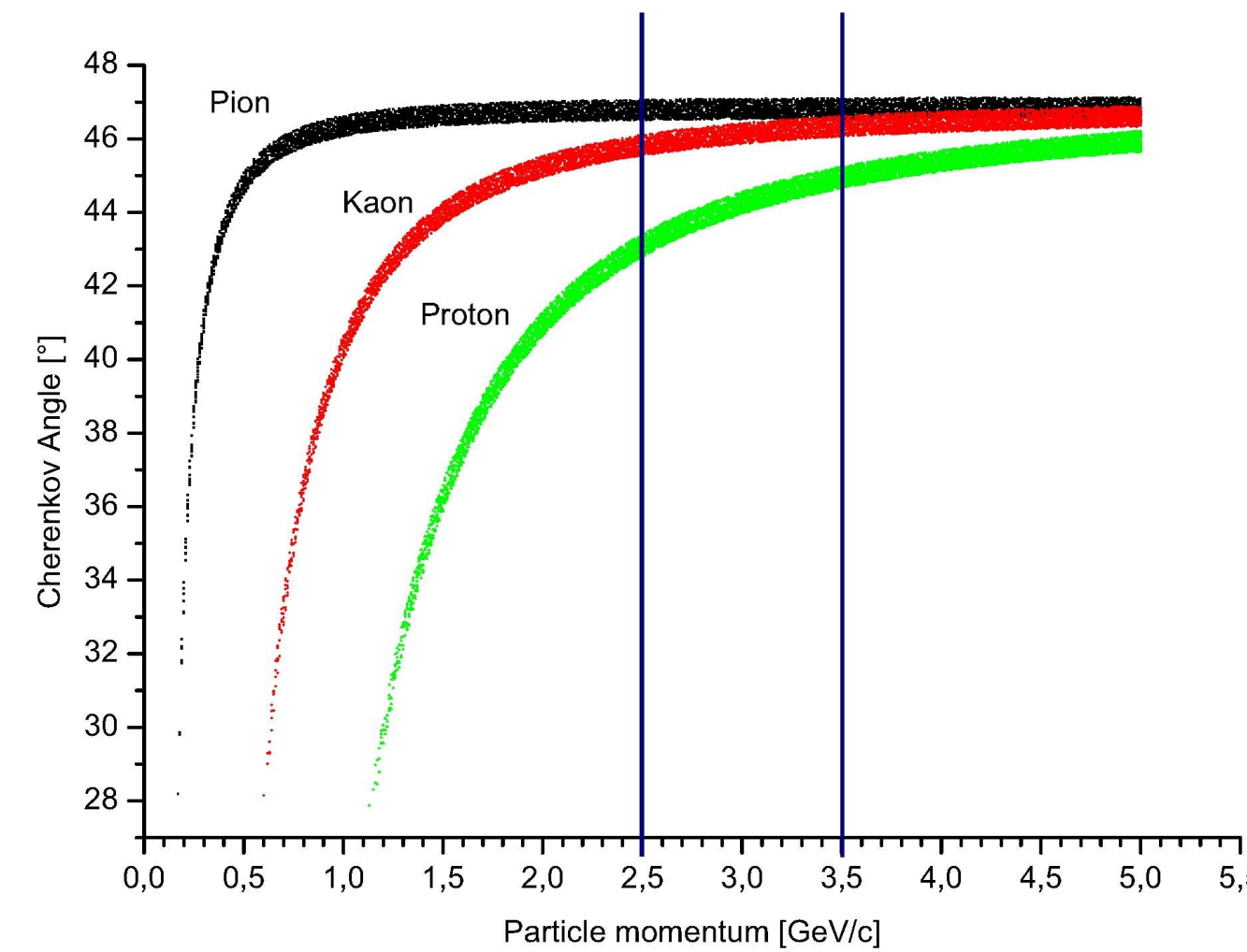
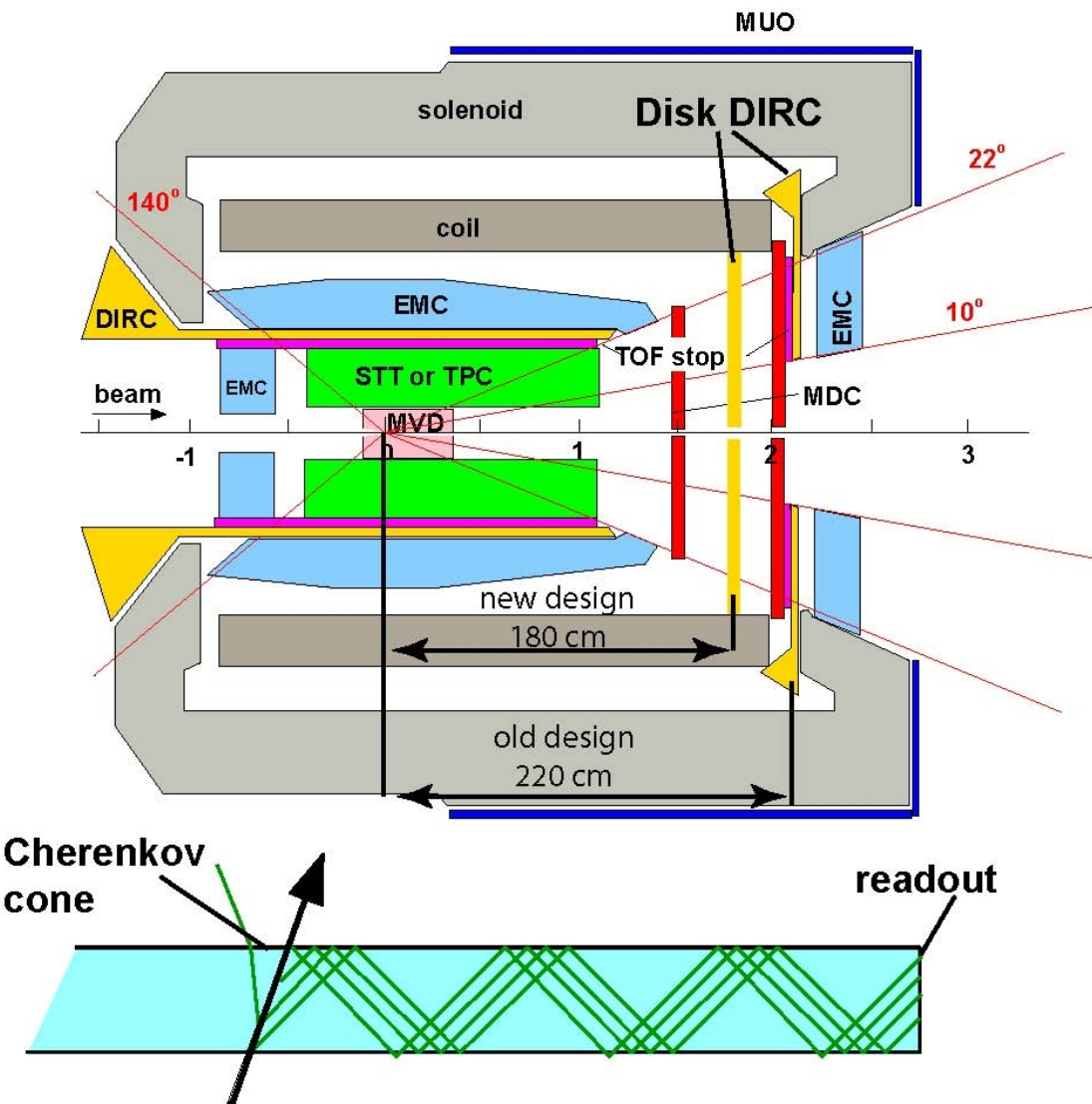


