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A novel SiPM-based detector for Time-of-Flight Mass Spectrometry

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Time-of-Flight Mass Spectrometry (ToFMS) is a well-established technique used to identify, discover and quantify compounds in a sample and to study the structure and chemical properties of molecules. It has a wide range of applications in different fields like proteomics, drug development, environmental analysis/monitoring, space exploration or forensic analysis. In ToFMS the sample under study is ionized and the resulting ions are accelerated to the same kinetic energy. The time it takes the ions to reach the detector depends on their mass-to-charge ratio (m/z). Most ToFMS instruments employ microchannel plate detectors (MCPs), mainly due to their excellent time resolution and high gain, which allows for single-ion detection with high mass resolution. However, MCPs are expensive, fragile, prone to saturation and require high vacuum. Besides, their dead time limits the maximum ion count rate. We propose a new detector for ToFMS that consists of a fast scintillator, an array of silicon photomultipliers (SiPMs) and FastIC, an ASIC for fast-timing applications. The arrival time and the amplitude of the pulses detected by the SiPMs are digitized by FastIC, which permits processing multiple channels with simplicity, low cost and power consumption. This detector has the potential to provide a time resolution comparable to that of the MCPs used in ToFMS, while overcoming most of their limitations. In particular, it could permit increasing the data taking rate and facilitate the construction of compact and portable instruments, which could have a significant impact in forensic, clinical and space applications. Additionally, it could be used for mass spectrometry imaging, for instance to study the dynamics of molecular reactions. We will describe our detector, the results obtained with a prototype installed in a research ToFMS system at Oxford University and the prospects for the next generation of these detectors.

Collaboration

Role of Submitter

I am the presenter

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