Aging Studies of Large–Area CsI Photocathodes

ALICE collaboration

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The ALICE High-Momentum-Particle-Identification (HMPID) RICH detector is equipped with CsI photocathodes in a MWPC for the detection of Cherenkov light. The stability of large-area CsI photocathodes has been investigated over long periods with beam tests. A quantum efficiency drop of less than 10% over 6 years has been observed. In addition, dedicated studies have shown that the exposure to oxygen and water vapor with limited contamination has no influence on the photocathodes response.

Summary of Talk: The ALICE High-Momentum-Particle-Identification (HMPID) system is based on a CsI-RICH detector, having a liquid C_6F_{14} radiator coupled, in a proximity-focusing geometry, to a MWPC and a CsI photocathode (PC) segmented into pads with 2D analog multiplexed readout. A procedure has been established to deduce the differential quantum efficiency of PC's through the analysis of Cherenkov rings obtained from beam tests, with the support of Monte Carlo simulation. The main sources of the quantum efficiency degradation for CsI PC's are: humidity, photon impact (at very high fluxes) and, for PC's operated under gas multiplication, ion bombardment. Several CsI PC's, of area up to 65×40 cm^2, have been produced in the last 6 years and checked periodically in a test-beam. Humidity resulted to be a critical parameter during the PC preparation and in all the subsequent phases of handling, storage and operation. The influence of the exposure to oxygen and water vapor was studied under stagnant conditions, through increased levels of O_2 and H_20 due to outgassing, and under gas flow, with large concentrations of O_2 in the detector gas mixture. No degradation of the photoemission has been observed under the experimental conditions of the test. The results of this study found a direct application for the storage of CsI photocathodes during the shipment of the HMPID prototype-2 to the STAR experiment at BNL. A decay of the photoemission could be determined by the impacts of ion clouds on the PC's surface at each avalanche. Several PC's exposed to an integrated charge larger than 0.05 mC/cm^2, corresponding to one year running with lead ions at ALICE, have shown very limited degradation, and a quantum efficiency drop of less than 10% has been observed in PC's 6 years old.