Phosphor screen imaging system for 8'' X 8'' MCP characterization

†The Large Area Picosecond Photodetector (LAPPD) Collaboration leading by High Energy Physics (HEP) division at Argonne are developing 8'' X 8'' large area, cost effective microchannel plate (MCP) based photodetectors with spatial resolution of millimeter and time resolution of a few picoseconds. The fast time resolution and precise spatial resolution enable the photodetector with wide applications in particle detections such as time of flight (TOF) measurement, calorimeter, Cherenkov light detection and medical imaging. In principle, incoming photon interferes with photoemission material to generate photoelectron, multiplied through MCP arrays producing a detectable signal pulse. As an essential component of the large area photodetector, MCPs made of inexpensive bare glass capillary arrays are coated with resistive layers and secondary electron emissive layers through atomic layer deposition (ALD) to multiply the photoelectrons by a factor of 1-10 million. To achieve a high performance large area photodetector, it is important to obtain uniformly coated MCPs. Therefore, for a production line, it becomes very necessary to evaluate the uniformity of the ALD coated MCPs in an easy and fast manner.

At HEP division, an imaging system is designed and built to evaluate the uniformity of ALD coated 8'' X 8'' large area MCPs. The imaging system consists of a vacuum housing with view ports, a pen-ray UV light source, an aluminized phosphor screen, a testing MCP and two positive power suppliers. When UV beam hits the MCP front surface, secondary electrons are generated and multiplied through the high voltage across the MCP. These output electrons are then accelerated onto phosphor screen to excite the phosphor, producing an image. The image is visible through a glass window and captured by a wide angle camera for quantitative analysis. With a pre-calibrated uniform UV beam, the image on phosphor screen represents the uniformity profile of the ALD coated MCP.

Initial 8'' X 8'' MCP uniformity tests were performed with both single and double MCP imaging on a phosphor screen readout through UV illumination (254nm). The following image shows a uniform overall response of an ALD coated MCP with sharply defined hexagonal boundaries. The hexagonal boundaries are multi-fiber packing structures during MCP fabrication process. Further analysis of the images using MATLAB leads to quantitative results for MCP uniformity evaluation.

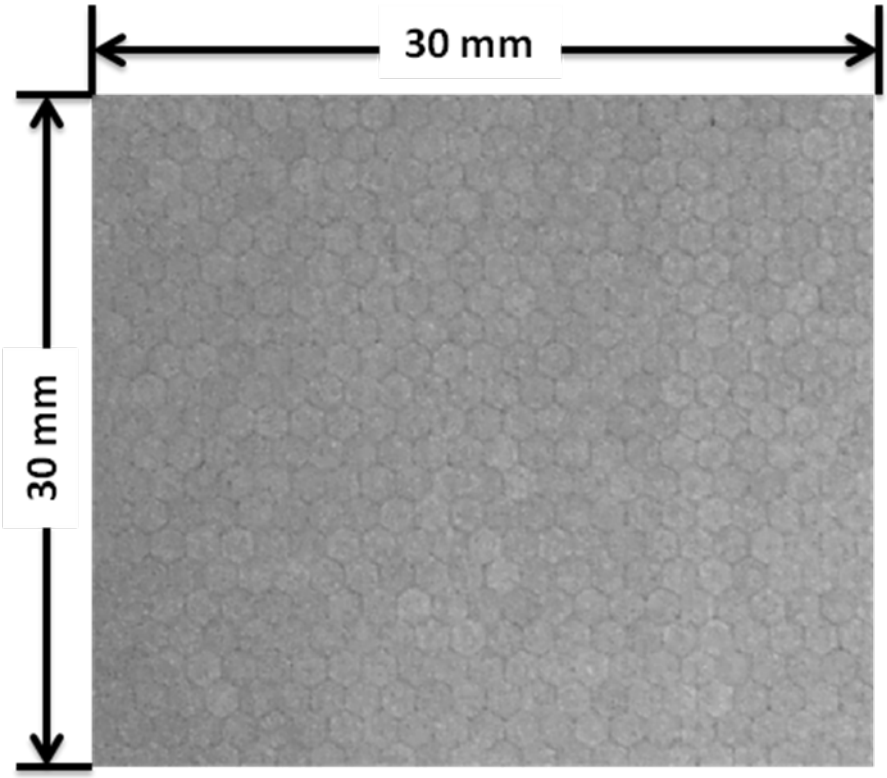

Figure 1. Enlarged phosphorescent image (in gray scale) of an ALD coated MCP illuminated with 254 nm UV. The hexagonal multi-fiber structure is clearly visible as the image is enlarged.

