Test of a PANDA Barrel DIRC Prototype in a Particle Beam at CERN*

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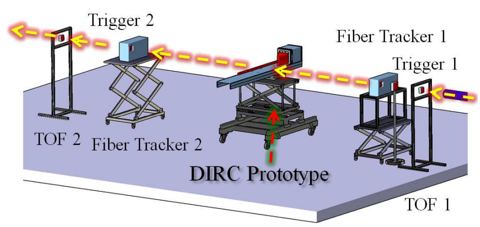
Particle identification (PID) will play a crucial role in reaching the physics goals of the PANDA experiment at FAIR. The charged PID in the barrel region of the target spectrometer (polar angles between 22° and 140°) needs a thin detector operating in a 1 T magnetic field, capable of pion-kaon separation with more than three standard deviations for momenta between 0.5 and 3.5 GeV/c. A Ring Imaging Cherenkov detector using the DIRC (Detection of Internally Reflected Cherenkov light) principle is an excellent candidate to match to those requirements.

The PANDA Barrel DIRC design [1] is based on the successful *BABAR* DIRC [2] detector with several important improvements, such as focusing optics, fast timing, and a compact expansion region. Several key aspects of the current design were implemented in a prototype and tested in the summer of 2012 in a hadronic particle beam at CERN.



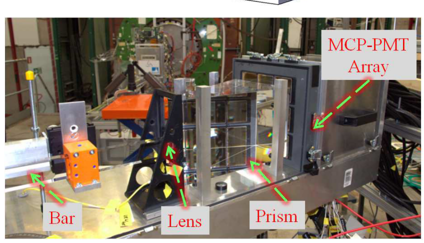


Figure 1: Schematic (top) and photo of the prototype setup.

A schematic of the setup and a photo of the prototype components are shown in Figure 1. Most of the measurements were performed with a synthetic fused silica bar ($17 \times 35 \times 1225$ mm^3) with a focusing lens attached to one end and a mirror attached to the other end, placed into a light-tight container. A large synthetic fused silica prism with a depth of 30 cm, located about 2 mm from the lens, served as expansion volume. An array of 9 Photonis XP85112 Micro-Channel Plate Photomultiplier Tubes (MCP-PMTs) was coupled with optical grease to the back surface of the prism. The data acquisition[1] for 896 detector channels was performed using the HADES trigger and readout board (TRB) [3] with the TOF add-on, combining the NINO chip and CERN HPTDC to provide timing with a resolution of 98 ps per count and pulse height information from charge-to-width.

The setup was placed into the mixed hadron beam at the T9 area of the CERN PS with momenta adjustable between 1.5 and 10 GeV/c. The trigger was provided by two scintillator counters. Two tracking stations using scintillating fibers measured the beam direction. A time-of-flight system provided pion/proton tagging up to 6 GeV/c momentum. A total of about 220M triggers were recorded in several configurations. Spherical and cylindrical focusing lenses with and without anti-reflective coating were tested in combination with bars produced from different manufacturers, including a bar made of acryllic glass and a 17 cm-wide radiator plate made from synthetic fused silica as a possible alternative to the narrow bar geometry. The polar angle between the particle beam and the bar was varied between 20° and 156° and the interception point between beam and bar was adjusted by some 80 cm along the long bar axis. Figure 2 shows the distribution of hits per MCP-PMT pixel for a 124° polar angle. The overlapping ring segments, corresponding to reflections from the top and bottom surfaces of the prism, are consistent with the expected Cherenkov ring image for 10 GeV/c pions, calculated from simulation (shown as points). Detailed analysis of the data set, including the determination of the Cherenkov angle resolution for each prototype and beam configuration, is ongoing.

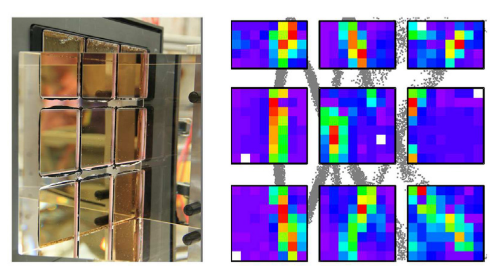


Figure 2: Photo of the prism and MCP-PMT array (left) and example of the observed Cherenkov hit pattern (right).

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References

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