Disc DIRC Endcap-Cherenkov Detector for PANDA @ FAIR

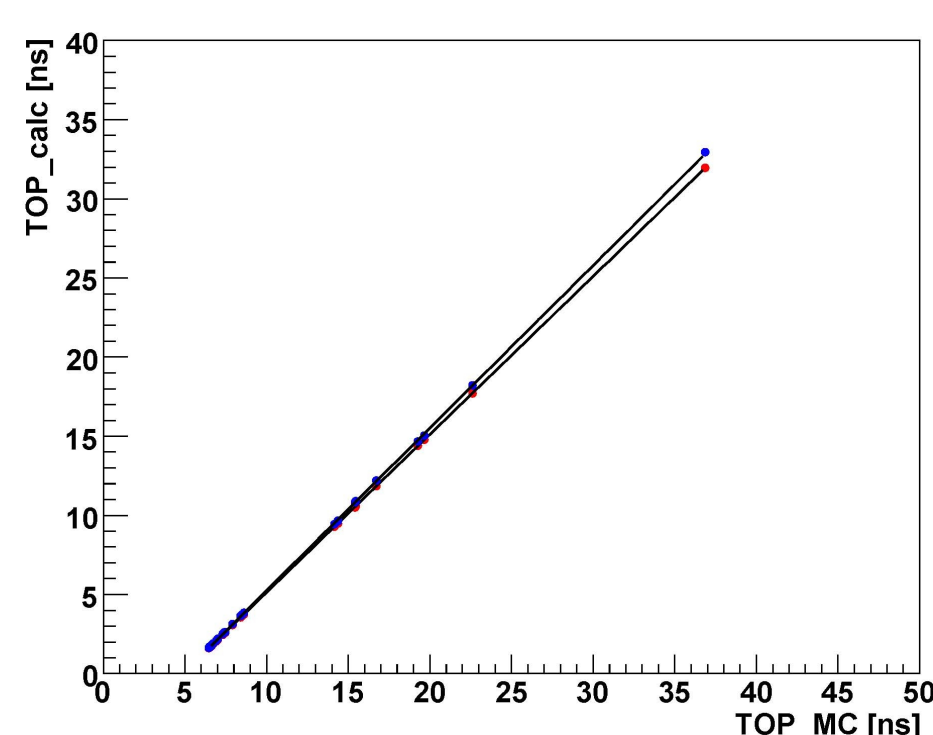
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The Disc DIRC (detection of internally reflected Cherenkov light) detector is a fused silica solid radiator with a readout, sensitive for single photons. Intending to separate π - κ up to 4 GeV/c, PANDA provides two possible radiator positions. A particle passing the radiator creates Cherenkov light, which is propagated by internal reflection to the rim area. To avoid broad distributions, dispersion correction is necessary. The readout must be sensitive for single photons. Two possible solutions are investigated.

