

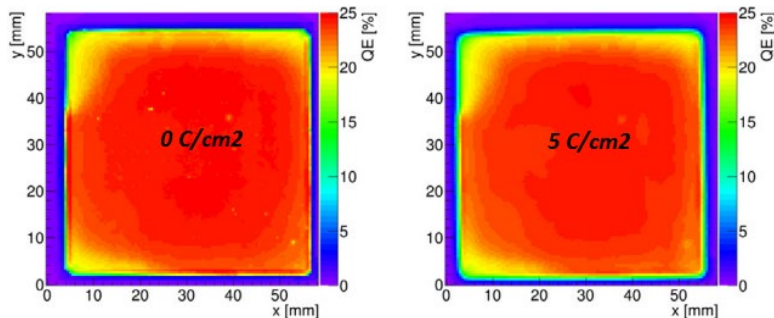


ARRADIANCE *Sneak Preview*

Lifetime and performance of the very latest microchannel-plate photomultipliers

March 17, 2023

High-energy physics experiments at the Facility for Antiproton and Ion Research in Europe (FAIR), which seek to understand how proton-antiproton annihilation (PANDA) works on a more fundamental level, impose demanding requirements on Cherenkov light photon detectors placed inside the magnetic field of the target spectrometer. The detectors must have a lifespan of more than 10 years and possess the following attributes: withstand magnetic fields > 1 Tesla, high radiation hardness and low dark count, no degradation to timing or spatial resolution, and a high detection rate and quantum efficiency (DQE). This paper¹ by researchers from Friedrich Alexander-University of Erlangen–Nuremberg and other German institutions, further supported by previous² research, verifies that only microchannel-plate based photomultipliers (MCP-PMTs), enabled by atomic layer deposition (ALD), deliver the required performance. The researchers used MCP-PMTs containing technology first developed by Arradiance, from three different manufacturers for their study. The Arradiance technology includes both resistive and emissive ALD coatings. These coatings may be applied to MCPs, as in this case, or on other substrates or devices with high aspect ratios including lead-free glass structures.



Quantum efficiency scans of MCP-PMT with 5 C/cm² charge extracted. Best performing MCP-PMT DQE is shown before and after extraction.

High-surface area MCP-PMTs of up to 53x53mm in size with 10 μ m microchannel capillary pores, similar to the 2-layer ALD-enabled MCP-PMTs used in the 2017 publication², demonstrated exceptionally long lifetime, high gain and quantum efficiency.

Lifetime was measured by an accelerated extracted charge test – these plates delivered an equivalent of > 70 years of continuous detector operation (under normal conditions). It is hypothesized that the 2-layer ALD film also provides photocathode protection from heavy ion bombardment.

¹ D. Miehling, M. Böhm, K. Gumbert et. al., “Lifetime and performance of the very latest microchannel-plate photomultipliers”, *Nuclear Inst. and Methods in Physics Research A*, Volume 1049 (2023)
<https://doi.org/10.1016/j.nima.2023.168047>

² A. Lehmann, A. Britting, W. Eyrich et. al., “Tremendously increased lifetime of MCP-PMTs”, *Nuclear Inst. and Methods in Physics Research A*, Volume 845 (2017)
<https://doi.org/10.1016/j.nima.2016.05.017>

Arradiance technology enables resistive and emissive ALD films in numerous applications, including reduced lead glass replacement. If you would like more information or wish to inquire about GEMStar™ Technology, ALD systems or Foundry services, please [contact Arradiance](#)