIGHT – ZENO TRAP OFF (FRAGMENT XIC FILLED)

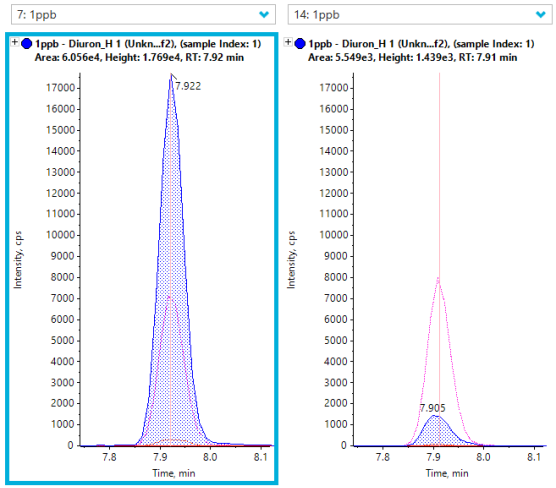
Atrazine



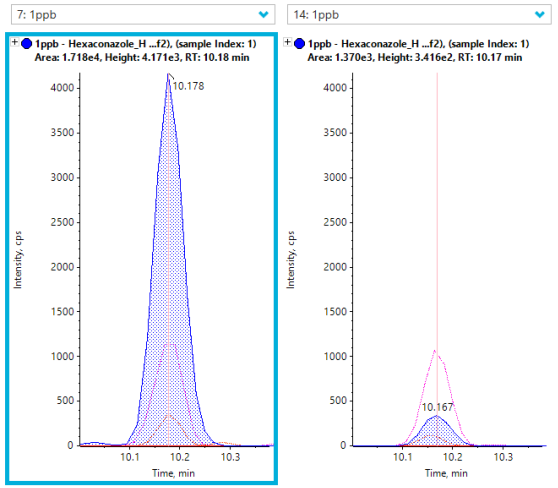
Carbendazim



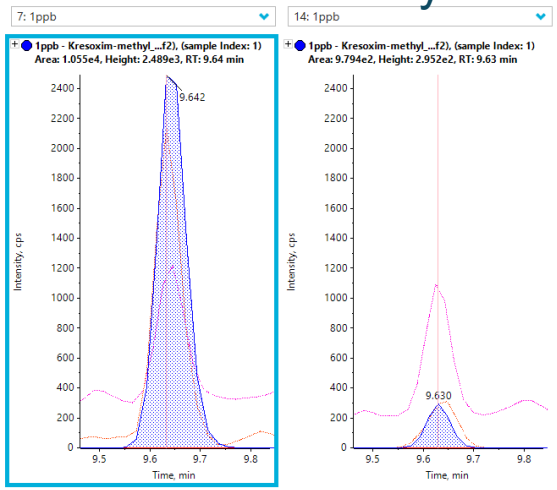
Diuron



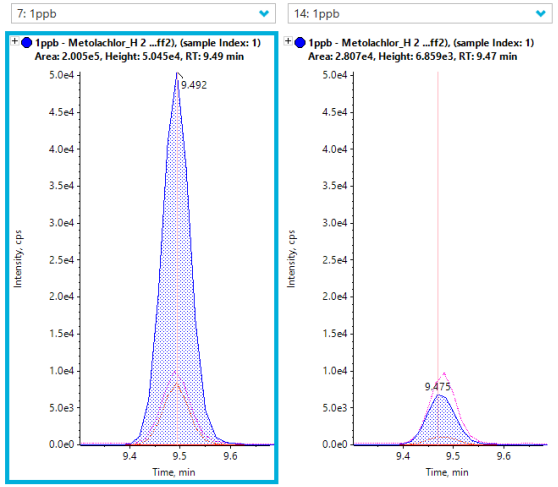
Hexaconazole



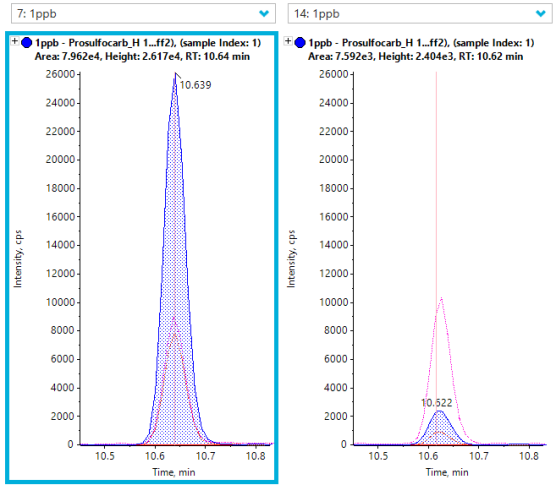