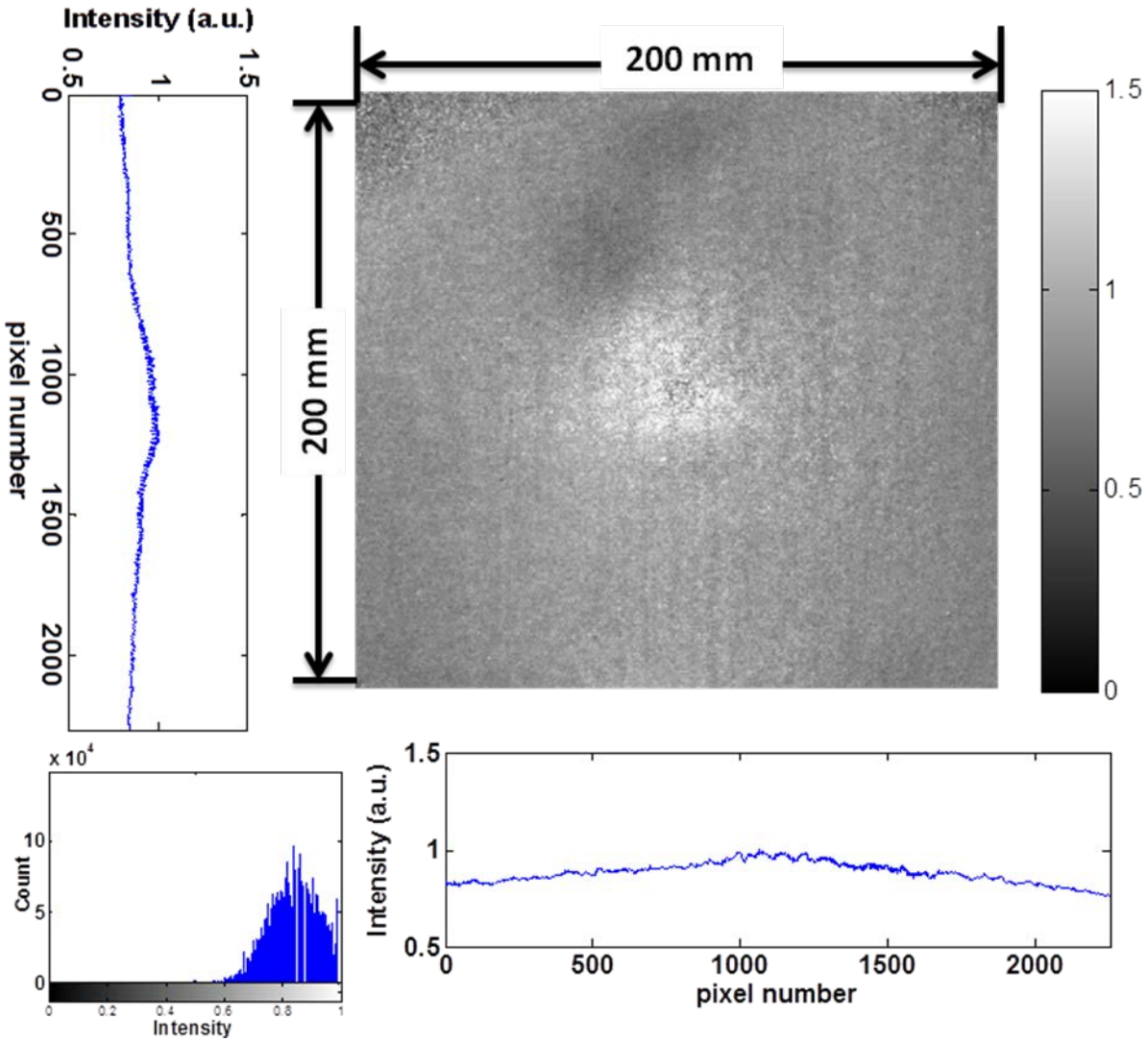

Figure 2. Phosphorescent image (in gray scale) of an 8'' x 8'' MCP, the image is analyzed using MATLAB software, the MCP is uniform at large area and the standard deviation (sigma) is 0.085.

