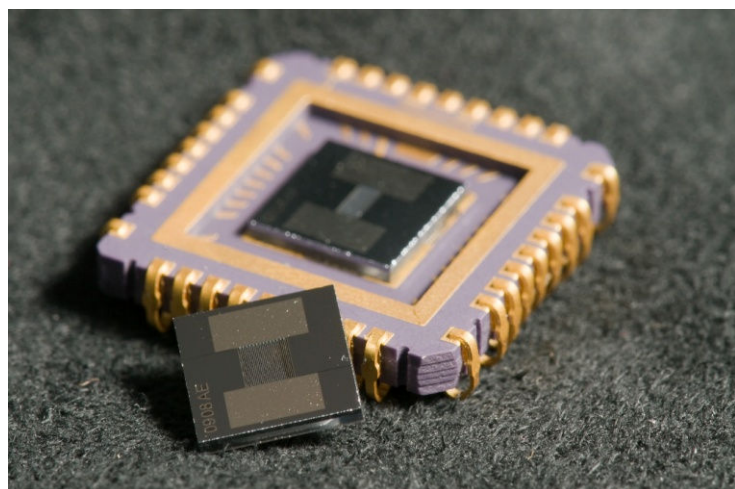


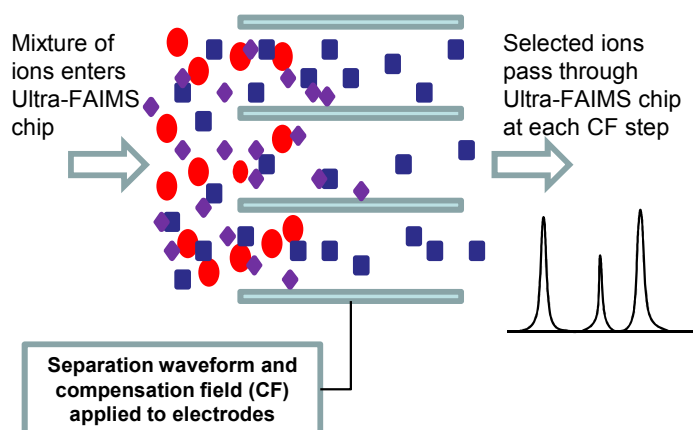
# Ultra-FAIMS microchip

## Enhancing LC-MS analysis



The Ultra-FAIMS microchip is a new, miniaturized device that interfaces with a Mass Spectrometer inlet to provide additional in-source separation of ions.

FAIMS separates ions based on the differences in ion mobility of specific species at strong and weak fields, in other words this approach separates compounds according to how their charged forms move through a gas under a varying electric field. FAIMS devices selectively transmit ion species by applying an asymmetric high-frequency separation field that causes ions to drift towards the electrodes, and then superimposing a constant compensation field (CF) which allows a specific subset of ions to pass through the device. Scanning the compensation field produces a spectrum of ions separated by their differential mobilities.



A major advantage of FAIMS is its high orthogonality to MS and LC – this means FAIMS separates on the basis of an ion property that is not closely correlated to mass or retention time – and this is the basis for the power and versatility of the FAIMS-MS combination.

**Ultra-Field Asymmetric Ion Mobility Spectrometry (Ultra-FAIMS)** is a high speed, gas phase ion separation technique. When interfaced to a Mass Spectrometer, the ultra-FAIMS device provides extra separation that can benefit a wide range of LC-MS analyses. FAIMS filters orthogonally to both LC and MS, so it can reduce interference from complex backgrounds and separate analytes that are difficult to distinguish using only LC-MS.

For further information, go to [ultraFAIMS.com](http://ultraFAIMS.com)

### What does the Ultra-FAIMS microchip do?

- Reduces chemical background noise
- Separates isobaric analytes (improving accurate mass measurement)
- Separates protein and peptide charge states
- Helps identification of low abundance analytes in a noisy background
- Separates conformers & isomers
- Filters complex samples



Ultra-FAIMS microchip installed on Agilent 6230 TOF

#### References

Shvartsburg AA, Tang K, Smith RD, Holden M, Rush M, Thompson A, Toutoungi D. "Ultrafast Differential Ion Mobility Spectrometry at Extreme Electric Fields Coupled to Mass Spectrometry." *Analytical Chemistry* 2009; 81(19):8048-53

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### Advantages of the Ultra-FAIMS microchip

#### ➤ Higher separation speed.

The extreme electric fields that can be attained within the microscale gaps of the ultra-FAIMS microchip enable much shorter separation times of ~20 to 50  $\mu$ s, which is ~100 times faster than the fastest previous FAIMS devices. This high speed is crucial for adding FAIMS to online LC-MS, where typical peaks may only be 10-20s wide. Unlike macroscopic FAIMS devices, the ultra-FAIMS chip can scan the entire CF range multiple times as an LC peak elutes, enabling the full peak capacity of the FAIMS device to be used.

#### ➤ Improved dynamic range and sensitivity.

FAIMS performance is sensitive to the shape of the gap between the electrodes. In the curved gaps of previous FAIMS-MS systems, an inhomogeneous field focuses ions, which improves the transmission of some ions but degrades others. In the planar gaps of the new chips, a homogeneous field provides much more uniform analyses. Planar gaps also provide a much better resolution/sensitivity balance for moderate ion currents. By using multiple separation channels, ultra-FAIMS microchips also avoid the ion current limitations that would be seen in a single narrow channel. This makes the device more suitable for quantitative measurements.