Kresoxim-methyl



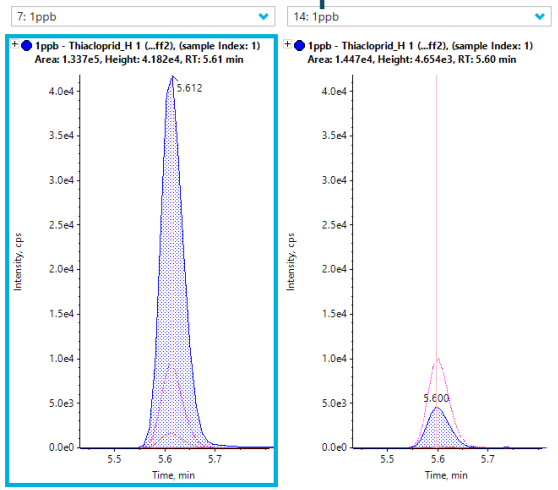
Metalochlor



Prosulfocarb



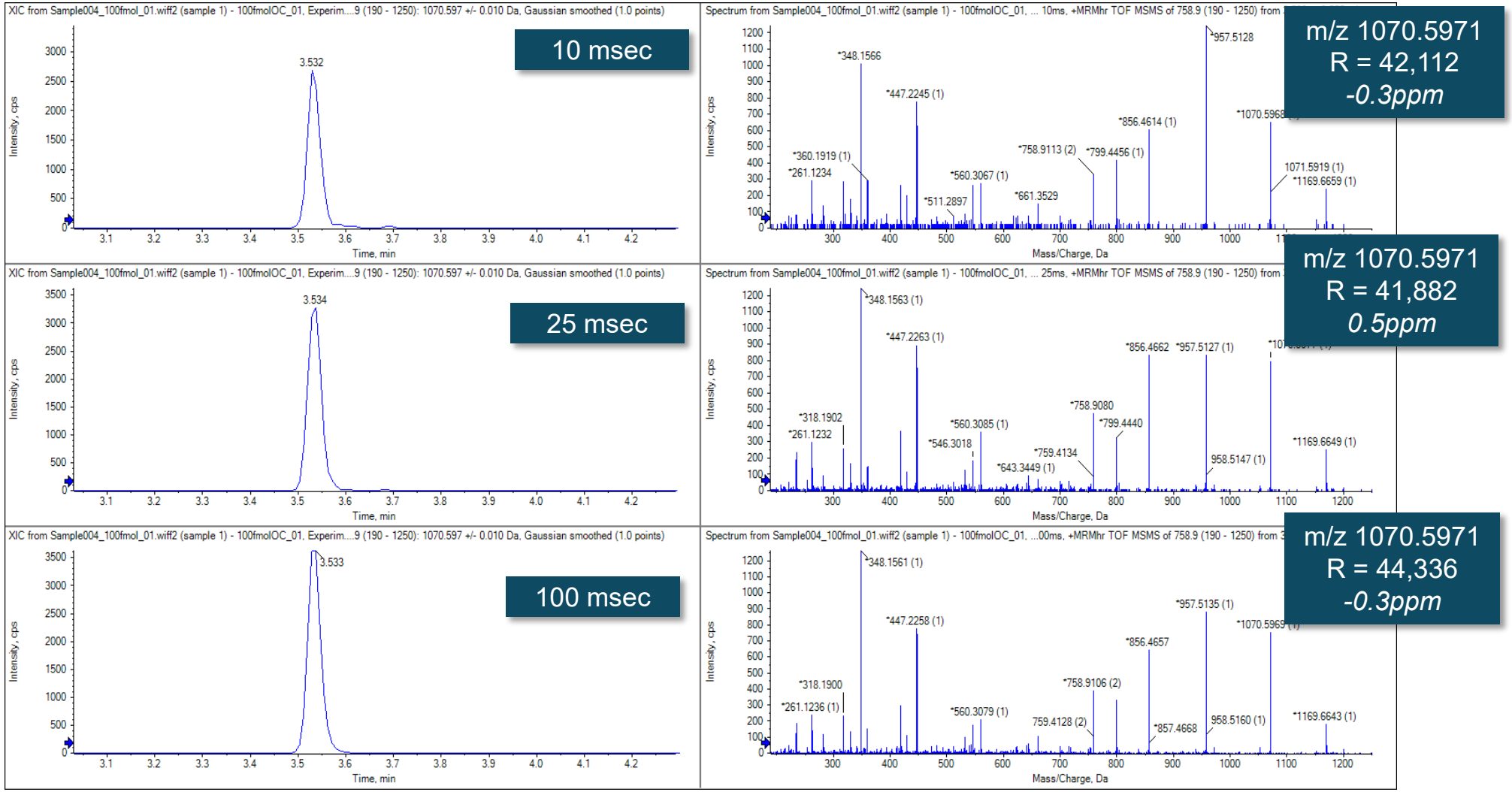
Thiacloprid



MS/MS acquisition speed

ZenoTOF 7600 System

ACQUISITION RATES SUITABLE FOR HIGH MULTIPLEXING AND RAPID LC SEPARATION



