

# New high voltage power supplies for triple quadrupole MS polarity switching in under 5 ms

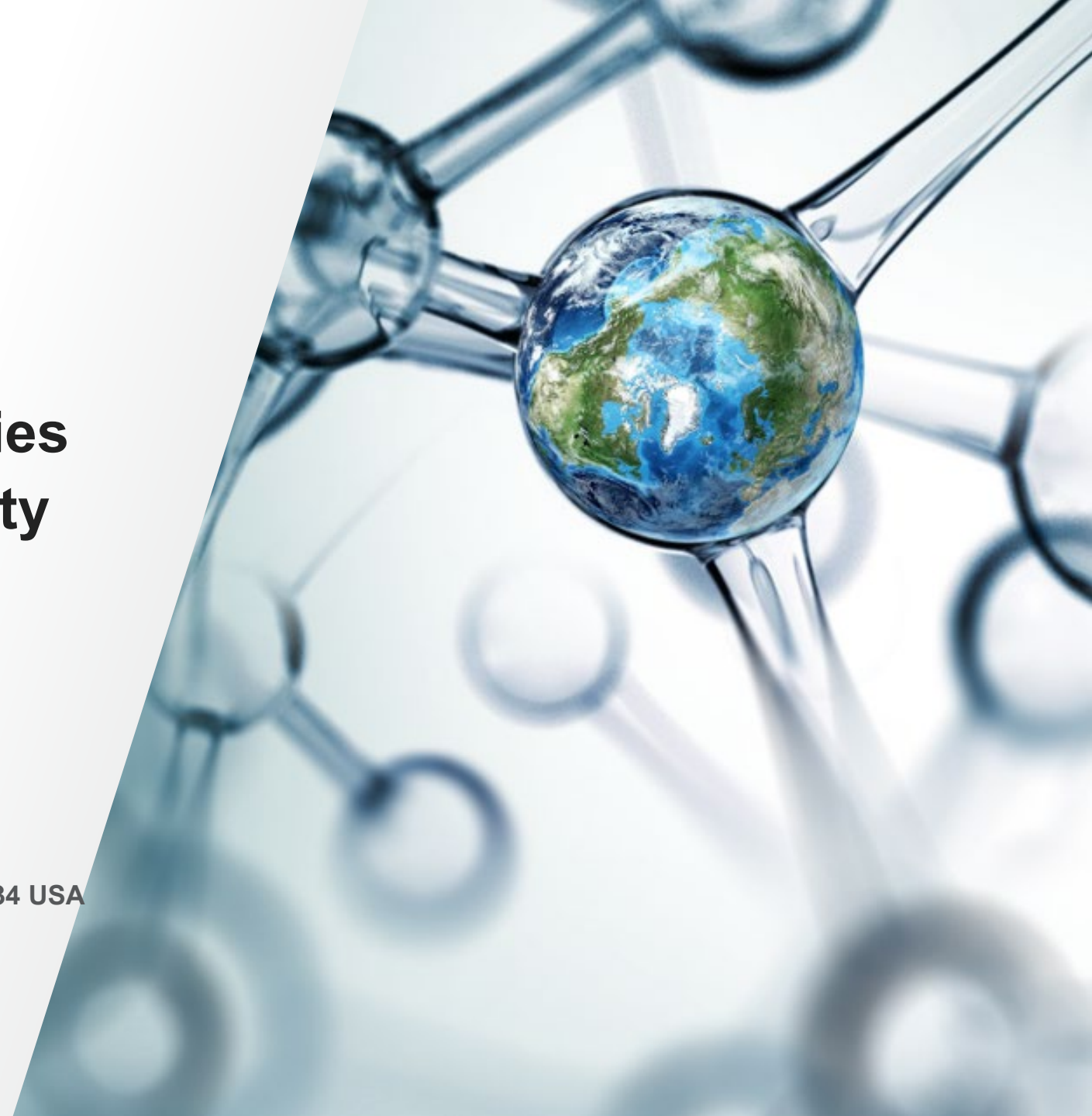
**Oleg Silivra**

Senior Scientist

November 5, 2021

Oleg Silivra, Harald Oser, Michael Ugarov, David Minkler,  
Claudia Martins, and Neloni Wijeratne  
Thermo Fisher Scientific, 355 River Oaks Pkwy, San Jose, CA 95134 USA

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- Getting more data in less time is one of the major directions in advancing MS instrumentation.
- Reduction of non-productive time is one of the methods used to increase instrument throughput.
- Time necessary to change instrument acquisition polarity is an example of non-productive time.
- Slowest reversing components of mass spectrometer define polarity switching time.
- For many types of mass spectrometers, slower elements include high voltage power supplies (HVPS).
- Our recent development allowed less than 5 ms polarity switching time on prototype triple stage quadrupole instruments.

