# A Focussing Disc DIRC for PANDA

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## Introduction

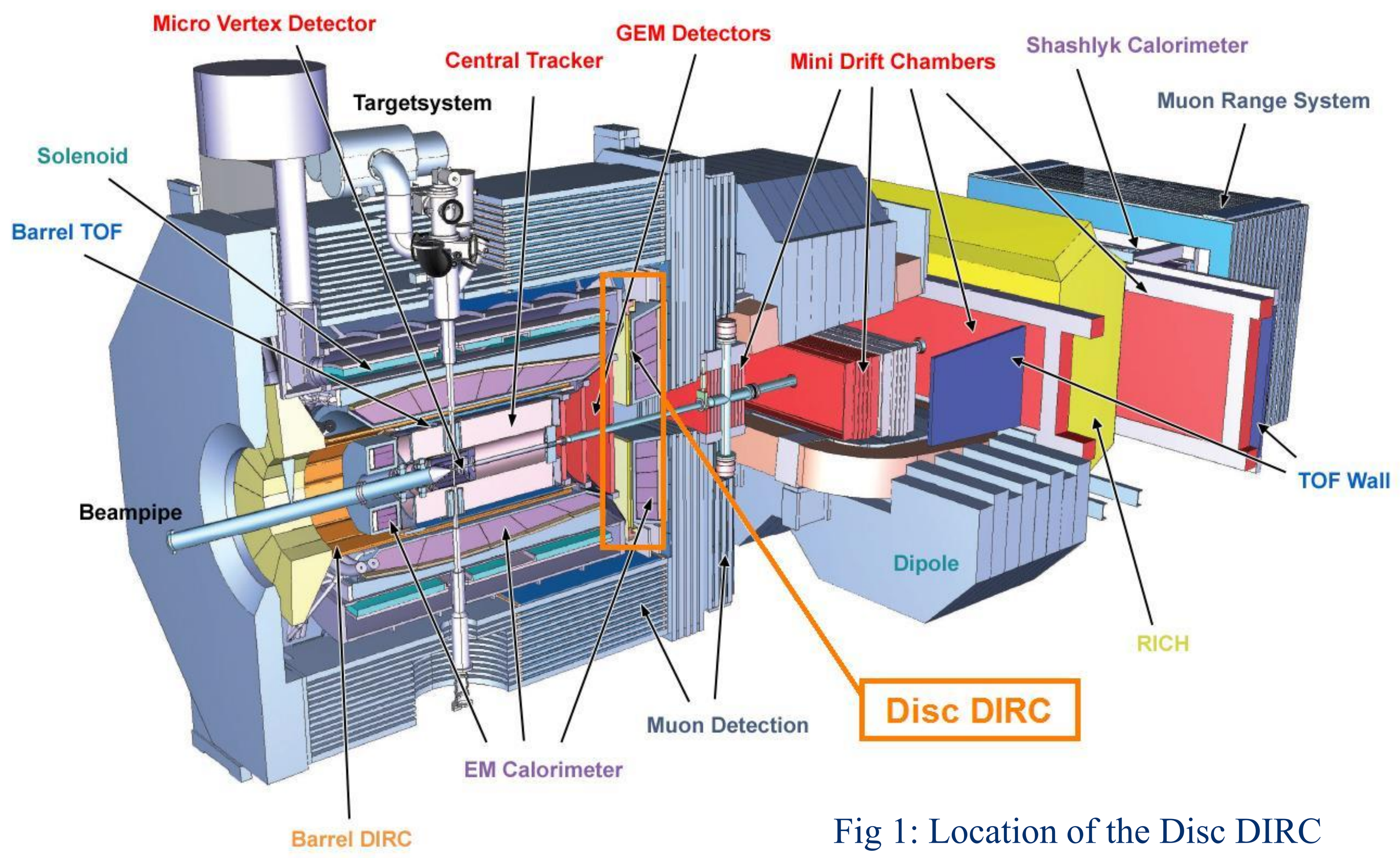


Fig 1: Location of the Disc DIRC within PANDA

PANDA is a general purpose detector for the FAIR facility to be built at GSI in Darmstadt, Germany. Proposed for Particle ID in the endcap of the target spectrometer is a Focussing Lightguide Disc DIRC (FLDD). The design of the FLDD will:

•Be a Disc of radius 1100 mm constructed from 6 sections

•Utilise focussing lightguides to convert angle of propagation through the disc into position on the photon detector

•Use hardware based chromatic dispersion correction to reduce the major uncertainty in Cherenkov angle brought about the wavelength dependence of refractive index[1].

By combining these principles the FLDD will be highly suitable for PANDA.