These data show how mass resolution and peak intensity is maintained when reducing the scan rate from 100 msec to 10 msec

The high-speed nature of the detector enables this very effectively

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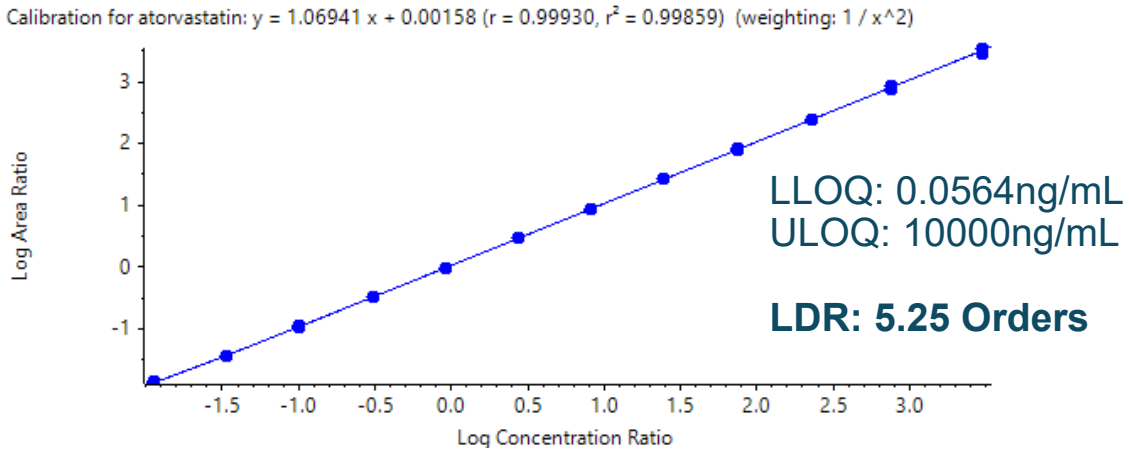
Linear dynamic range