# Materials and Methods

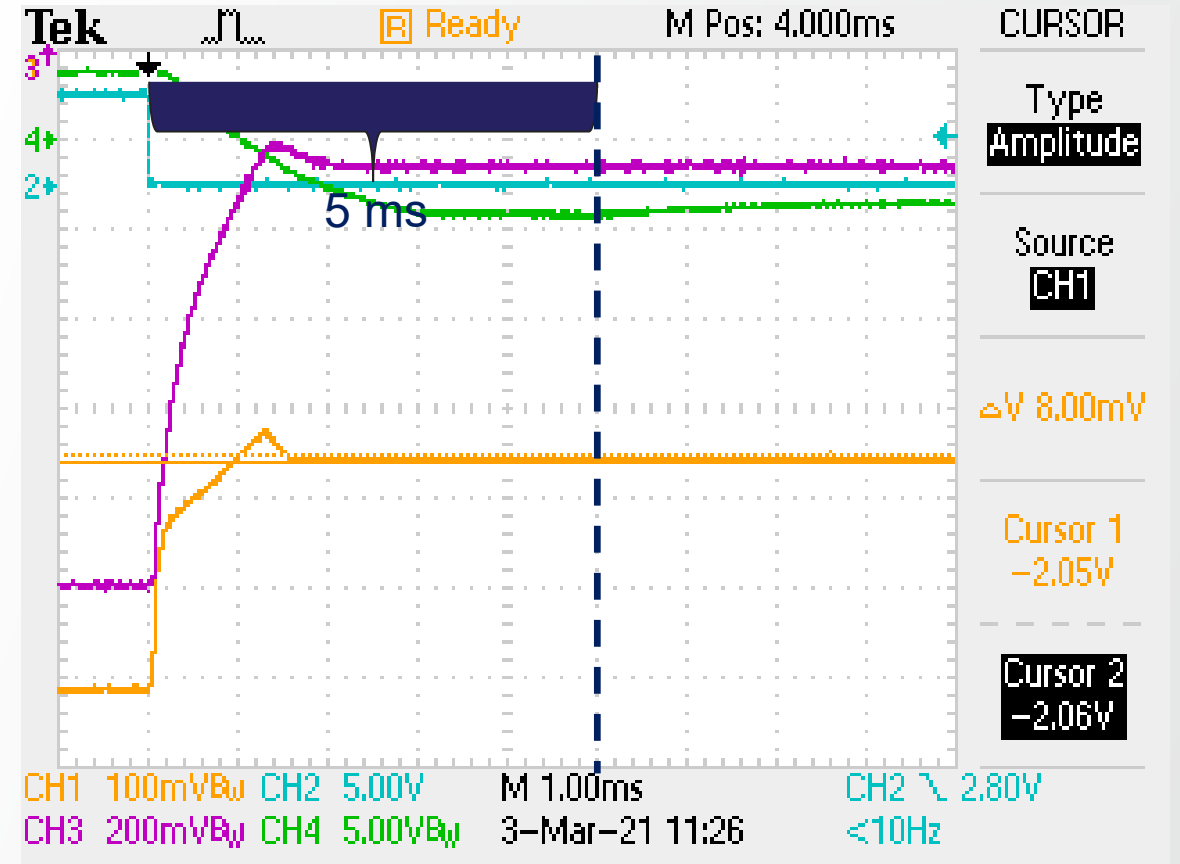
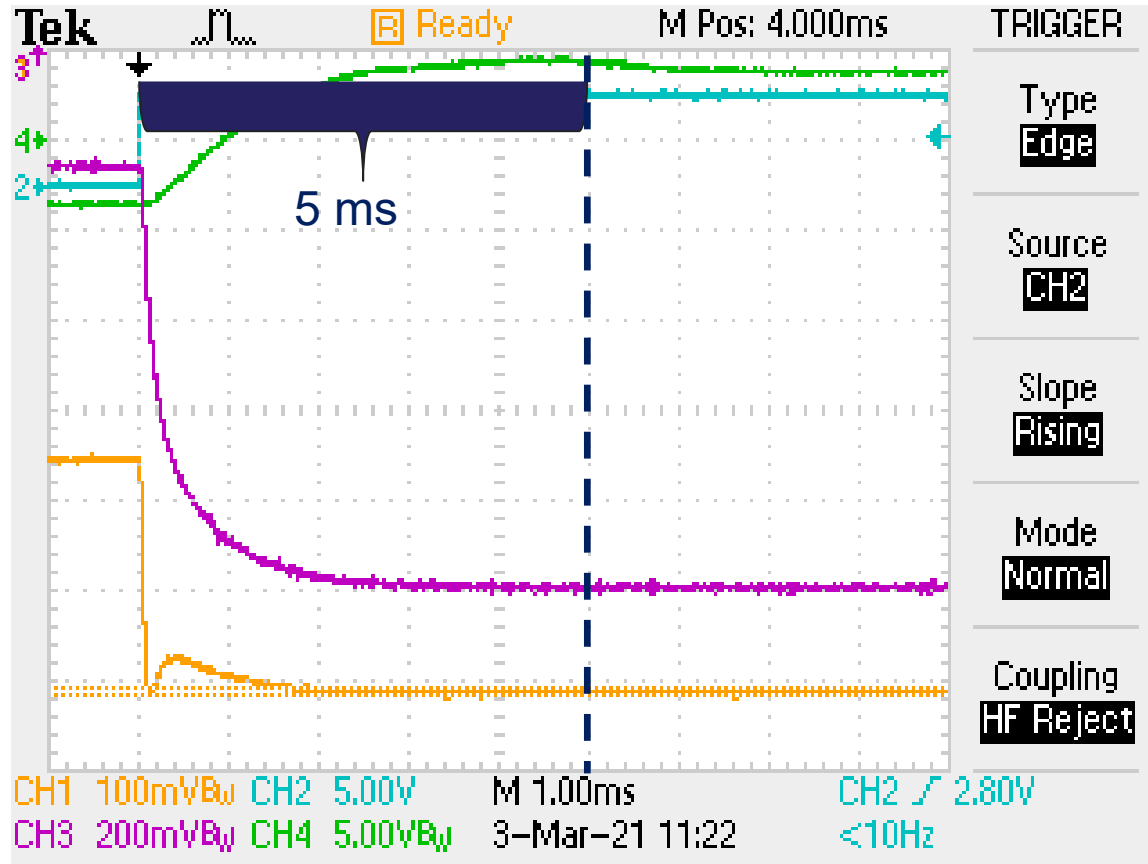
- Faster than 5 ms polarity switching time was achieved by incorporating a newly developed series of power supplies from Spellman High-Voltage Electronics (Hauppauge, NY).
- The HVPS prototype testing comprised several major activities which may be separated in two major groups.
- The first group of tests was performed on a mass spectrometer with path-through voltage magnitude and time profile measurements.
- The second group of tests relied on ion signal time profile measurements for the evaluation of polarity switching time of specific HVPSs, as well as of the entire instrument.
- Benefits of faster polarity switching have been verified while performing quantitative analysis of nutraceuticals in a food authentication assay.

