

High Definition Data Directed Analysis (HD-DDA)

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This is an Application Brief and does not contain a detailed Experimental section.

Abstract

To improve routine discovery workflows with High Definition Data Directed Analysis (HD-DDA), a novel data acquisition mode for the Waters SYNAPT G2-*Si* HDMS mass spectrometer.

Benefits

High Definition Data Directed Analysis provides the highest sensitivity MS/MS data possible, enabling a better understanding of sample components regardless of concentration and complexity.

Introduction

Automated MS/MS approaches like Waters' Data Directed Analysis (DDA) method are an ideal way to generate high quality fragmentation spectra from very low level components in highly complex mixtures. In addition, DDA data can be easily processed and searched using a wide variety of software packages.

Results and Discussion

This note describes a mode of operation for the SYNAPT G2-*Si*, High Definition DDA (HD-DDA), that dramatically increases the detection limits and efficiency of LC-MS/MS analysis. A significant factor contributing to these performance enhancements is the substantial increase in MS/MS sensitivity achieved by combining MS/MS with 'Wideband Enhancement' transmission mode. HD-DDA combines this ultra sensitive MS/MS data acquisition method with improved real-time decision making to provide a significantly greater number of high quality MS/MS spectra from a single injection.

HD-DDA enhancements include:

- Enhanced MS/MS sensitivity using Wideband Enhancement for maximum ToF transmission and fragment ion spectrum quality
- Intelligent MS/MS to MS switchback: accumulated TIC switchback criteria enabling more MS/MS acquisitions during the run

- Faster decision making: increased MS/MS acquisitions per run
- Ion mobility-based charge separation in the MS survey scan for better, faster MS to MS/MS decisions by separation of ions of interest from background

During an HD-DDA acquisition, the system monitors MS survey data for ions that pass the acceptance criteria specified for MS/MS acquisition. Up to 15 precursors can be automatically selected for MS/MS from a single MS survey. The MS/MS acquisition of each precursor is halted when the accumulated TIC target is reached, or after a predefined time. Thus, more time is spent on the less intense precursors and switchback to MS survey is rapid without sacrificing MS/MS spectral quality. In addition to enabling more MS/MS spectra, HD-DDA uses Wideband Enhancement to increase duty cycle on fragments which can increase sensitivity for specific m/z ranges up to approximately ten times. The duty cycle enhancement is achieved by synchronizing the ToF pusher with target m/z ranges as ions are released from the Triwave device. Wideband Enhancement thus uses ion mobility separations to provide full duty cycle for a full m/z range. The maximum achievable enhancement is m/z -dependant, as shown in Figure 1. A comparison of two MS/MS spectra, one acquired with Wideband Enhancement and one without, is shown in Figure 2.

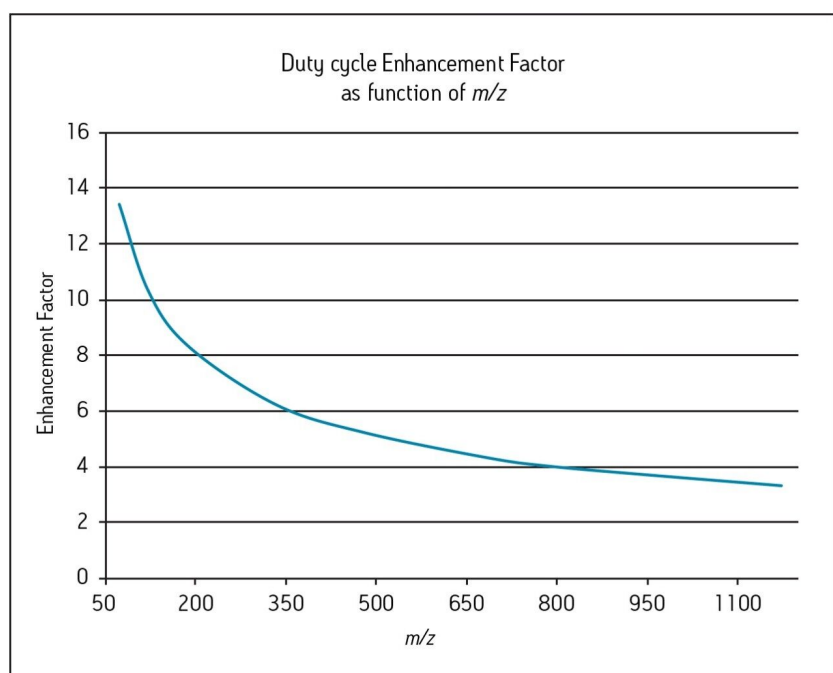


Figure 1. Expected duty cycle enhancement factor (and therefore sensitivity) as a function of m/z .