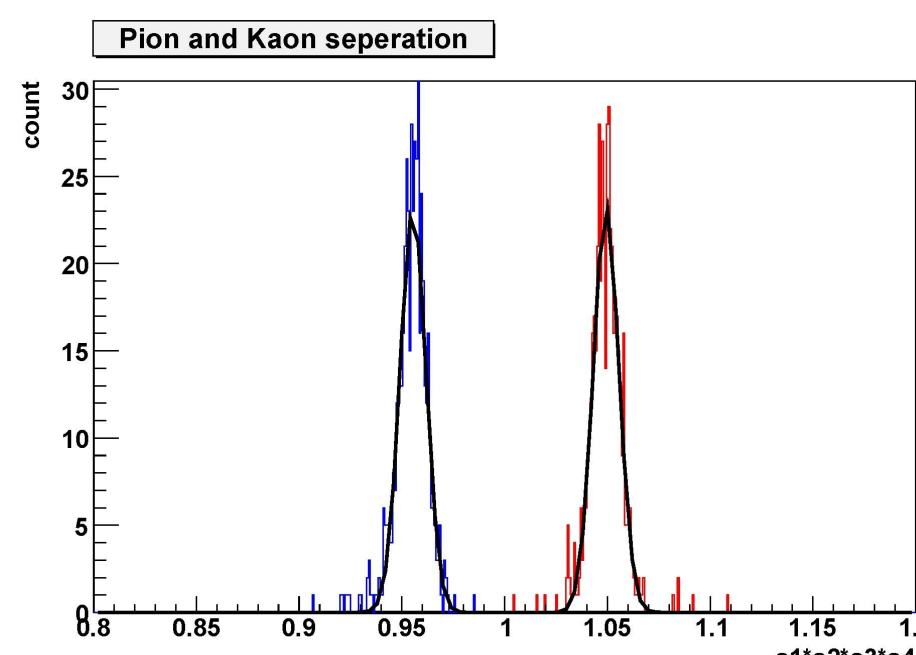


Even dispersion in the visible light range (400nm – 700nm) leads to an overlapping of the graphs. For fused silica radiators, separating π and κ up to a momentum of 2.5GeV/c is easily feasible. At momentum ranges above 3.5GeV/c the separation becomes quite hard. All designs presented reach a separation of above 4GeV/c by different dispersion corrections.

