Study of the Single Photon Response of the HADES-RICH Detector ◇

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The **R**ing **I**mage **CH**erenkov detector (RICH) [1] of the dilepton spectrometer HADES at GSI, Darmstadt, is used to identify e^+/e^- exploiting the production of Cherenkov photons by these particles.

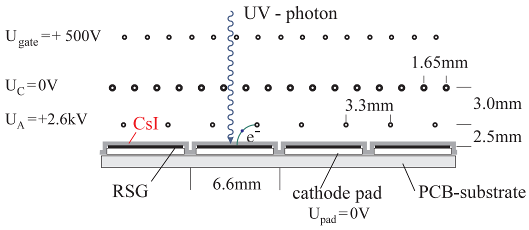

Fig. 1: Schematic view of the MWPC.

The photon detector consists of a multi-wire photo-sensitive proportional chamber (MWPC) with a cathodic pad-plane. Fig. 1 shows a cross-section of the photon-detector, the cathodic plane and the anodic wires are visible. When a photon reaches the pad-plane a photo-electron can be ejected from the CsI layer that covers the plane. The emitted photo-electron drifts from the cathodic pad-plane to the anodic wires and a charge avalanche is generated, a mirror charge is induced on the cathode. Pad clusters of different size are formed on the pad-plane [2] and the charge deposited on each pad can been read out. The measured hits on the detector do not only stem from single photons, indeed in the avalanche excitations of the detector gas can lead to the ejection of a so called feed-back photon. The signal on the pad-plane by primary and feed-back photons overlap in the same cluster, making the determination of the detector response quite complicated. It has been assumed that small clusters are formed by primary photons only [3,4], hence Class **1** has been defined that contains clusters with at most three pads. Taking into account only these clusters, the dependency of the total charge induced on the pad-plane by a single photon has been studied as a function of different anode voltages.

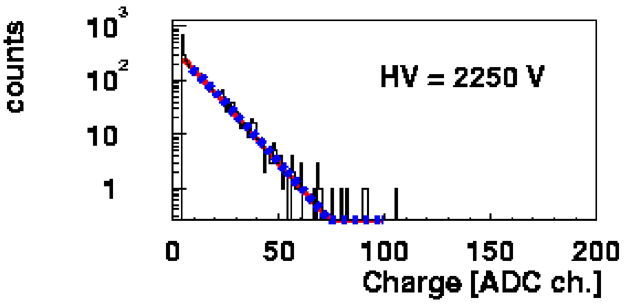

Fig. 2: Pulse height distribution for the class **1** cluster. The solid line shows an exponential fit, the dashed line a fit done with the Polya function [5].

Fig 2 shows the total pulse height distribution of the class **1** clusters obtained with an anode voltage of 2250 Volt, the total pulse height is obtained summing up the pulse height of all the pads in a cluster. The inverse of the slope obtained by the exponential fit of this distribution corresponds to the average pulse height and is a measure of the detector gain.

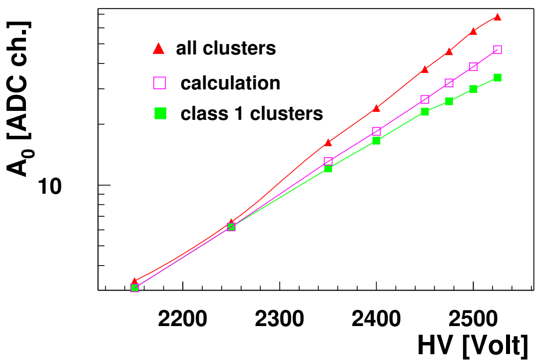

Fig. 3: Average pulse height of single photons as a function of the anode voltage.

Data have been collected for an anode voltage between 2150 and 2550 Volt and the inverse slope A_0 of the pulse height distributions has been calculated.
Fig. 3 shows the parameter A_0 as a function of the anode voltage. The empty squares shown in fig. 3 represents the results obtained by a finite element calculation with a realistic field geometry [6]. The full squares show the results obtained by the analysis of the class **1** clusters. These data points underestimate the calculation for values of the anode voltage higher than 2400 V. This effect can be explained considering that the small dimension of the class **1** clusters introduces a cut-off in the pulse height distribution and hence smaller inverse slope are obtained.
The full triangles represent the average pulse height obtained taking all clusters. The difference between this distribution and the empty squares measures the feed-back contribution.
This way, an average photon pulse height $A_0$of about 28 ADC channels has been obtained at the operating voltage of 2450 Volt. Given the relation 1 ADC channel = 1730 e^-, A_0 corresponds to 4.8 × 10^4 e^-. At this voltage the contribution of the feed-back photons has been estimated to be of about 30%.

References

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