# EM HVPS: -4000 V $\leftrightarrow$ -4500 V switches in less than 5 ms

BLUE – trigger

GREEN – readback

ORANGE – PS output



For electron multiplier HVPS testing was done simulating different ages of the electron multiplier life cycle

# Dynode HVPS switches within 5 ms

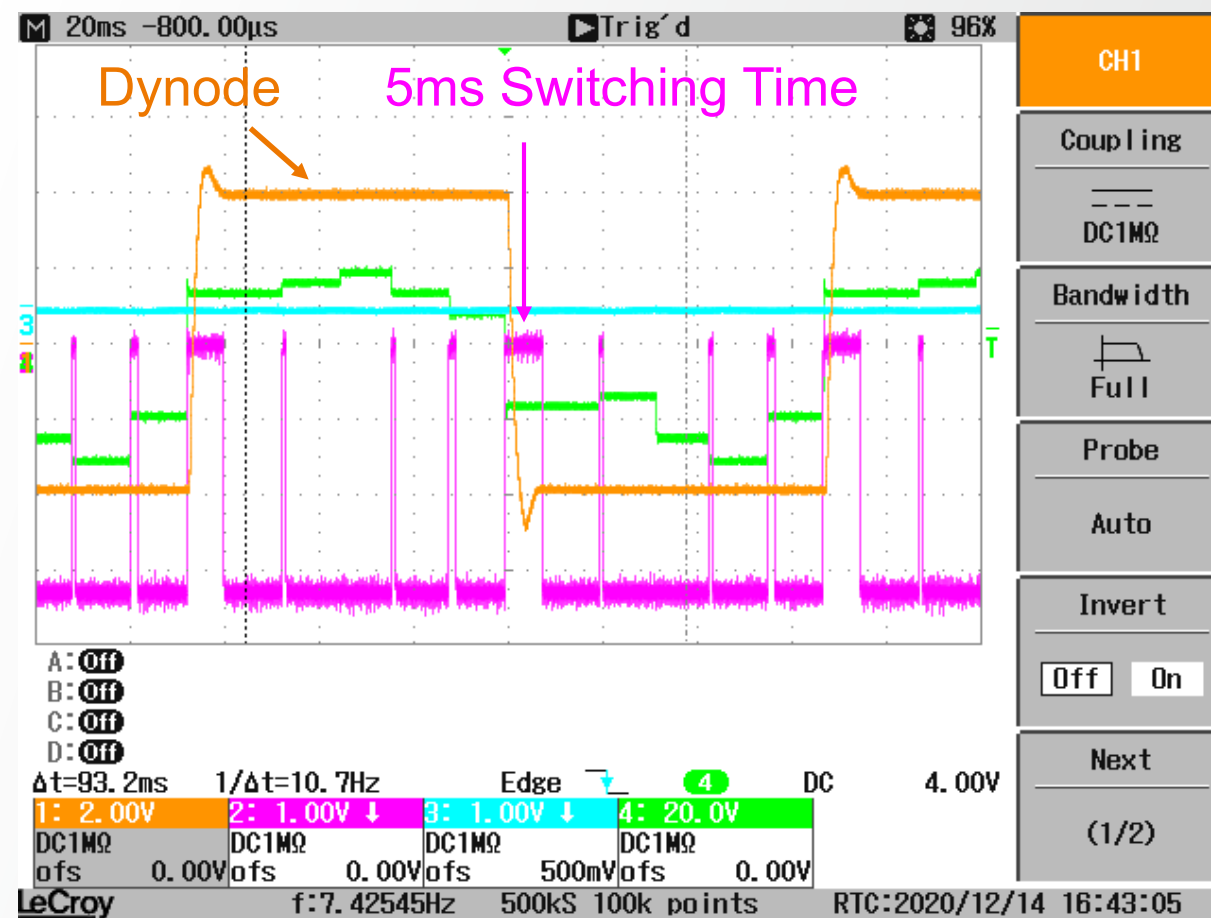
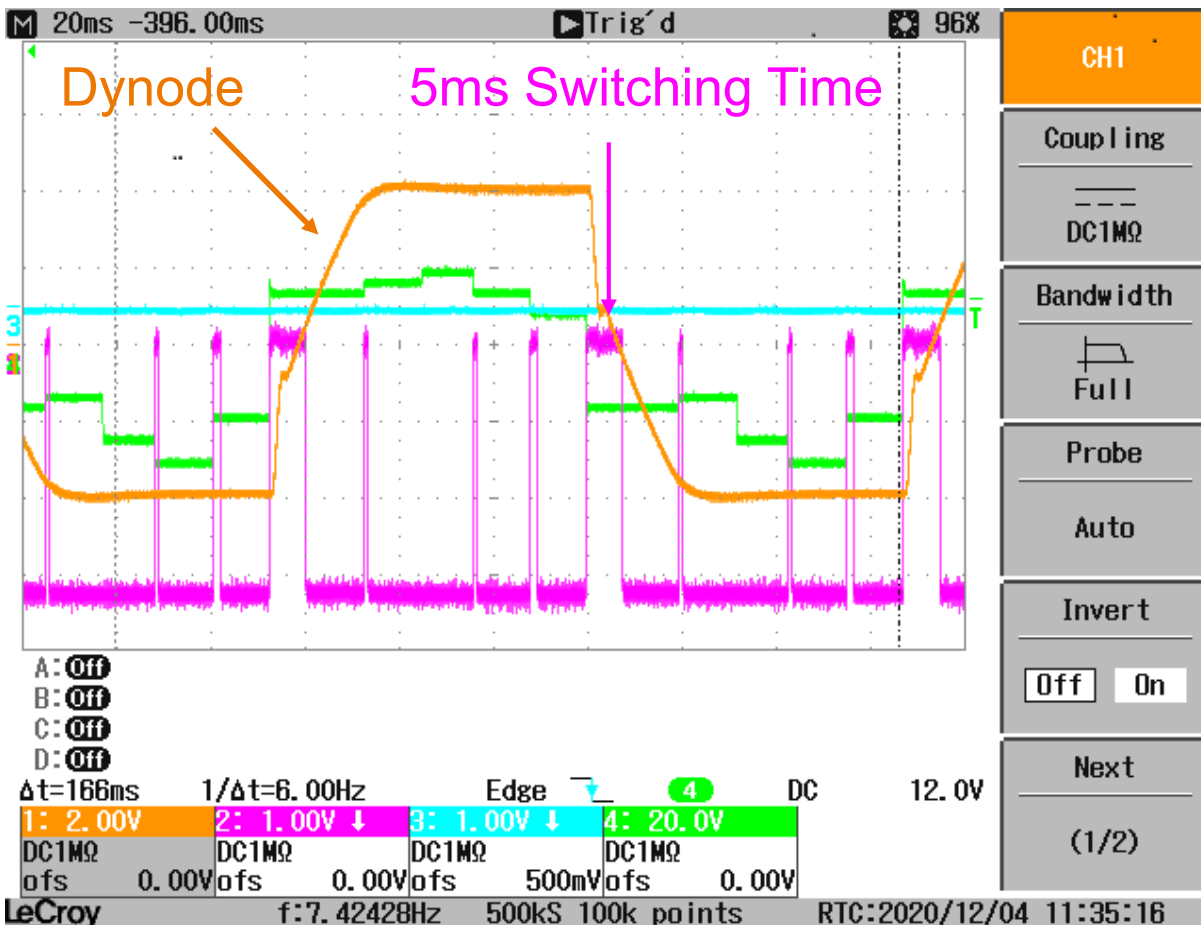
**MAGENTA** – acquisition state

