In-Beam Test of the HADES-RICH Prototype

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The study of the in-medium properties of hadrons at moderate temperatures and baryon densities is one of the main goals of the forthcoming di-electron spectrometer HADES at the GSI in Darmstadt. Its design allows an invariant mass reconstruction of e.g. vector meson decays with a resolution of about 1 %. To cope with high charged particle multiplicities in central heavy ion collisions and collision rates up to 10^6 s^{-1} the toroidal magnet spectrometer is equipped with a fast Ring Imaging Cherenkov Detector (RICH) and a forward wall (META) consisting of a shower detector and scintillator modules for lepton identification and event characterization, and 4 layers of low mass density drift chambers (MDC) for particle tracking.

The RICH detector will act as a hadron blind online trigger device to identify e^+e^--pairs of interest. It consists of a C_4F_{10} gas radiator ($\gamma_{th} \simeq 18.3$) surrounding the target, a spherical VUV-mirror and six multiwire proportional chambers (MWPC) with cathode pad readout and CsI photon converter for single VUV-photon detection [1].

In July 1997, a test experiment equipped with prototype modules of each detector component was performed at the GSI using an $E_{kin} = 1$ A $\cdot$ GeV ^{238}U-beam with beam intensity up to 10^6 s^{-1} and ^{208}Pb-targets of 1 % and 10 % interaction length. For the first time a common data aquisition system based on individual detector-CPUs connected via Ethernet switch was used thus allowing a correlated data analysis.

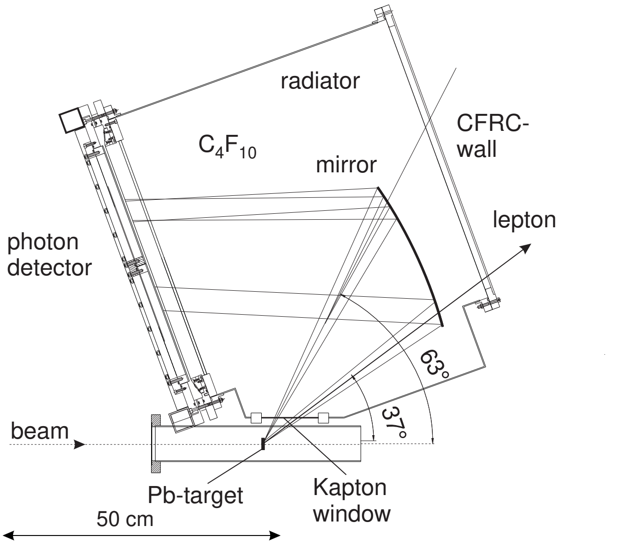

Fig. 1: Schematic view of the RICH in the beam test experiment

The RICH prototype shown in fig.1 was operated in the geometry of the final HADES setup. Cherenkov light produced by leptons passing through the radiator (average path length L $\simeq$ 470 mm) was focussed by a thin spherical VUV-mirror (curvature R = 870 mm, d = 1 mm glass + Al + MgF_2) into rings of constant radius (R $\simeq$ 2.8 cm) on the photon detector operated with CH_4 at a gain g $\simeq 10^5$. The signals of about 4000 pads (size 6 $\times$ 6 mm^2) were read out with a detection efficiency of $\varepsilon > 95$ % for single photo electrons. All leptons within the acceptance indicated in fig.1 were then detected in the modules mounted behind the RICH.

During the test special interest was given to the new full size SPS-controlled gas system including a purification and pressure regulation of both radiator and detector gas and the new CaF_2-photon detector entrance window. Apart from mirror reflectivity and quantum efficiency of the CsI-converter [2] the VUV-transparency of gases and window is intimately related to the number of detected photons and hence to the ring detection efficiency. Fig.2 shows the photon detector response in a particular central collision event. The two cherenkov rings belong to an open e^+e^--pair from an external conversion in the 10 % lead target.

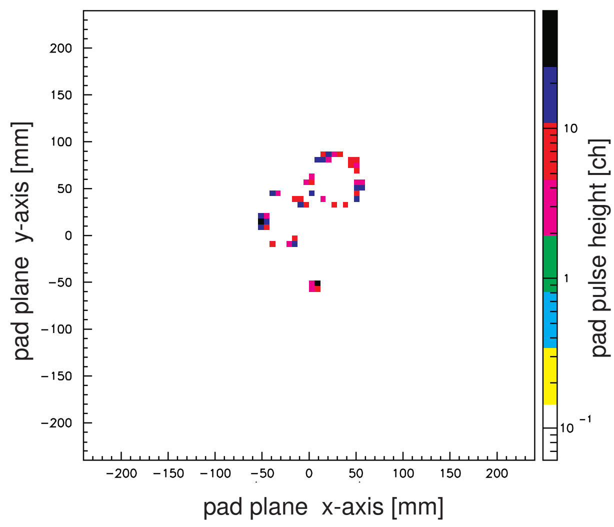

Fig. 2: Two cherenkov rings detected for an open e^+e^--pair from an external conversion in the lead target.

Even for the high multiplicity environment of this collision type two important conclusions can be drawn. The quality of the cherenkov ring image is sufficient for a fast online ring recognition, and the image is not obscured by background hits originating from e.g. electronic noise, scintillation photons or charged particles passing the photon detector mounted upstream the target. Although a detailed analysis of the results is still in progress we suppose the RICH to fulfill the HADES requirements.

References

[1] R. Gernhäuser *et al.*, Jahresbericht 1996, p. 98
[2] C.Erbe *et al.*, Jahresbericht 1996, p. 99