

Bruker Daltonics



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maxis

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Fig. 1: maXis: Maximum Information@Maximum Speed

High-Speed LC's New Partner

Ultra-High Resolution Mass Spectrometry

At ASMS 2008, Bruker Daltonics announced the maXis, a revolutionary new Electrospray Ultra-High Resolution tandem TOF mass spectrometer. The instrument was designed to meet head-on the biggest challenge in discovery LCMS today: to deliver ultra-high performance mass spectrometry data at speeds capable to fully exploit modern Ultra Performance Liquid Chromatography. The resulting instrument provides the definitive solution to future requirements in applications including small molecule identification, metabolomics, quantitative proteomics, and biomarker discovery. maXis redefines the scientist's expectations of what can be achieved under LCMS conditions.

Speed Matters

Modern discovery applications demand definitive tandem LCMS and MSMS results on ever more complex samples. Pursuing maximum resolution from both LC and MS techniques is a natural response to the challenges of such complexity. maXis (fig. 1) is the only mass spectrometer able to provide the maximum MS performance specification at the very highest speeds delivered by modern Ultra Performance Liquid Chromatography and Capillary Electrophoresis.

In an example experiment, a 5-component drug mixture was separated in 30 seconds, providing LC peak widths of 1 second or less. maXis confidently assigned the elemental formula of each drug compound taking advantage of sub-ppm mass accuracy, over 40,000 resolution while acquiring some 20 spectra over each LC peak [4].

One-Shot Molecular Formula Machine

The exceptional accurate mass capabilities of < 1 ppm of the maXis UHR-TOF (Ultra High Resolution Time-of-Flight mass spectrometer) define new confidence standards in formula elucidation. The few resulting formula candidates from very precise mass measurement

are further reduced to typically one single formula by SmartFormula. This algorithm takes advantage of the exact measured isotopic pattern profile and excludes further candidates by comparing the isotopic pattern from the spectrum with the theoretical isotopic pattern. Species are identified without assumptions or recourse to libraries. Moreover, the sub-ppm MS/MS capabilities of the instrument further enhances correct formula elucidation for e.g. larger molecules. Adding MS/MS fragment information with isotopic data to a sophisticated relational algorithm, SmartFormula 3D solves real life identification problems in record time, making maXis the first "One-Shot Molecular Formula Machine" (fig. 2) [2]. SmartFormula 3D was jointly developed with Pfizer UK.

Quantitative Proteomics

The astonishing stability over dynamic range of the UHR-TOF technology has given rise to an entirely new selectivity criteria for analysis of trace species in complex matrices: high resolution extracted ion chromatograms (hrEIC) are the definition of an entire compound LC peak by a trace of only 1.5 millidalton width. Comparisons using such selective chromatograms permits a new rapid, high sample num-

ber and high fidelity quantitative method for quantitative proteomics and biomarker discovery in combination with Brukers dedicated ProteomeQuant software [3].

Biomarker Discovery

In both metabolomics and proteomics, the sample complexity often is a limitation to biomarker evaluation. A resolution of beyond 40,000 FWHM enables the maXis for the discreet analysis of near-isobaric species. Peptides extremely close in mass can be clearly separated even at relatively high mass. High precision hrEIC definition of marker peaks over large sample sets permits high confidence valid data comparisons.

Intact Protein Analysis

Analysis of intact proteins requires outstanding resolution capabilities at high mass ranges. maXis high resolution power accompanied by extended mass range and high mass accuracy allows for precise protein analysis. β -Casein, for example, with a molecular weight of 24 kDa, can be analysed with isotopic resolution and a mass accuracy of $\Delta m_w = 1.5$ ppm.

Enabling Technology: Making Performance@Speed Possible

Modern chromatography can now deliver LC peakwidths of around 1 second wide, compelling the requirement for MS technologies to work at speeds of 15 or 20 Hz to provide sufficient data-points to characterise the LC peak. Time-of-flight technology is the natural

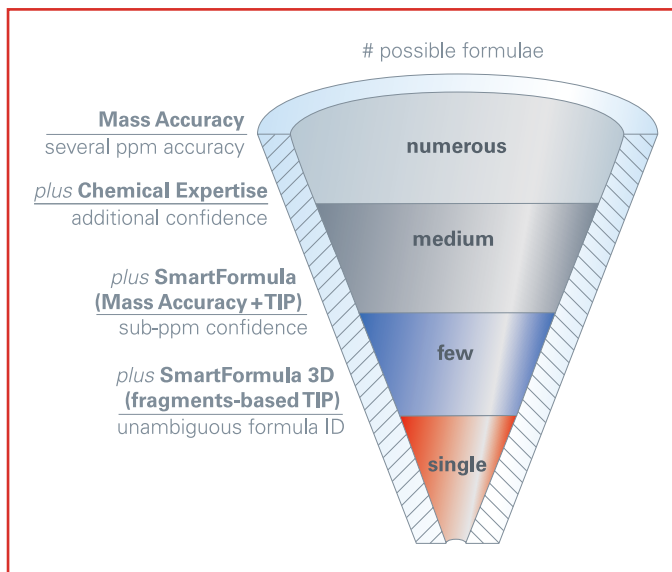


Fig. 2: Confident molecular formulae determination

choice for high-speed acquisition, however, for over a decade time-of-flight technology was believed to be limited to moderate performance in the 15,000 mass resolution range. Technologies such as FTMS or orbital trapping designs could deliver significantly higher mass performance, but such enhanced MS performance is entirely lost when running at speeds of 10 to 20 spectra-per-second required for high resolving LC. With UHR-TOF technology embodied first in maXis, Bruker scientists have broken through the limitations of previous technology with an uncompromised 40,000 plus resolution and sub ppm mass accuracy on both MS and MSMS, all achievable simultaneously at full 20 spectra per second [5].

Speed, Accuracy and Sensitivity – Fundamental for Your Applications

maXis is a revolution in high-resolution tandem mass spectrometry, offering a no-compromise solution for exceptional accurate mass, high resolution and high sensitivity analysis at a speed able to take full advantage of ultra-high performance chromatography:

- Extract full quantitative information from ultra performance chromatography
- High resolution analysis for the evaluation of complex samples in metabolomics and biomarker discovery
- Selectivity from complex mixtures with high resolution extracted ion chromatograms (hrEICs) for quantitative studies
- Certainty in identification in combination with SmartFormula 3D – unequivocal formula generation with superb mass accuracy.

References

- [1] Brochure maXis – Maximum Information@Maximum Speed
- [2] Technical Note # TN-23: Certainty in Small Molecule Identification by Applying SmartFormula 3D on a UHR-TOF Mass Spectrometer
- [3] Technical Note # TN-27: ProteomeQuant – A Highly efficient Solution for Biomarker Discovery and label-free Identification of Regulated Proteins in Biological Systems
- [4] Technical Note # TN-28: maXis High Resolution LC/MS Makes the Most of Ultrafast LC Separations
- [5] Technical Note # TN-29: UHR-TOF: A Revolution in Time-Of-Flight Technology
- [6] www.bdal.com/maxis

Literature is available from the authors upon request.

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Fig. 3: The maXis supports a wide variety of different HPLC and sample inlet systems.