#### ➤ Operational flexibility, ease, and safety.

Previous FAIMS devices operated inherently near the electrical breakdown point, making them prone to failure and limiting the gases to more insulating ones rather than those optimum for routine use or the quality of analyses. In particular, helium/nitrogen mixtures can improve separations compared to nitrogen gas alone, and the benefit grows at higher helium fractions. However, the electrical breakdown occurs more easily in helium, which previously limited its content to <50%. The extremely high resistance to electrical breakdown in the microscopic gaps allows the use of up to 100% helium, which improves the achievable separation power and operational flexibility.

#### US Office:

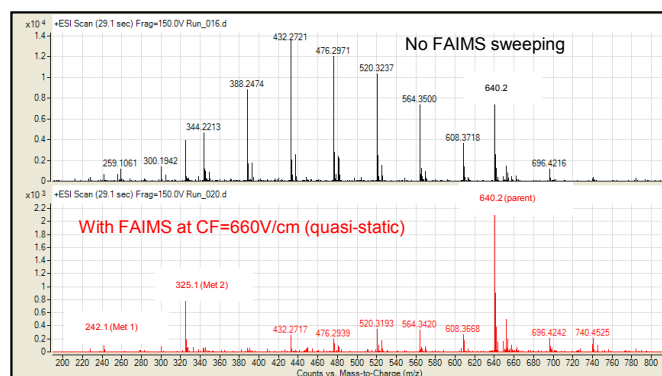
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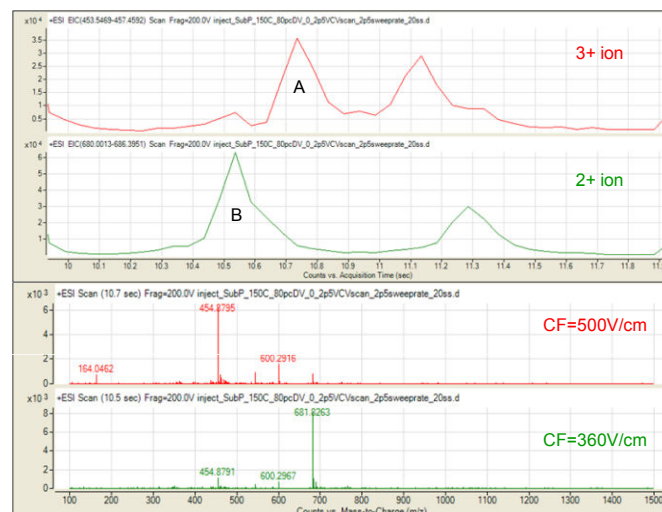
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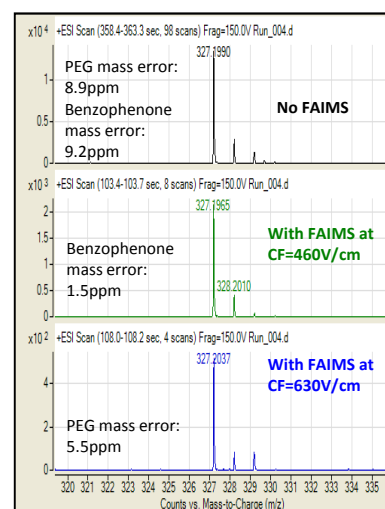
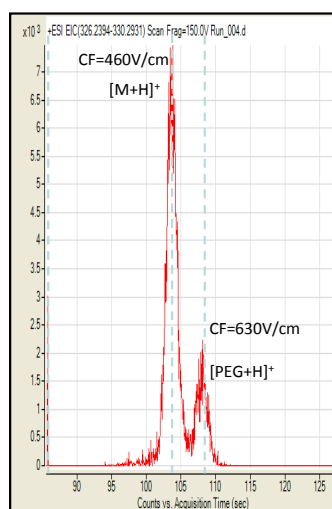
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Use of quasi-static FAIMS filtering to suppress PEG peaks while enhancing the relative intensity of parent drug and metabolite peaks (labelled), assisting analysis of complex biological samples. Top spectrum is without FAIMS, bottom with FAIMS.



Dynamic separation of protein charge states of [Met-OME<sup>11</sup>]-substance P during LC run. Top 2 traces are extracted ion chromatograms for 3+ and 2+ charge states, showing peaks where the FAIMS CF permits transmission of each ion. Bottom 2 traces are the mass spectra at the peaks of each EIC (marked A and B), confirming that red trace corresponds to 3+ ion (454) and green trace corresponds to 2+ ion (681)



Separation of isobaric ions (2-hydroxy-4-(octyloxy)benzophenone and the PEG m/z 327 ion). Right trace shows extracted ion chromatogram for m/z = 327 - the presence of two peaks at different CFs demonstrates that these ions are resolved by FAIMS. Right traces show the spectra with (top) no FAIMS, (middle) FAIMS at CF=460V/cm and (bottom) CF=630V/cm. The two lower spectra give much improved mass accuracy for the isobaric ions.