ZenoTOF 7600 System

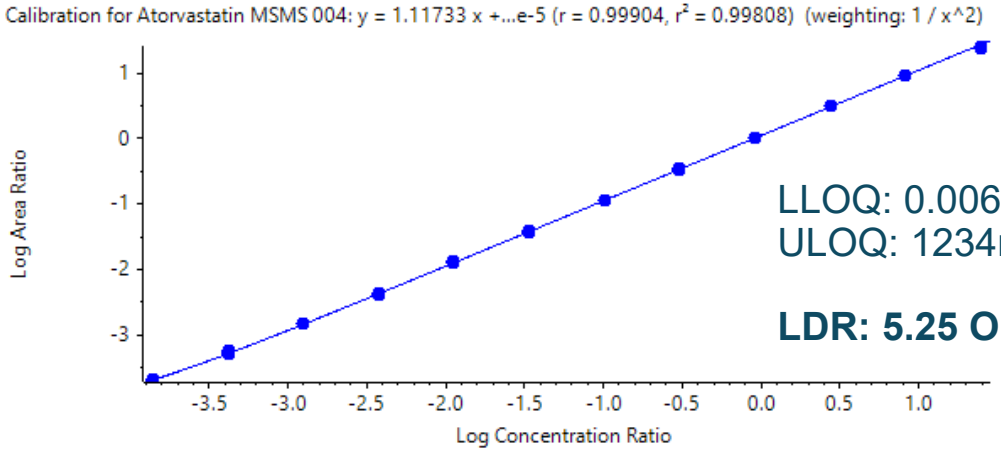
TOF MS LDR Positive Mode



LLOQ: 0.0564ng/mL
ULOQ: 10000ng/mL

LDR: 5.25 Orders

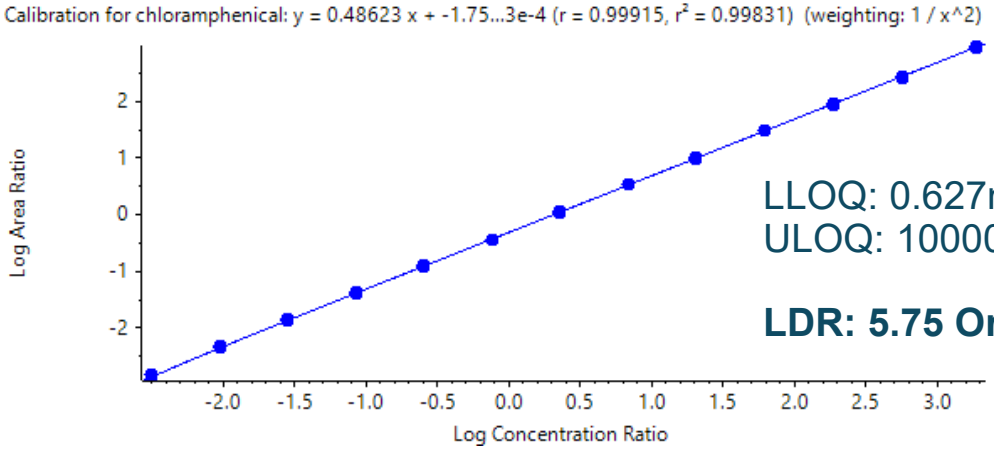
Zeno MRM^{HR} LDR Positive Mode



LLOQ: 0.0069ng/mL
ULOQ: 1234ng/mL

LDR: 5.25 Orders

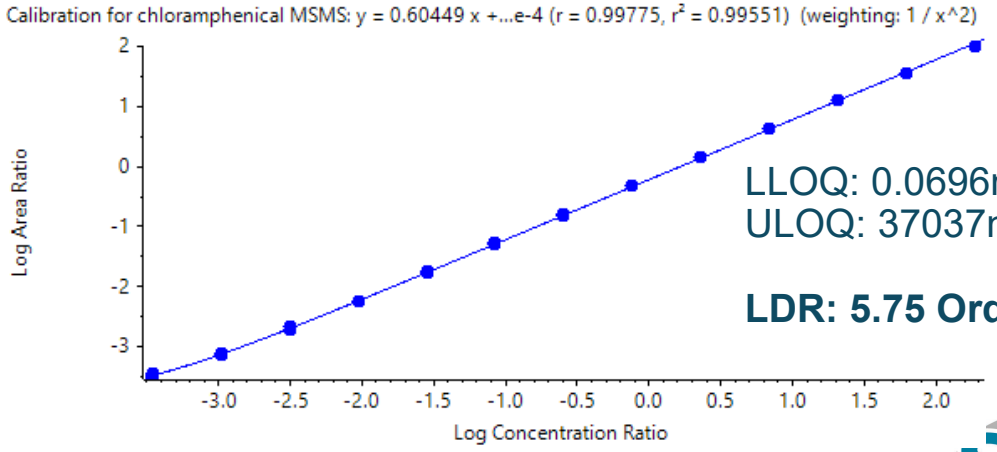
TOF MS LDR Negative Mode



LLOQ: 0.627ng/mL
ULOQ: 1000000ng/mL

LDR: 5.75 Orders

Zeno MRM^{HR} LDR Negative Mode



LLOQ: 0.0696ng/mL
ULOQ: 37037ng/mL

LDR: 5.75 Orders

LDR defined as log[ULOQ / LLOQ]

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Thank you!

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