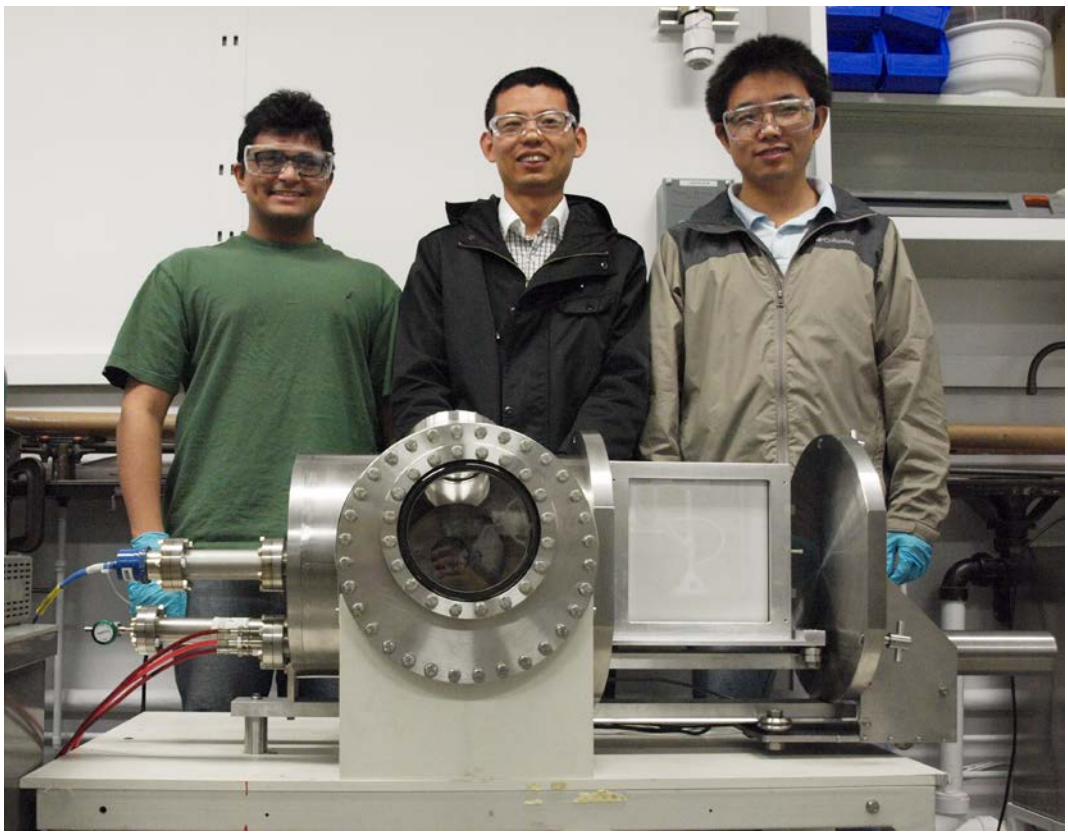

Figure 3. Phosphor screen imaging system for large area MCP uniformity evaluation built by Argonne researchers (from right to left: Junqi Xie, Xing Wang and Sagar Setru). The phosphor is coated on a glass and placed in a holder together with MCPs for illumination.

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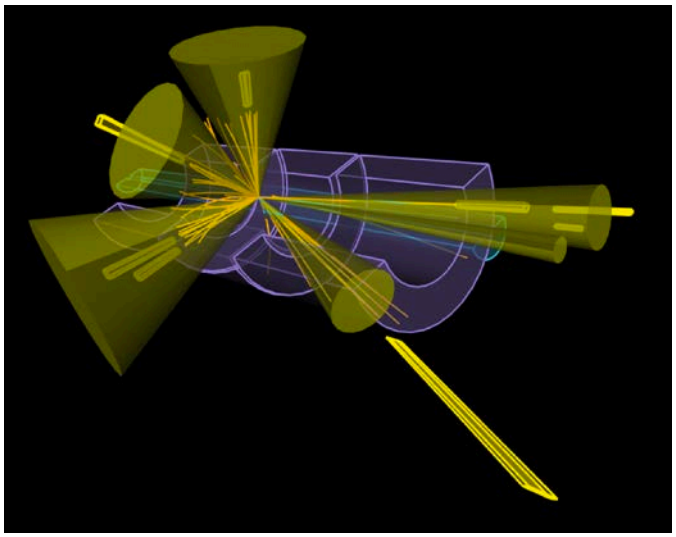
Initial Monte Carlo simulations run on Mira for the ATLAS (LHC) Experiment

†This month the HPC effort has delivered 98,000 simulated events to the ATLAS experiment at the Large Hadron Collider - events that were specifically requested by ATLAS as part of the integration of high performance computing with other computing resources. These are Alpgen Z+4and Z+5 jets followed by the Z decaying to tau+tau-pairs and the taus subsequently decaying to leptons. The entire task used 30,000 CPU-hours on Mira.



A Z+5 jet event in Alpgen simulated on Mira using the ALPGEN Monte Carlo generator code.

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