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A Novel gain stage for Microchannel Plate Imaging Photomultipliers

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Microchannel plate based photomultipliers are the major technology for single photon imaging at time resolutions below 200 ps. We describe a technique to improve microchannel plate (MCP) detector dynamic range and lifetime by means of a novel technology, an "active anode"employing atomic layer deposition (ALD) to provide an additional gain stage after the MCP. The technique has direct application to ring imaging Cherenkov (RICH) detectors for particle physics and other applications requiring time-resolved photon-counting imaging.

The ALD technique allows complex surfaces to be conformally coated with ultra thin films in a wide variety of materials. ALD has already been shown to benefit MCP detectors, allowing increased detector gain and reducing outgassing with dramatic benefit to detector lifetime.

We describe an additional gain stage behind the MCP stack comprising a mesh anode and reflection dynode and incorporating a two-dimensional image readout via the Image Charge technique. ALD is used to provide a dynode coating with high secondary electron emission and the resistive properties required for Image Charge. The additional gain stage allows MCP gain to be lowered increasing both the local and global count rate limits and enhancing detector lifetime.

We present measurements of secondary electron emission from ALD coatings and imaging performance of an MCP detector employing the active anode device.

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