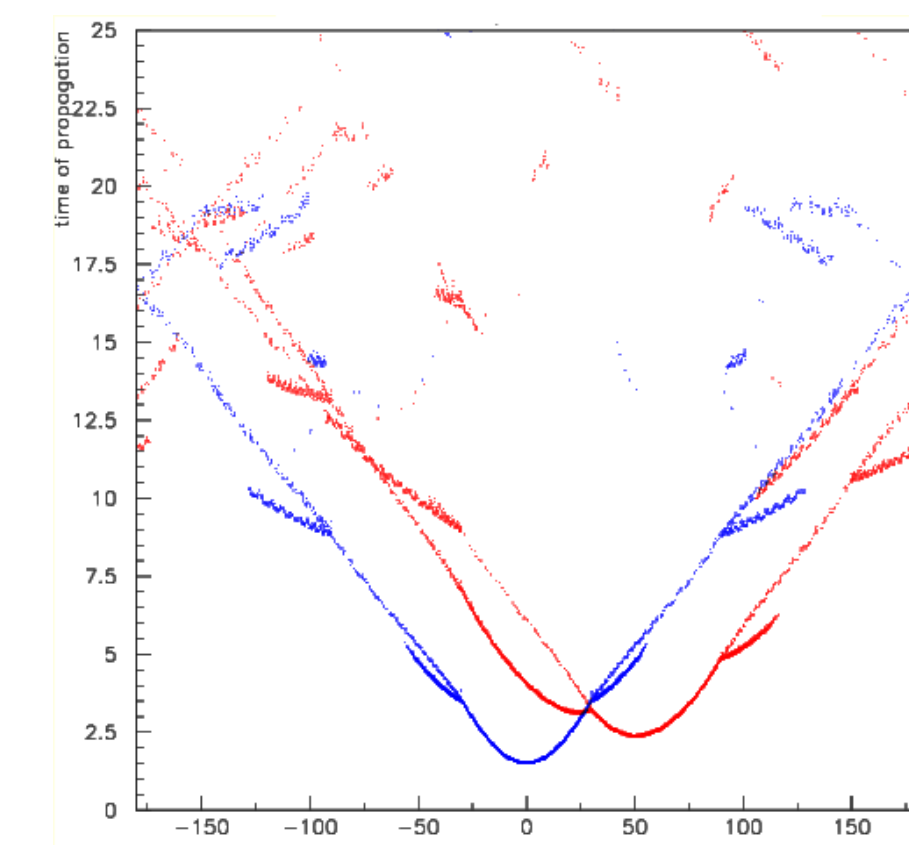
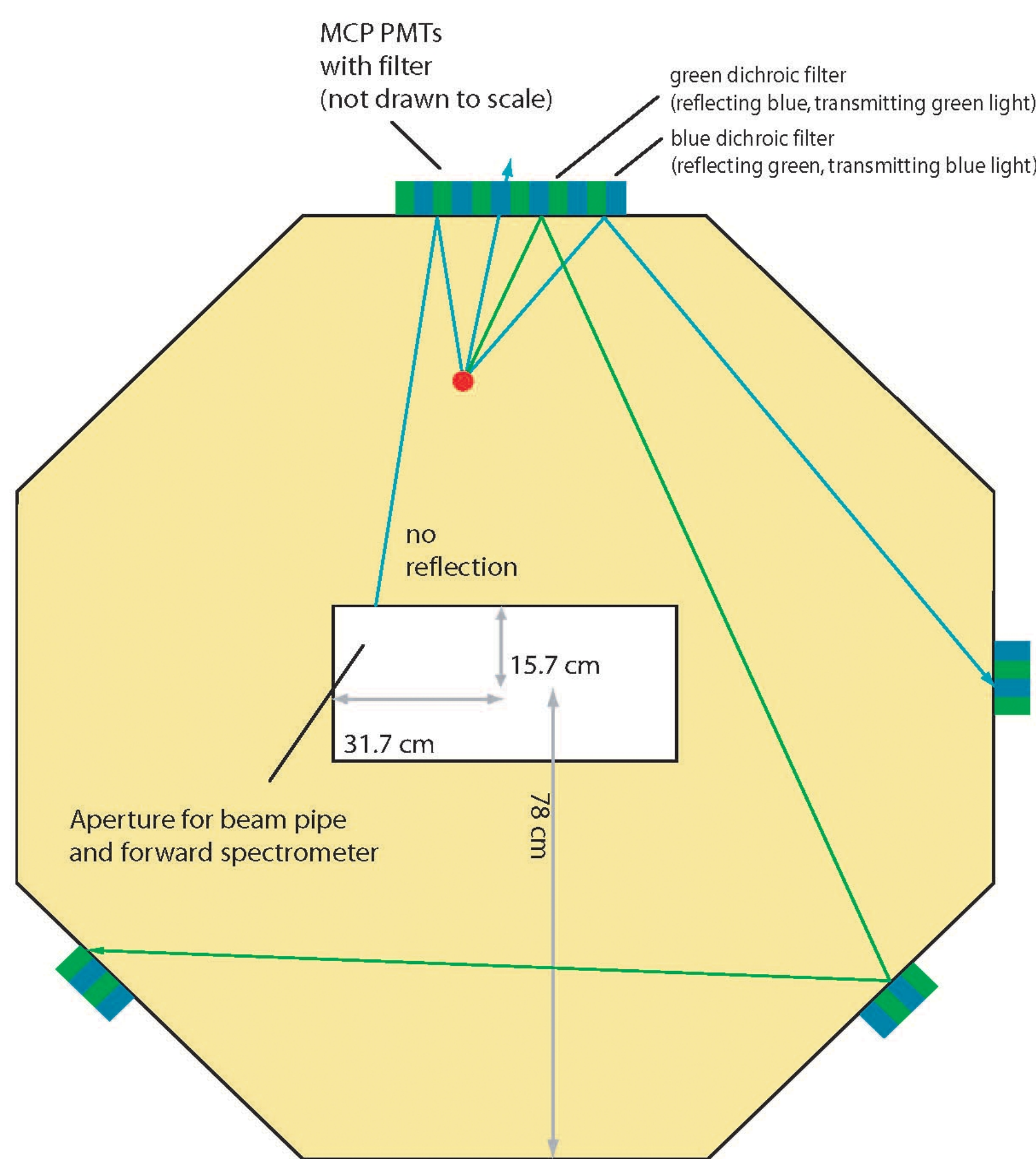
Time of Propagation (ToP) design