**GREEN** – lens readback

**ORANGE** – PS output

## Regular PS

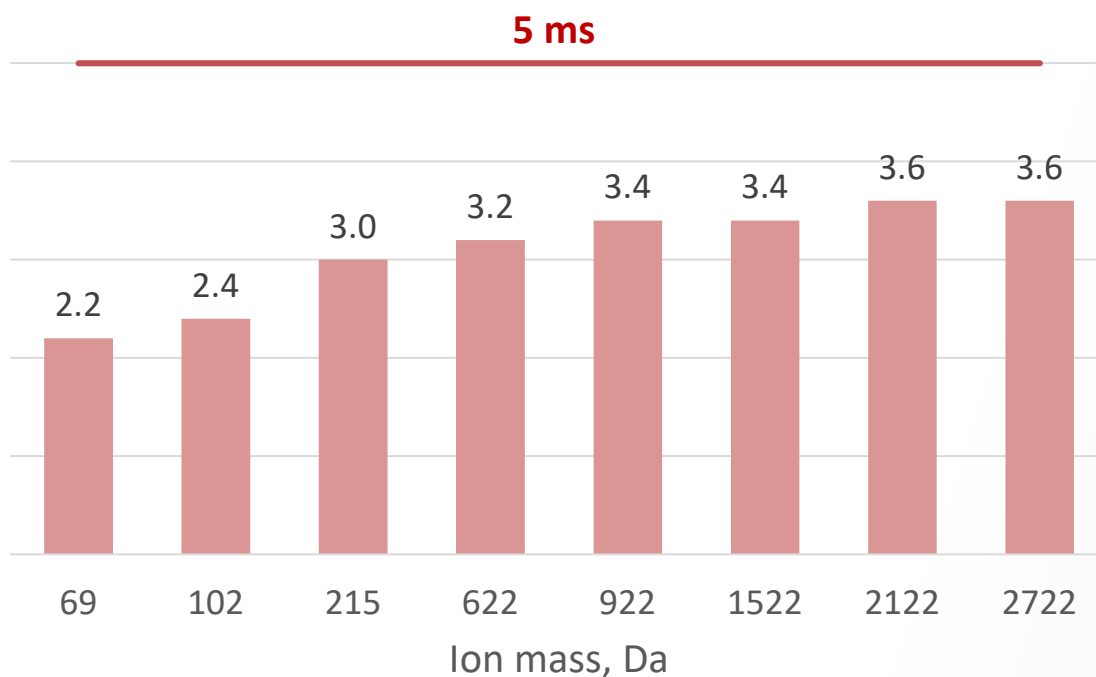
## New fast PS



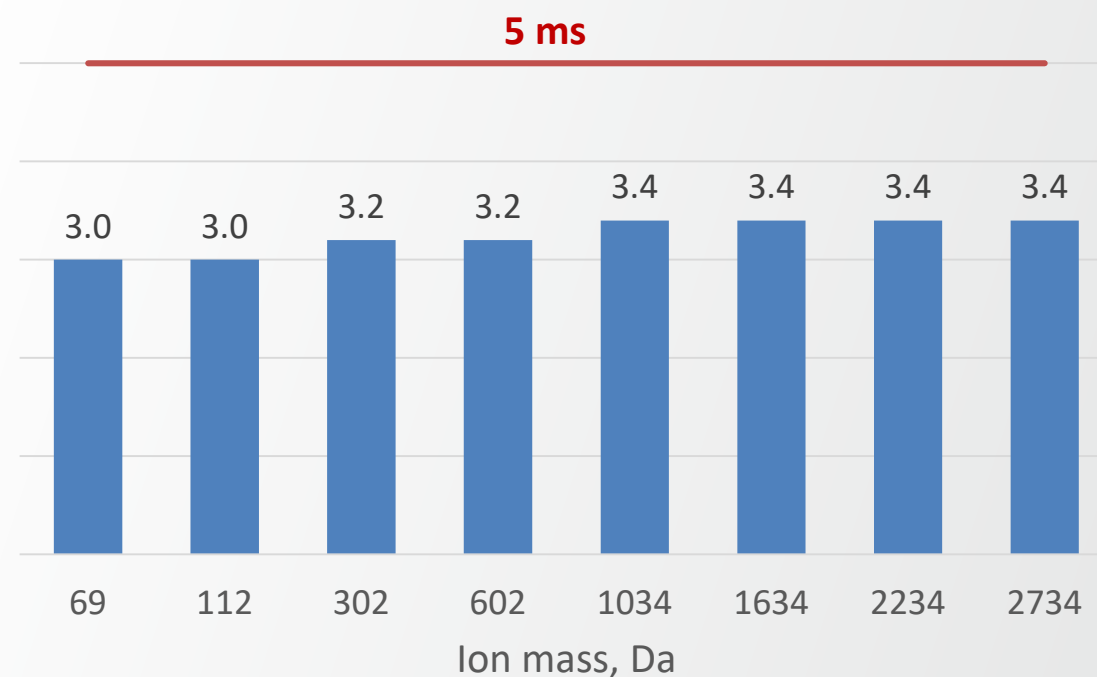
Positive to negative and negative to positive switching of dynode and source HVPS showed similar timing profiles.

