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Tremendously Increased Lifetime of Microchannel-Plate PMTs

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Microchannel plate (MCP) PMTs are very attractive photon sensors for low light level applications in B-fields. However, until recently the main drawback of MCP-PMTs was their aging behaviour which manifests itself in a limited lifetime due to a rapidly decreasing quantum efficiency (QE) of the photo cathode (PC) as the integrated anode charge (IAC) increases. In the latest models of PHOTONIS, Hamamatsu, and BINP novel techniques are applied to avoid these aging effects which are mainly caused by ion backflow impinging on the PC and damaging it.

Since four years we are running an aging test for new lifetime-enhanced MCP-PMT models by simultaneously illuminating various PMT types with roughly the same photon rate. This allows a fair comparison of the lifetime of all investigated MCP-PMTs and will give some insight in the best techniques for a lifetime enhancement.

In this presentation the results of comprehensive aging tests will be discussed. Gain, dark count rate and QE were investigated for their dependence on the IAC. The QE was measured spectrally resolved and as a function of the position across the photo cathode to identify regions where the PC damage develops first. For the best performing tubes the lifetime improvement in comparison to the older MCP-PMTs is a factor of ˜50 based on an IAC of meanwhile >9 C/cm2. This breakthrough in the lifetime of MCP-PMTs was accomplished by coating the MCP pores using an atomic layer deposition (ALD) technique.

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