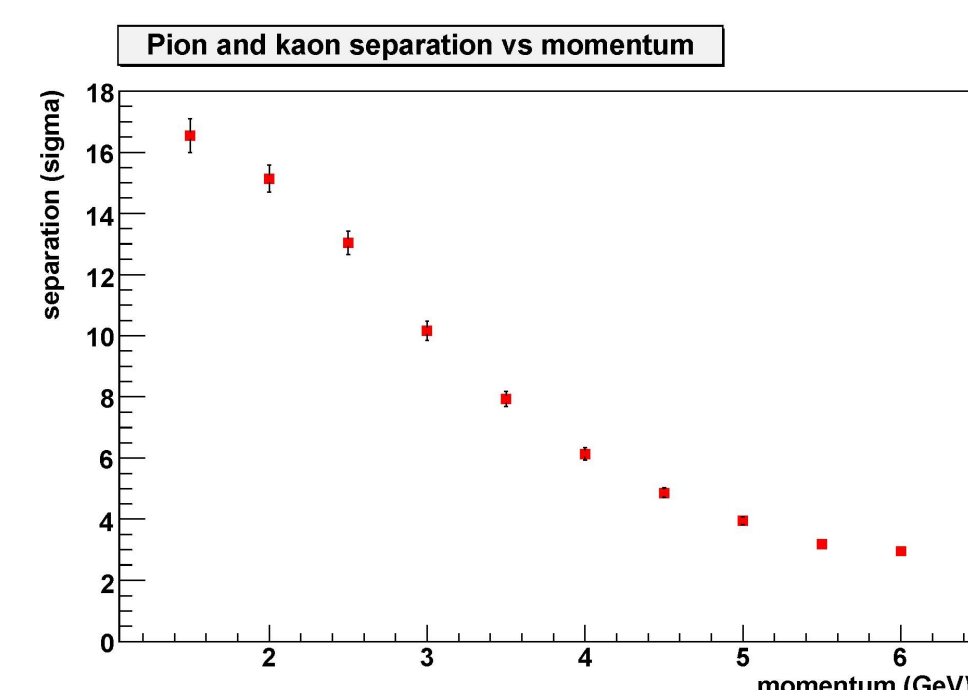
Assuming two different particles (a pion and a kaon) the ToP of each can be calculated analytically. The ratio of those two ToP vs. the real ToP, from in the experiment, results in two slopes. This is done for each mirror colour and results in $S_0 \cdot S_1 \cdot S_2 \cdot S_3$.



A characteristic value is found by $S_0 \cdot S_1 \cdot S_2 \cdot S_3$. In case the real particle was a pion this value is smaller than 1, if it was a kaon this value is larger than 1. Therefore a way of separation is resulting.



Hit pattern of two particles penetrating the disk at different positions. The time of incident is the same. The photons of the different particles can easily be distinguished.

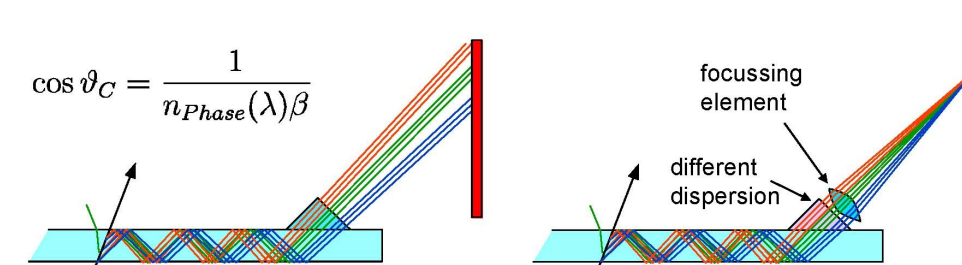
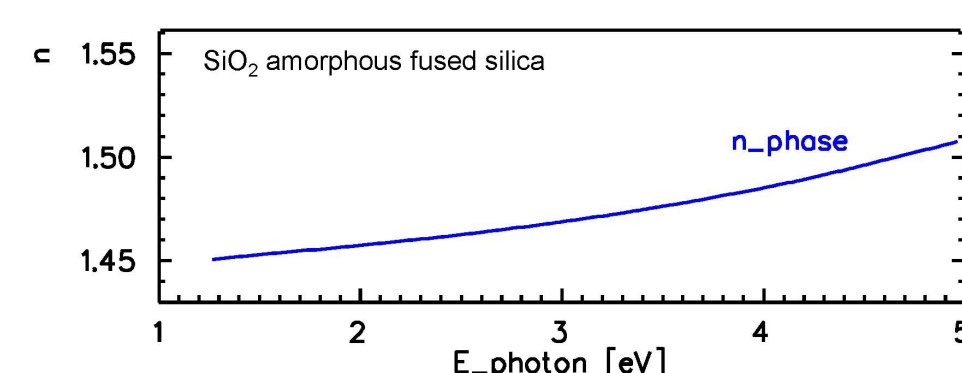