# Establishing ion signal after dynode HVPS switching

Establishing Positive Ion Signal, milliseconds

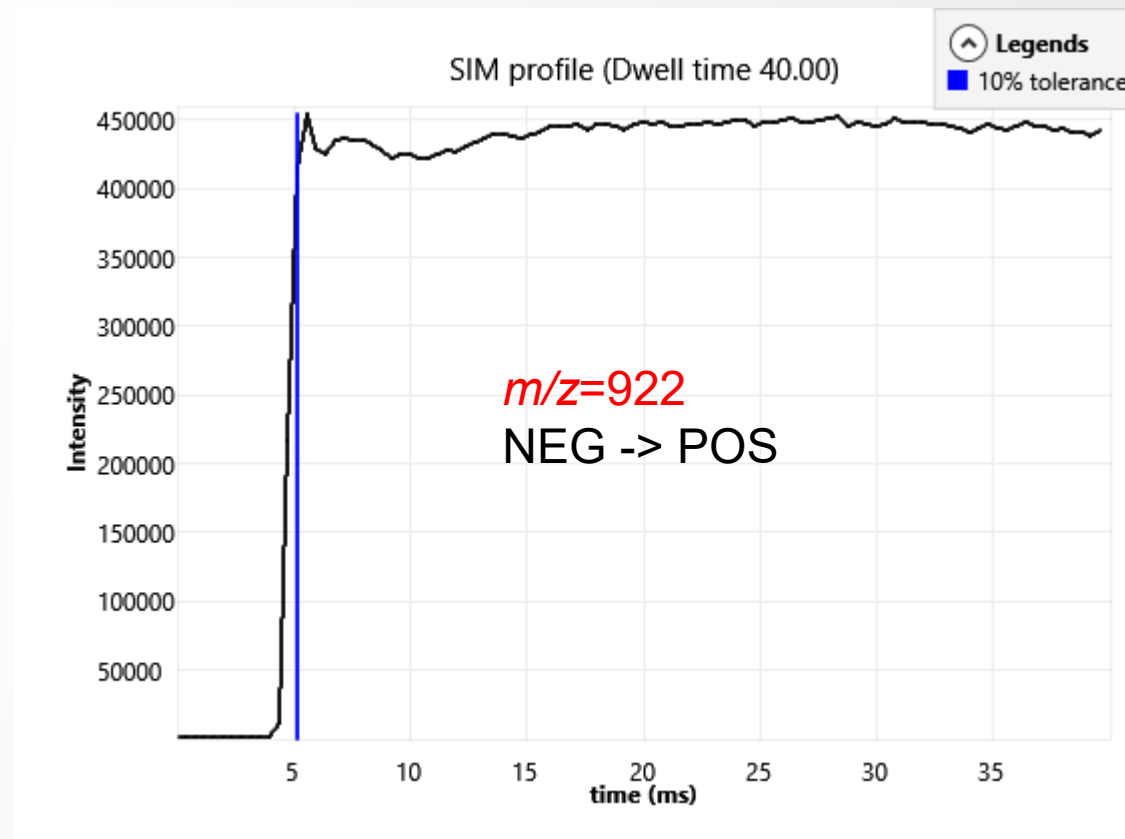
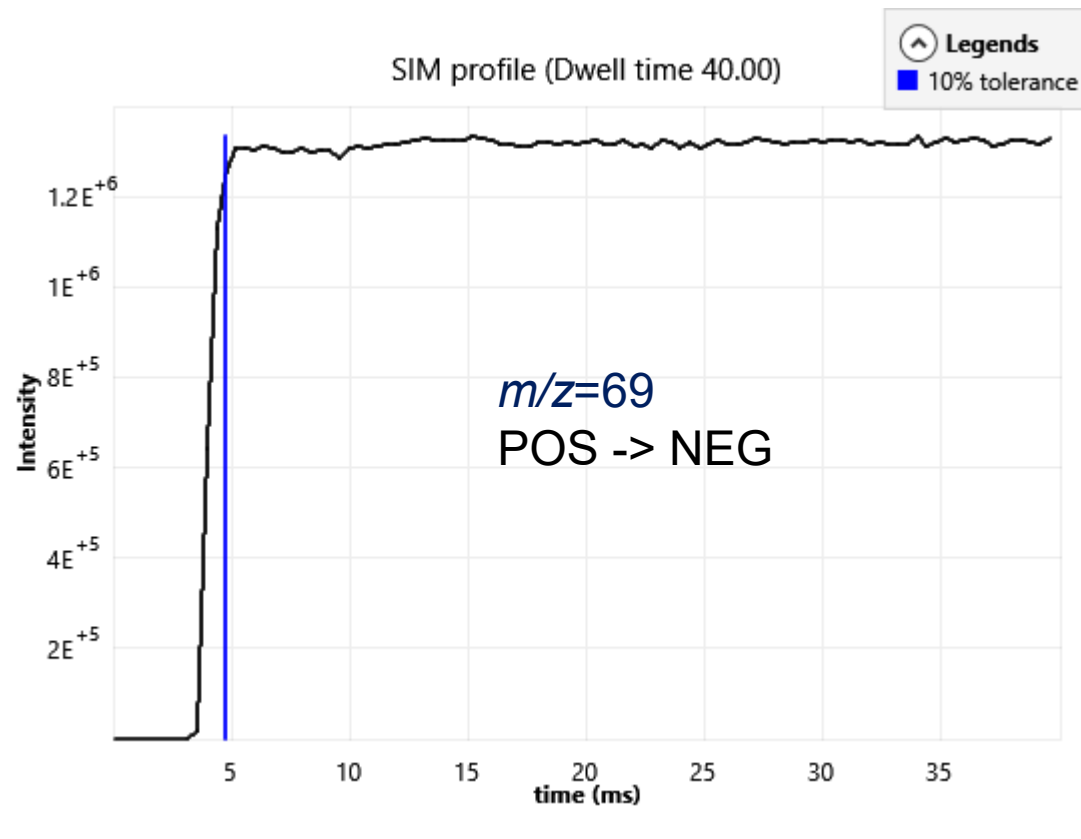


Establishing Negative Ion Signal, milliseconds