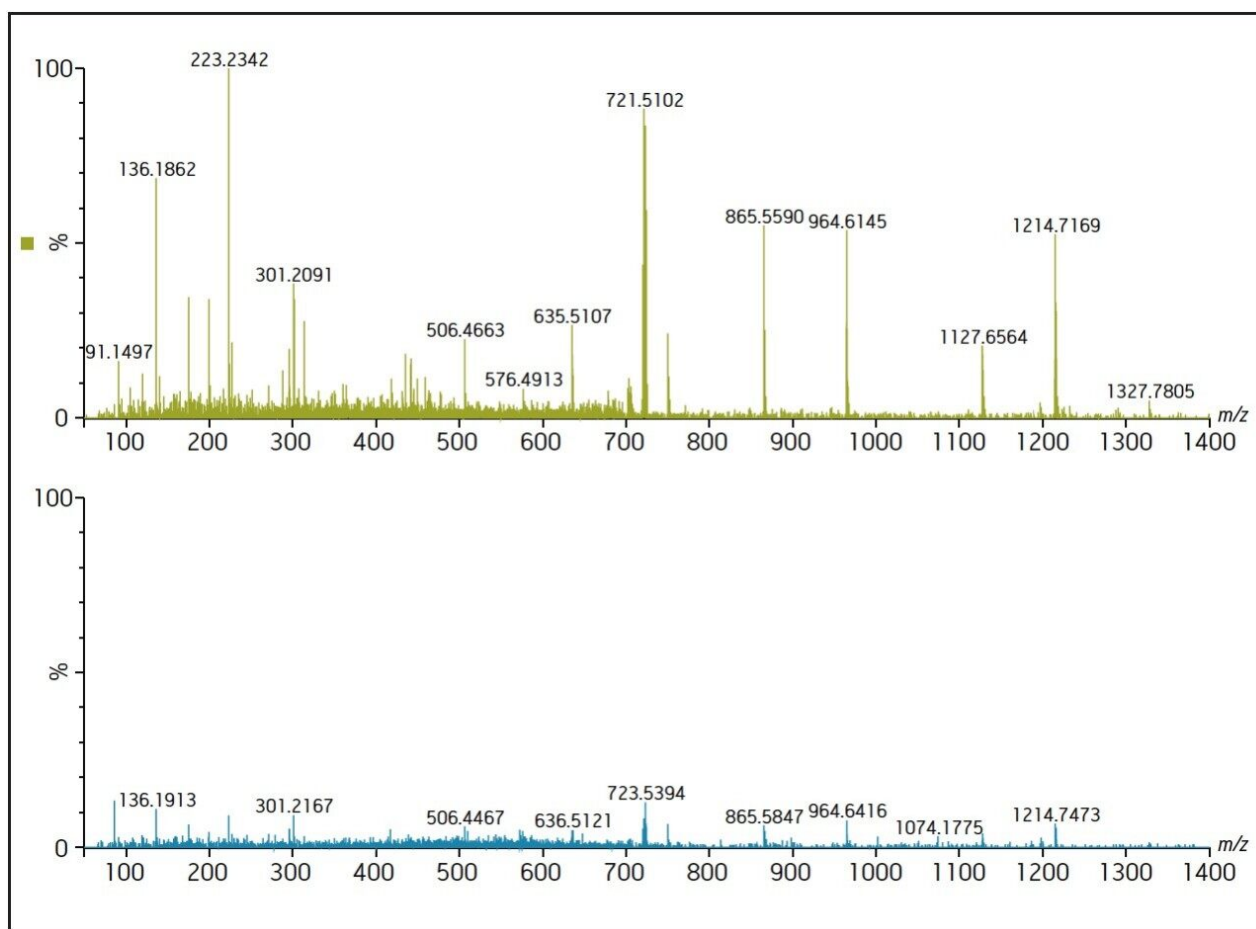


Figure 2. Five fmol tryptic peptide in solvent on a UPLC 2.1 x 100 mm Column. The lower trace shows combined spectrum from normal MS/MS experiment, while the upper trace shows combined spectrum from Wideband Enhanced MS/MS experiment.

The increase in sensitivity facilitates both increasing the total number of MS/MS events during an analysis by enabling return to MS Survey faster, and providing quality MS/MS data on exceptionally low intensity precursors.

Conclusion

Waters' HD-DDA combines intelligent acquisition routines and T-Wave Ion Mobility with Wideband Enhancement to deliver the best possible MS/MS spectra and resulting information from the most complex samples.

Wideband Enhancement increases sensitivity for fragments up to 10 times, thereby lowering detection limits as well as facilitating a faster return to the MS survey scan. This ultimately increases the number of MS/MS spectra that can be recorded during an analysis, resulting in a more comprehensive sample analysis.

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