Separation power of the ToP Disk DIRC vs. the momentum is calculated with $\sigma_{sep} = \frac{|m_1 - m_2|}{(\sigma_1 + \sigma_2)/2}$, resulting in 2.3% miss identification for 4σ

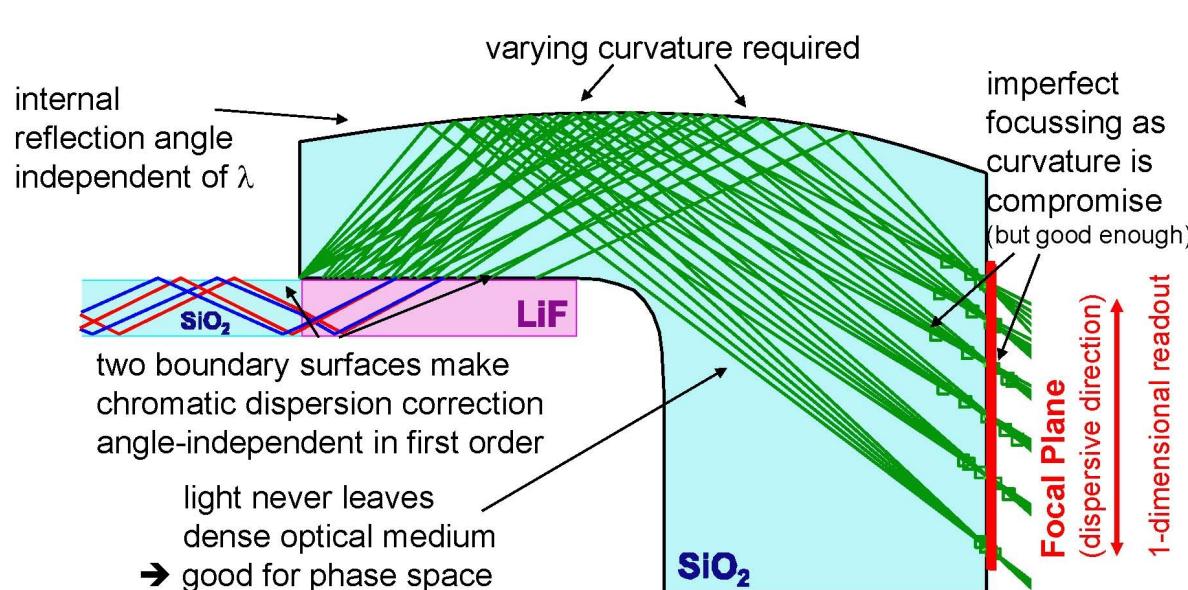
ToP Endcap Disc DIRC. The disk is of octagonal shape with a rectangular hole. The acceptance range is 5° to 22° in one direction and 10° to 22° in the other. Each side is equipped with with 120 dichroic mirrors, separating at a wavelength of 500nm. Behind each mirror is a single photon readout by MCP-PMTs. The penetrating particle creates Cherenkov photons. The photons are propagated through the disk by total reflection. As soon as they reach the rim of the disk, interaction with the mirrors occurs.

With the probability of 0.5 they are reflected towards the next mirror. In case they are not reflected but transmitted, the time of the photon is measured by the MCP. Additionally it is possible to calculate the expected ToP analytically for both wavelength ranges of the mirrors, assuming the penetrating particle to be a pion or a kaon. By comparing those four assumptions with the real measured ToP, four slopes are gained. A value, received by multiplying all four slopes, is received. This value is characteristic for the particle and enables the separation.