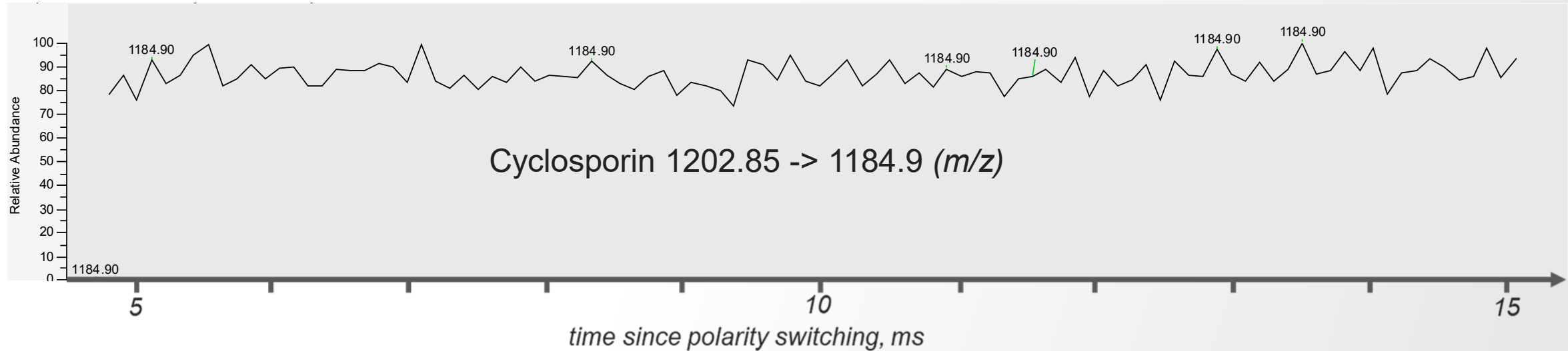
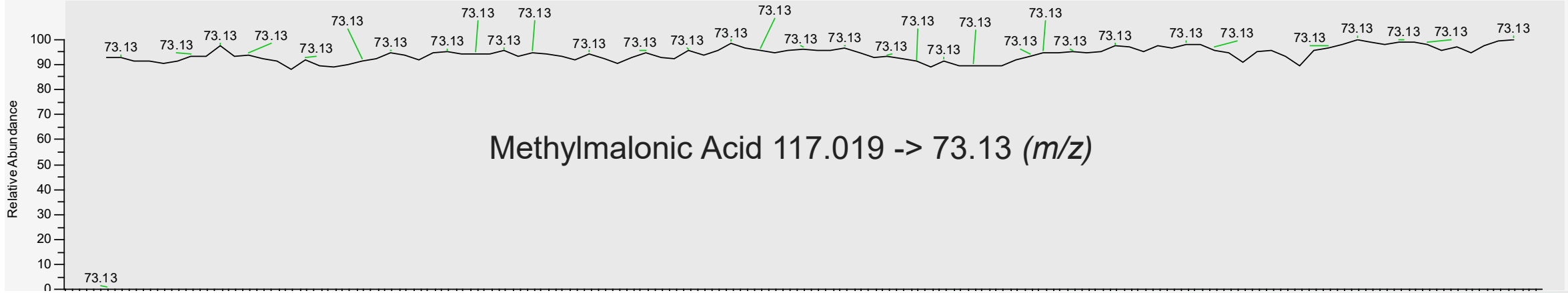
The time difference in establishing signal for positive and negative ions may be caused by a different mechanism of generation of secondary particles in the detector optics.

