Recent progress in high resolution photon counting detectors with Microchannel Plates

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Abstract

Detectors with Microchannel Plates have found niche applications in soft X-ray UV and sometimes visible photon detection, where event counting with high spatial and timing resolution is needed. Different types of readouts for these detectors have been developed over last several decades. The Timepix readout ASIC placed directly below MCP in the vacuum is one of the possible readout options. The capability of pixelated Timepix readout to detect many simultaneous events substantially increases the count rate capabilities of these devices to GHz levels. In this talk, we review the possible readout configurations for the MCP detectors and present the recent developments of this photon counting technology and present the results obtained with an MCP detector coupled to a quad Timepix/ Timepix3 and a single-chip Timepix4 readouts. The spatial resolution of this detector can routinely reach ~6 μm values (the size of the MCP pores). This resolution is achieved in real time through the event centroiding. Optimization of detector characteristics needs to be performed to achieve such a high spatial resolution. Timing resolution of 1.6 ns with Timepix3 readout and is expected to be better than 200 ps with the latest generation Timepix4 readout. A couple of application examples of these detectors at Resonance Inelastic X-ray Scattering (RIXS) and X-ray Photon Correlation Spectroscopy demonstrate the unique capabilities of such devices for certain synchrotron-based experimental studies. Same MCP/Timepix detectors can be very attractive for the applications where the photon/electron/ion/ neutron counting with high spatial and temporal resolution is required, such as Time of Flight experiments in energy-resolving neutron imaging at spallation neutron sources, fluorescence lifetime imaging and, if adapted for the electron detection, experiments on photoelectron spectroscopy.