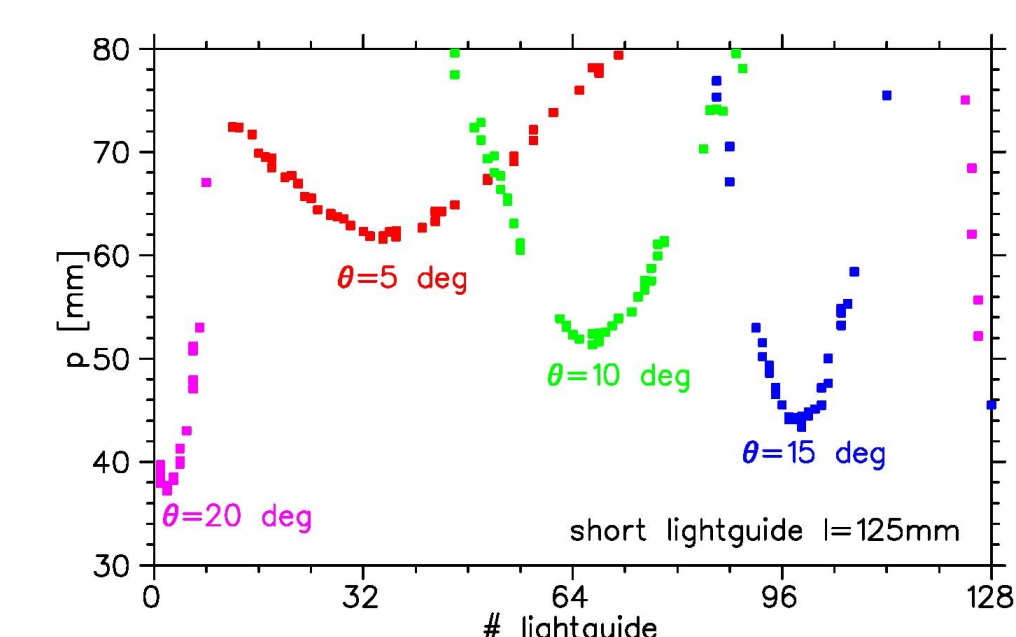
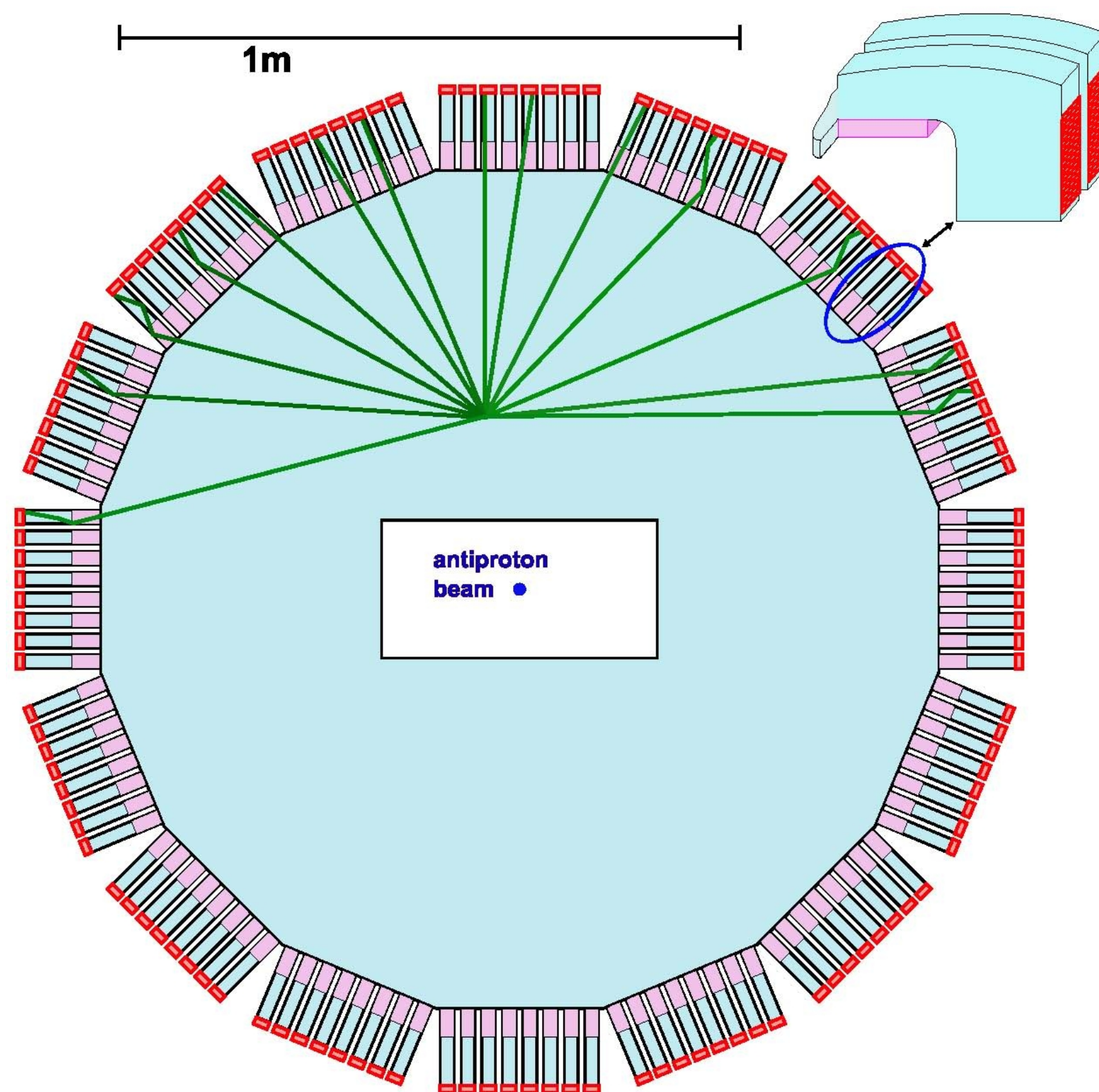
Focussing Light guide design



