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The TORCH PMT:A close packing, multi-anode, long life MCP-PMT for Cherenkov applications

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Photek (UK) and the TORCH collaboration are undertaking a three year development program to produce a novel square MCP-PMT for single photon detection. The TORCH detector aims to provide particle identification in the 2-10 GeV/c momentum range, using a Time-of-Flight method based on Cherenkov light, and has been proposed for the LHCb Upgrade. The MCP will provide a timing accuracy of ˜40 ps, and its development will include the following properties:

1. Long lifetime up to at least 5 C / cm2 of accumulated anode charge without degradation in sensitivity. Previous work published by Photek has demonstrated a significant lifetime improvement in an MCP-PMT when the MCP is coated by Atomic layer Deposition (ALD).
2. Multi-anode output with a spatial resolution of 0.4 mm and 6 mm respectively in the x and y directions, incorporating a novel charge-sharing technique.
3. Close packing on two opposing sides with an active area fill factor of 88% in the x direction.

First results will be presented of the charge-sharing anode. The building and testing of long lifetime prototypes and high fill factor (square) tube body shape developments will be also described. The front-end read-out of choice is currently the NINO ASIC. The method of coupling the MCP-PMT output pads to a PCB through an ACF film will be described. This minimises any parasitic input capacitance by allowing very close proximity between the NINO and the detector. The gain and performance uniformity of the PMTs will be compared with current industry standards. We will also report on software simulations that factor in the pulse height variation from the detector, NINO threshold levels and potential charge sharing techniques that enhance the position resolution beyond the physical pitch of the pixel layout.

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