In this work we demonstrate the utility of high field extraction in orthogonally accelerated time-of-flight mass spectrometry.

The high field extraction helps to reduce the spread of the arrival time distributions (ATD) for ions of a given mass to charge ratio (m/z) at the detector.

Dual stage reflectrons together with biased instrument geometry allow the creation of time of flight for the narrow arrival time distributions.

The combination of the two effects is to increase the resolving power by the factor of 2 over current instrumentalisation of a similar mass.

The resolution of most OA-ToF mass analysers is given by:

\[ R = \frac{1}{2} \frac{1}{\Delta \theta} \]

where \( \Delta \theta \) is the time of flight for a specific mass to charge ratio (m/z) and E is the full with half maximum (FWHM) of the arrival time distribution for this mass at the detector.

The BT term is in equation (1) is itself a population of many ATD broadening effects. These include, but are not limited to, mechanical imperfections such as misalignments and parallelism, analysis chamber pressure fluctuations, grid catch efficiency, and charging of the ion beam. The varying level of these losses results in an almost linear change in spread of ions as peak stresses through grids, optical stages, the flight path, and at the detector.

OA-ToF mass analysers have a limited dynamic range. On current instrumentation, measurements and simulations have indicated that the pre-extraction velocity spread is the largest contributor to the width of the final ATD. It is well known that additional reflectron stages allow increased orthogonal extraction fields reduce the contribution of ions prior to extraction and the orthogonal velocity spread of ions prior to extraction.

The benefits of high resolution (R) in OA-ToF MS are well documented. High resolution OA-ToF MS makes it ideal for interfacing to fast GC and IMS.

The high extraction field helps to reduce the pre-extraction velocity spread of ions and facilitate a ~2-3 fold increase in resolution over multiple dual stage and single stage reflectrons of OA-ToF mass analysers.

All experiments were performed on a prototype Synapt G2 instrument shown in figure 1.

In OA-ToF type geometries the gas cell, or transfer travelling wave wall is one of the key elements of the OA-ToF design. The gas cell has a series of electrodes arranged in an order that manipulates the phase space of the ion beam reducing the orthogonal velocity spread. The gas cell has a series of electrodes arranged in such a way that ions with a particular charge to mass ratio are accelerated to the desired energy. The sampled ion beam from the gas cell to the OA-ToF.

The detector incorporates a novel wide dynamic range ADC based detection system.

In-Q-ToF type geometries the gas cell, or transfer travelling wave wall is one of the key elements of the OA-ToF design. The gas cell has a series of electrodes for manipulates the phase space of the ion beam reducing the orthogonal velocity spread. The gas cell has a series of electrodes arranged in such a way that ions with a particular charge to mass ratio are accelerated to the desired energy. The sampled ion beam from the gas cell to the OA-ToF.

The detector incorporates a novel wide dynamic range ADC based detection system.

In-Q-ToF the spread of ions prior to extraction and the spread of ions prior to extraction is the largest contributor to the width of the final ATD. It is well known that additional reflectron stages allow increased orthogonal extraction fields reduce the contribution of ions prior to extraction and the orthogonal velocity spread of ions prior to extraction.

The detector incorporates a novel wide dynamic range ADC based detection system.

In-Q-ToF the spread of ions prior to extraction and the spread of ions prior to extraction is the largest contributor to the width of the final ATD. It is well known that additional reflectron stages allow increased orthogonal extraction fields reduce the contribution of ions prior to extraction and the orthogonal velocity spread of ions prior to extraction.

The detector incorporates a novel wide dynamic range ADC based detection system.

In-Q-ToF type geometries the gas cell, or transfer travelling wave wall is one of the key elements of the OA-ToF design. The gas cell has a series of electrodes arranged in an order that manipulates the phase space of the ion beam reducing the orthogonal velocity spread. The gas cell has a series of electrodes arranged in such a way that ions with a particular charge to mass ratio are accelerated to the desired energy. The sampled ion beam from the gas cell to the OA-ToF.

The detector incorporates a novel wide dynamic range ADC based detection system.

In-Q-ToF the spread of ions prior to extraction and the spread of ions prior to extraction is the largest contributor to the width of the final ATD. It is well known that additional reflectron stages allow increased orthogonal extraction fields reduce the contribution of ions prior to extraction and the orthogonal velocity spread of ions prior to extraction.

The detector incorporates a novel wide dynamic range ADC based detection system.

In-Q-ToF type geometries the gas cell, or transfer travelling wave wall is one of the key elements of the OA-ToF design. The gas cell has a series of electrodes arranged in an order that manipulates the phase space of the ion beam reducing the orthogonal velocity spread. The gas cell has a series of electrodes arranged in such a way that ions with a particular charge to mass ratio are accelerated to the desired energy. The sampled ion beam from the gas cell to the OA-ToF.

The detector incorporates a novel wide dynamic range ADC based detection system.

In-Q-ToF the spread of ions prior to extraction and the spread of ions prior to extraction is the largest contributor to the width of the final ATD. It is well known that additional reflectron stages allow increased orthogonal extraction fields reduce the contribution of ions prior to extraction and the orthogonal velocity spread of ions prior to extraction.

The detector incorporates a novel wide dynamic range ADC based detection system.

In-Q-ToF type geometries the gas cell, or transfer travelling wave wall is one of the key elements of the OA-ToF design. The gas cell has a series of electrodes arranged in an order that manipulates the phase space of the ion beam reducing the orthogonal velocity spread. The gas cell has a series of electrodes arranged in such a way that ions with a particular charge to mass ratio are accelerated to the desired energy. The sampled ion beam from the gas cell to the OA-ToF.

The detector incorporates a novel wide dynamic range ADC based detection system.

In-Q-ToF the spread of ions prior to extraction and the spread of ions prior to extraction is the largest contributor to the width of the final ATD. It is well known that additional reflectron stages allow increased orthogonal extraction fields reduce the contribution of ions prior to extraction and the orthogonal velocity spread of ions prior to extraction.

The detector incorporates a novel wide dynamic range ADC based detection system.

In-Q-ToF type geometries the gas cell, or transfer travelling wave wall is one of the key elements of the OA-ToF design. The gas cell has a series of electrodes arranged in an order that manipulates the phase space of the ion beam reducing the orthogonal velocity spread. The gas cell has a series of electrodes arranged in such a way that ions with a particular charge to mass ratio are accelerated to the desired energy. The sampled ion beam from the gas cell to the OA-ToF.

The detector incorporates a novel wide dynamic range ADC based detection system.