# Establishing low flow ESI ion signal after polarity switching of source HVPS



# No mass discrimination by new PSs in high flow method

QC\_4ppb\_1\_5ms\_5ul #1396 RT: 0.37 AV: 1 NL: 2.53E+005  
T: - p ESI SRM ms2 117.020 [73.129-73.131]

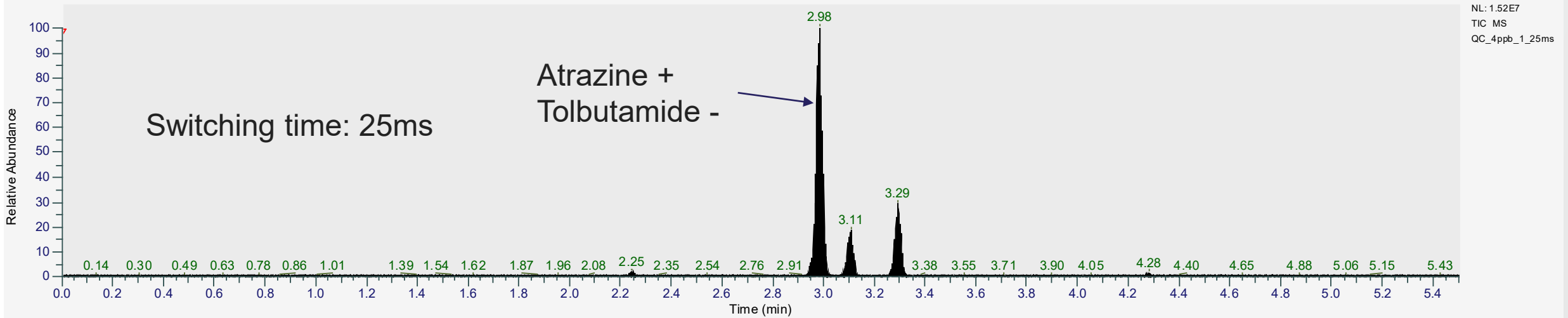


Sheath gas range: 35 to 60 a.u., Aux gas range: 5 to 15 a.u., Flow rate: 500ul/min

