# In-beam test of a DIRC Cherenkov radiator with SiPM

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## Introduction

One of the crucial points for any high energy physics experiment is to obtain a good pion/kaon separation i.e. particle identification (PID). For particles in minimum ionising range, the conventional methods of PID using energy loss and time of flight become insufficient. In such a situation, the measurement of velocity of particles using Cherenkov radiation is an effective tool for PID in combination with momentum information from a tracking detector. The PANDA experiment at FAIR/GSI plans to use a novel technique for PID with detection of internally reflected Cherenkov (DIRC) light. DIRC uses, in contrast to the convensional gas Cherenkov detectors, a solid radiator and total internal reflection to guide Cherenkov photons onto a detection plane where it will be detected by advanced photon counters. A SiPM is a very new generation photon counter that has several advantages over conventional PMTs[1]. Several prototype Cherenkov detectors with different readout systems are being developed for R&D studies. One such prototype detector with Geiger-APD readout has been built at Giessen and was tested in-beam at GSI. The present report provides details of the very first test measurement.

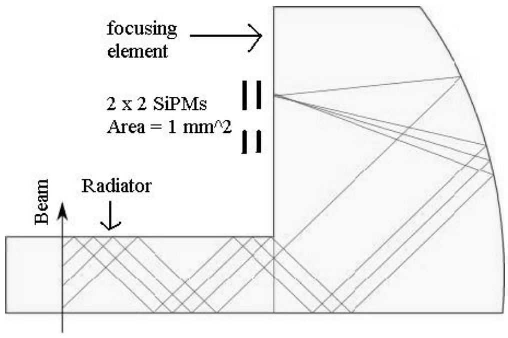


FIG. 1: A schematic diagram of the Cherenkov detector with focusing element. Four SiPMs (2 x 2) were placed on flat side of the focusing element to detect Cherenkov photons.

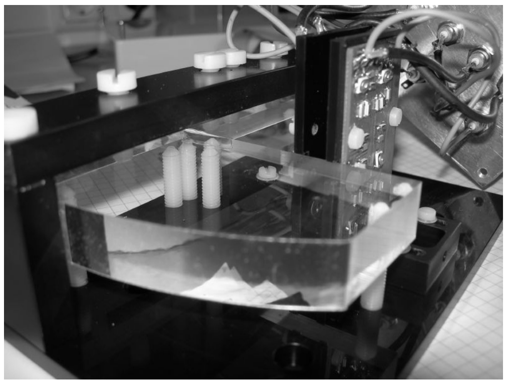

FIG. 2: A photograph of the Cherenkov detector with SiPM readout built at Giessen.

## Experimental Setup

A schematic diagram of the set-up used is show in Fig.1. The radiator was plexiglas, rectangular bar shaped with cross sectional area 15 mm × 20 mm and 70 mm long. It was coupled to a focussing element for focussing the Cherenkov photons onto SiPMs. At the focal plane, two sets of SiPM were mounted at different positions with each set having two SiPMs (active area = 1 mm$^2$). The positon was decided from a detailed simulation study. For a particular angle setting of

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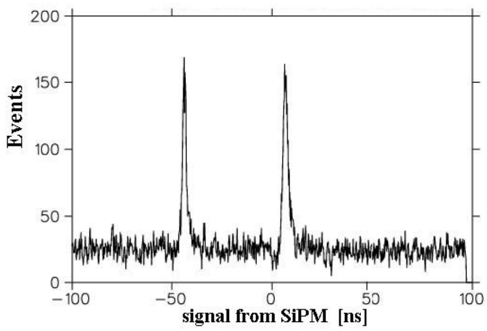


FIG. 3: Histogram output from one of the SiPMs (SiPM-3) that was positioned to see maximum Cherenkov light for an angle setting of $7.5^o$ of radiator w.r.t beam. The two peaks are due to triggering from both leadging edge and trailing edge.

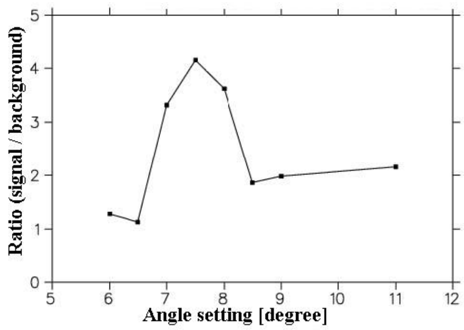


FIG. 4: Ratio (signal+background) / background for SiPM-3 plotted against angle of the radiator. $\theta \sim 7.5^o$ was found to be the optimum position due to focussing arrangement used. The findings are in agreement with the simulations.

the radiator bar (w.r.t the beam), two of the SiPMs (say SiPM-3 and SiPM-4) see maximum Cherenkov photon intensity whereas the other two ( SiPM-1 and SiPM-2 ) miss it. By rotating the bar, one gradually interchanges the role of the SiPM pairs. The beam was a proton beam of kinetic energy 2 GeV with a spill length of 5 sec and intensity about 50000 per spill. The beam was defined by scintillator hodoscopes mounted in a cross-geometry at several locations. Coincidence signals from these finger counters were used as trigger.

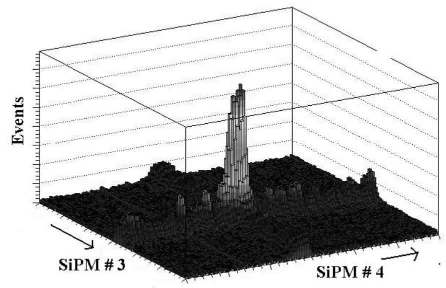


FIG. 5: Correlation spectra between SiPMs. Results from a very peliminary analysis of the data from the test run.

## Test Results

Results are presented in Figs. 3 - 5. An angle setting of $\sim 7.5^o$ was found to be optimum position for SiPM-3 and SiPM-4 and is in agreement with the simulation study. Preliminary analysis of the data (timing signal from SiPM-3 and SiPM-4) show a nice time correlation between these two SiPMs. Detailed analysis of the data is in progress.

## Acknowledgments

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## References

[1] B. J. Roy et. al., on "SiPM as photon counter for Cherenkov detector", contribution to this proceedings.