microchannel plate (MCP) detectors have been used in space-based astronomical detectors for decades. Modern MCPs have higher performance, allowing for the detection of fainter signals. Better quantum efficiency is enabled by improving the design of the photocathode coating on the front surface of the MCP. The coating is made of bialkali CsI, which is known for its high secondary electron yield. The quantum efficiency (QE) of the coating can be as high as 0.1% when illuminated at 250 nm.

The quantum efficiency of MCPs is also affected by the resolution of the detector. Finer spatial resolution is achieved by using smaller anodes (500,000 anodes on a 22 mm cross strip) and multiplexing the outputs. The Timepix ASIC, for example, allows for a 256x256 pixel (6.25µm) readout with an amplifier/discriminator/counter in each pixel. This results in a low noise (75e- discriminator/counter in each pixel) and a digital frame-based readout. The Timepix ASIC design baseline schematic showing the major components, including the amplifiers and ADCs (1 per strip) into an internal FPGA sequencer.

ALD allows the deposition of thin layers of electron amplifying materials such as MgO and Al2O3. MgO coatings in particular actually increase their secondary electron coefficient under electron bombardment, resulting in longer lived plates. ALD allows the deposition of thin layers of electron amplifying materials such as MgO and Al2O3. MgO coatings in particular actually increase their secondary electron coefficient under electron bombardment, resulting in longer lived plates.

We were awarded a Strategic Astrophysics Technology grant to raise the TRL level of our Cross Strip readouts from 4 to 6 by incorporating the amplifiers and ADCs (1 per strip) into an CMOS ASIC called the GRAPHIC which should decrease the power and mass requirements of the electronics by an order of magnitude. We are also working to develop sealed tube image intensifiers with large fill factors, eliminating the requirements for massive doors and actively pumped vacuum systems.

Microchannel Plate Detectors

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