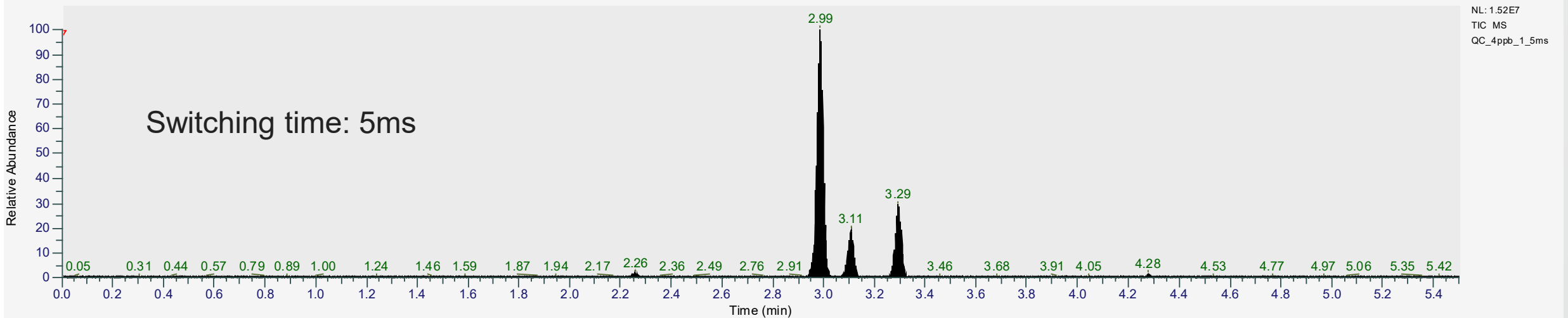


# Fast PSs deliver similar signal in high flow SST method

RT :0.00-5.50

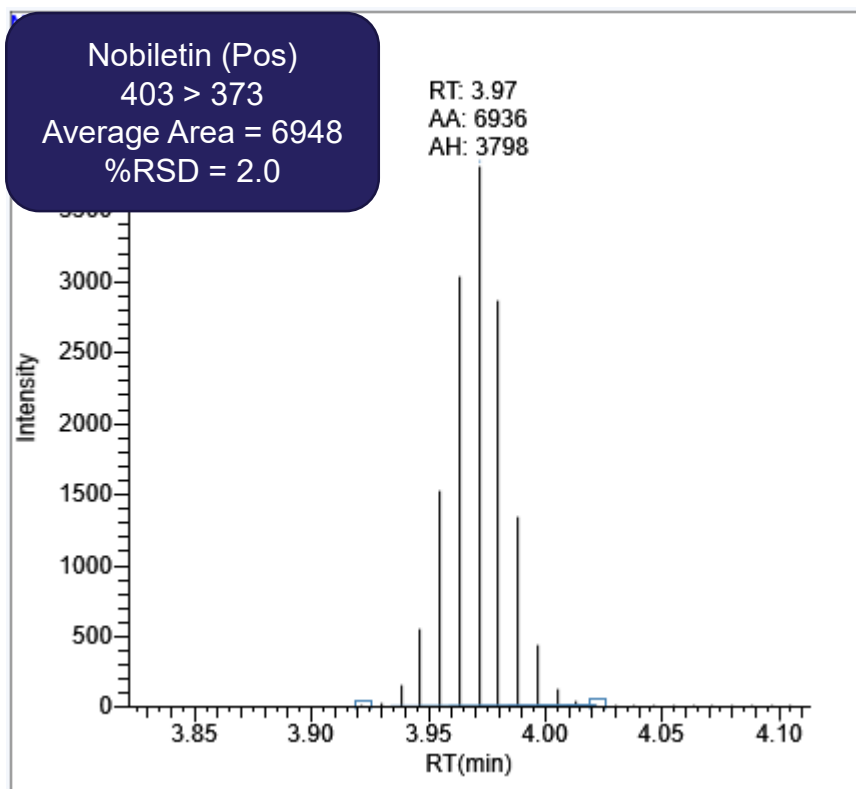


RT :0.00-5.50

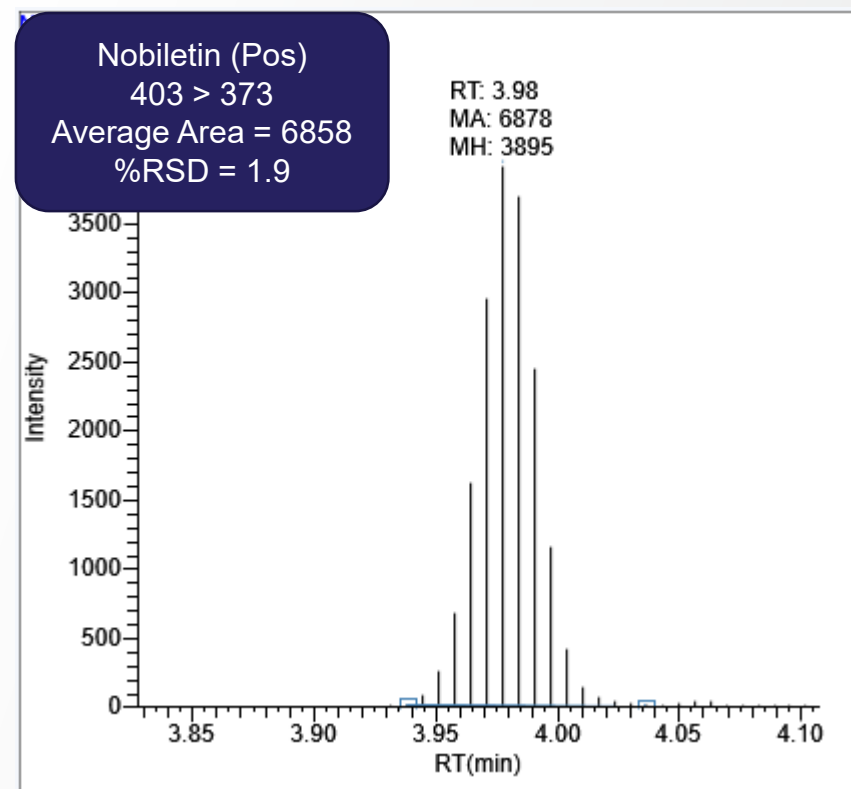


Sheath gas range: 35 to 60 a.u., Aux gas range: 5 to 15 a.u., Flow rate: 500ul/min

# No compromise in signal quality at < 5 ms dwell times in food authentication assay with polarity switching



With polarity switching



Without polarity switching

# Conclusions

- New **Dynode Power Supply** provides switching time **well within 5 milliseconds**.
- New **Electron Multiplier Power Supply** provides switching time **well within 5 milliseconds**.
- New **Source Power Supply** provides switching time in high flow **ESI** mode **well within 5 milliseconds**.

- New **Power Supplies** together with prototype triple stage quadrupole MS hardware and software may provide establishing real ion signal after polarity switching in **ESI** mode in **under 5 milliseconds**.
- Quantitative analysis of nutraceuticals in a food authentication assay confirmed **benefits of improved polarity switching time** without any loss of signal quality.