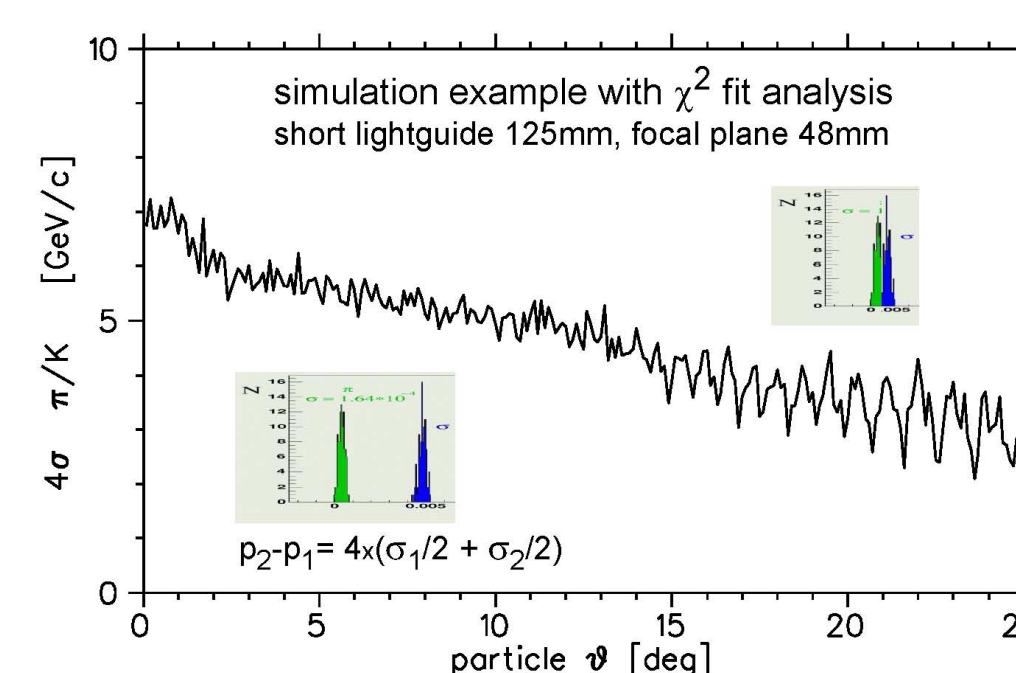
In a dispersive medium Cherenkov light has parallel light paths of colour-dependent angle. A prism element corrects the angle before a focussing element converts angle information into position information.



LiF with its special refractive index is the first step in dispersion correction. It is followed by a focussing correction due to the SiO_2 light guides.



Hit Pattern of the focal plane. 1 dimensional readout for a number of particles vs. the light guide number of incident.



Separation power of the Focussing Disk DIRC vs. the angle of incident is calculated with $\sigma_{sep} = \frac{|m_1 - m_2|}{(\sigma_1 + \sigma_2)/2}$, resulting in 2.3% miss identification for 4σ

Focussing Light guide Endcap Disc DIRC. The disk is of hexadecagonal shape with a rectangular hole. The acceptance range is 5° to 22° in one direction and 10° to 22° in the other. Each side is equipped with with a LiF bar leading the photons to fused silica light guides. In total 96 light guides are read out by 4608 single photon readout channels (PMTs) on their focal plane. The penetrating particle creates Cherenkov photons. The photons are propagated through the disk by total reflection. As the photons hit the LiF part of the disk, the first step of the dispersion cor-

rection is automatically achieved by the abnormal index of refraction of this material. Leaving the LiF to the fused silica light guides, the photons are now focused to a focal readout plane. By measuring the readout position, the Cherenkov angle can be reconstructed. This directly leads to the π - κ separation.