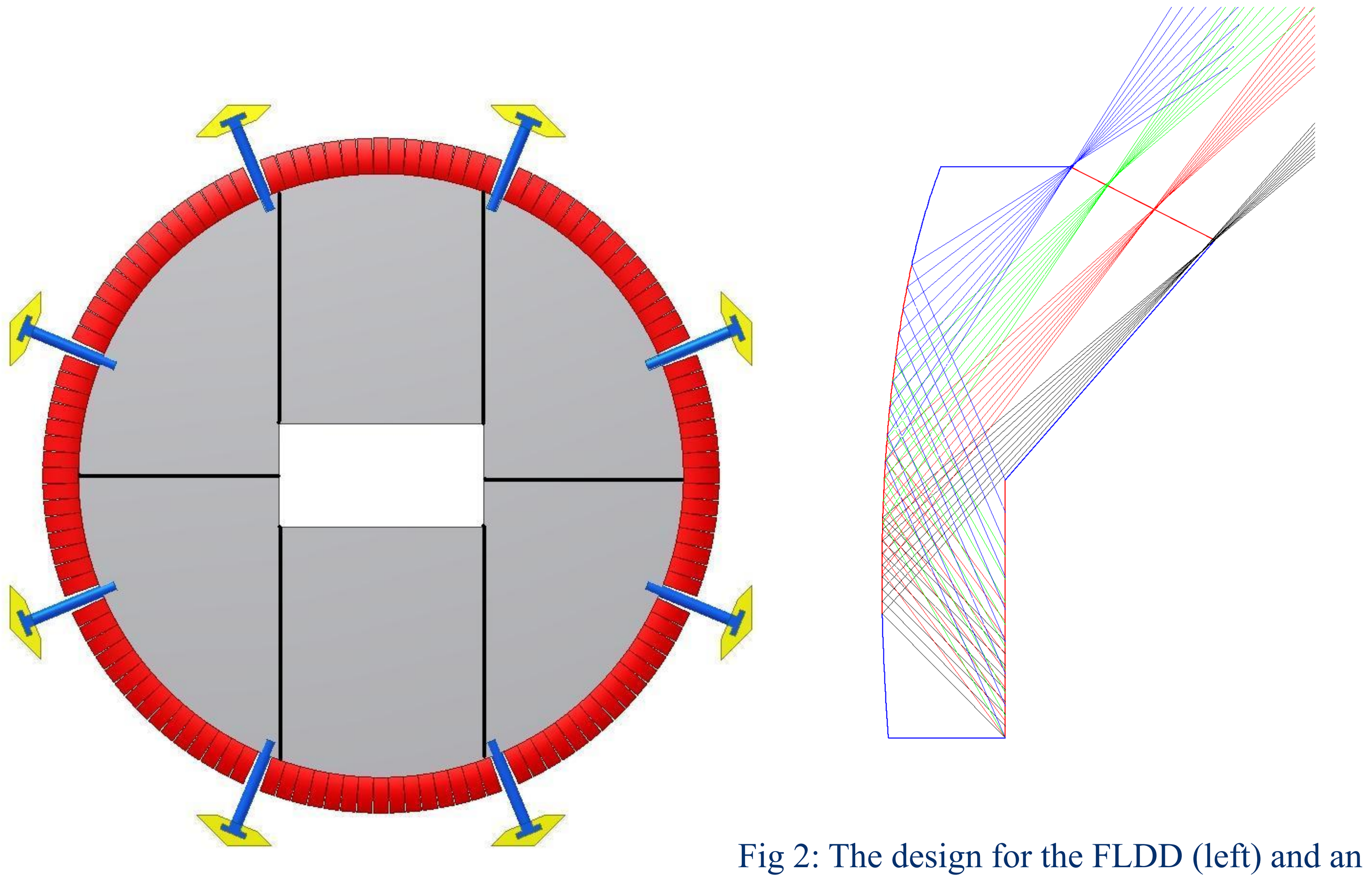

Fig 2: The design for the FLDD (left) and an example Focussing Lightguide (right)

## Chromatic Dispersion Correction

The Cherenkov angle depends on $n_{phase}$[2] which in turn depends on wavelength of the produced photon in the radiator. The FLDD will use a hardware based solution utilising plates of material with suitably different $dn/d\lambda$ to reduce this uncertainty.

