R&D results of a Very High Momentum Particle Identification (VHMPID) detector with a liquid C_6F_{14} radiator

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The Very High Momentum Particle Identification (VHMPID) detector [1] was proposed to extend the track-by-track particle identification (PID) capabilities of the ALICE [2] experiment in the momentum range 5-25 GeV/c. The detector was a state-of-the-art Ring Imaging *C*Herenkov (RICH) detector and based on the existing ALICE HMPID [3] detector. Because of operative constraints, the radiator was proposed to be a pressurized C_4F_8O gas because K separation is not possible with common radiator gases at atmospheric pressure from 5 GeV/c. But during the extensive and long test beam phase we also tested liquid C_6F_{14} as the radiator material as a cross check with the experience from the HMPID detector and for studying possible photon detector modifications. A CsI-MWPC (Multi Wire Proportional Counter) photon detector with a fixed anode-cathode gap of 0.8 mm (to test the desired anode-cathode gap of 0.6 mm), fabricated at SINP, was tested with C_6F_{14} as the radiator. The main results from this test beam are presented in this proceedings.

The RICH prototype (see figure 1) was a MWPC equipped with a 8×4 mm^2 pad cathode coated with a CsI photosensitive film, 20 μm anode wires with a 4 mm pitch and a fixed anode-cathode gap of 0.8 mm with a liquid C_6F_{14} radiator. The MWPC photon detector components were fabricated at Indian industries while the CsI coating was carried out using the CERN facility. The MWPC was separated from the radiator volume by a Sapphire window, 160 mm in diameter and 5 mm thick. The test beam setup also contained two Close Cathode Chamber-type (CCC) MIP detectors, one in front and one behind the Cherenkov unit. The CCC MIP detectors were used a precise and durable gaseous tracking chamber. The photon detector was tested with 5 different high voltages (1550, 1600, 1650, 1700 and 1750 V), 3 different radiator thicknesses (10, 6 and 3 mm) and 3 different beam momenta (6, 3, 2 GeV/c).

FIG. 1: RICH prototype at the PS/T10 beamline at CERN.

The most important results from the test beam are presented in figures 2- 5. In figure 2 both the MIP and the Cherenkov photon rings are clearly visible. The ring radius is shown in figure 3, fitted with a simple gaussian function giving an average value of 8.6 ± 0.0028 cm.

We have studied the detector setup with five different high voltages and the results are reported in figure 4, which shows the mean no.

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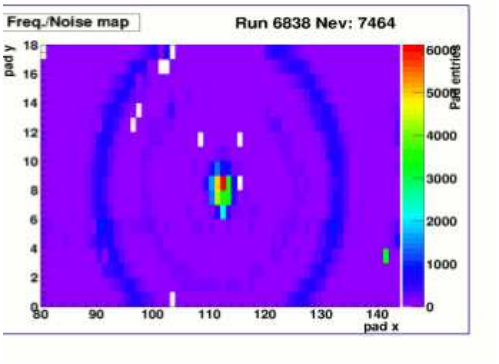

FIG. 2: A typical Cherenkov ring produced by a 6GeV/c π beam. Two Cherenkov rings are observed, the smaller one for protons and the bigger for pions.

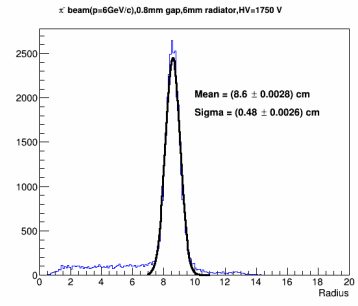

FIG. 3: The ring radius at 1750 V with a 6 GeV/c beam.

of clusters as a function of the high voltage for three different radiator thicknesses, being consistent with expectations.

Finally, to test the PID capabilities we tested the setup with two beam momenta, 2 and 3 GeV/c. Figure 5 shows one example of distinct π and proton peaks, obtained at 1700 V with a 10 mm thick radiator and a beam momentum of 3 GeV/c.

A dedicated R&D effort were carried out at T10/CERN with beam tests to study RICH prototypes to meet the new requirements for PID in the momentum range 5-25 GeV/c. In view of that, we tested a MWPC with a fixed anode-cathode gap of 0.8 mm with a liquid C_6F_{14} radiator. It showed a stable operation

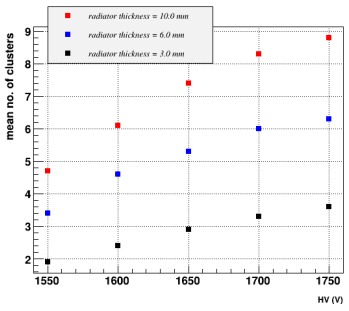

FIG. 4: Mean no. of clusters as a function of HV for three different radiator thicknesses with a 6 GeV/c beam.

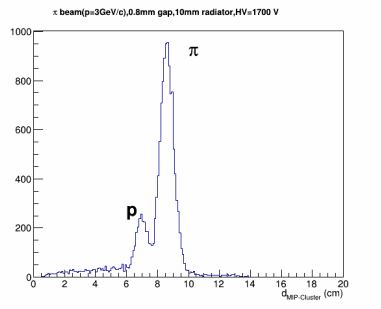

FIG. 5: The pion and proton distributions obtained with a π beam of 3 GeV/c at 1700 V and 10 mm radiator thickness.

in the test beam indicating that the desired anode-cathode gap of 0.6 mm could be achievable along with excellent PID capabilities.

References

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[2] B. Alessandro et al. [ALICE Collaboration], J.Phys.G:Nucl.Part.Phys. 32 (2006), 1295.

[3] CERN/LHCC 98-19, ALICE TDR 1.