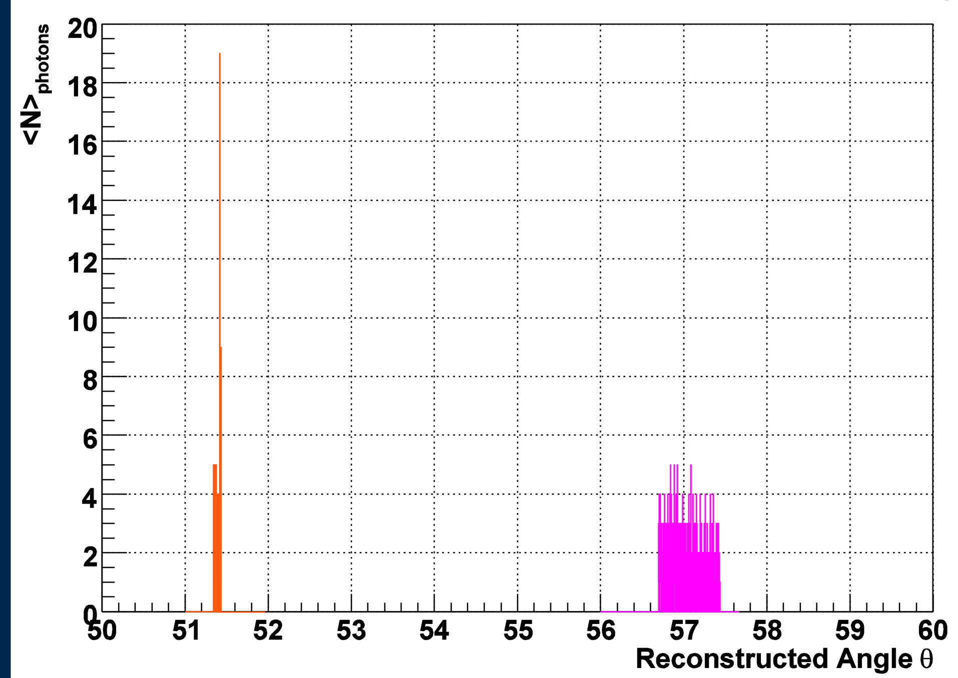


Fig 3: Reduction of spread in reconstructed angle with and without the addition of LiF

•Compared with continuous fused silica **alone**, the addition of a Lithium Fluoride **element** is predicted to produce a significant reduction in angular spread.

•The true effect of LiF in series with $SiO_2$ will be thoroughly tested as part of the FLDD prototype programme.

•A mercury lamp is shone through a **Pellin-Brocca** prism for wavelength selection.

•Light is then coupled into a plate of $SiO_2$ using a right angled prism.

•It then propagates through an interchangeable plate of **LiF** or **$SiO_2$**.

•A final plate of $SiO_2$ decouples the light and it is then detected by CCD.

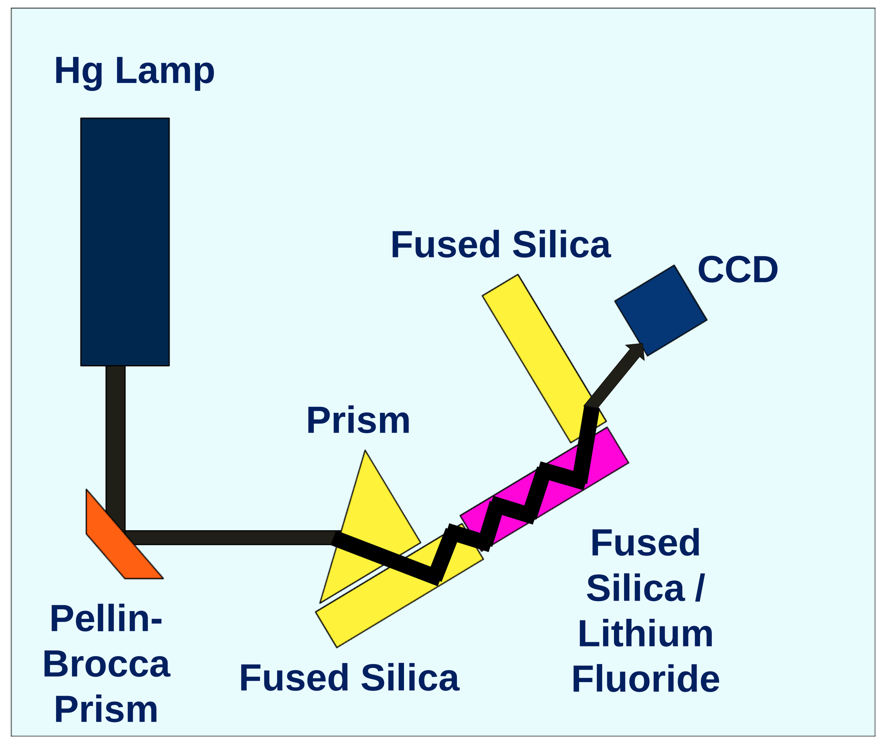


Fig 4: Initial set-up for testing chromatic dispersion correction properties of LiF

## Photon Yield Results

A β ≈ 0.95 primary proton beam was incident on a cuboid of Suprasil®-1 contained in a set-up as shown in Fig. **5**. The straightforward set-up used a calibrated 2” PMT to measure photon yield as a function of polar angle.

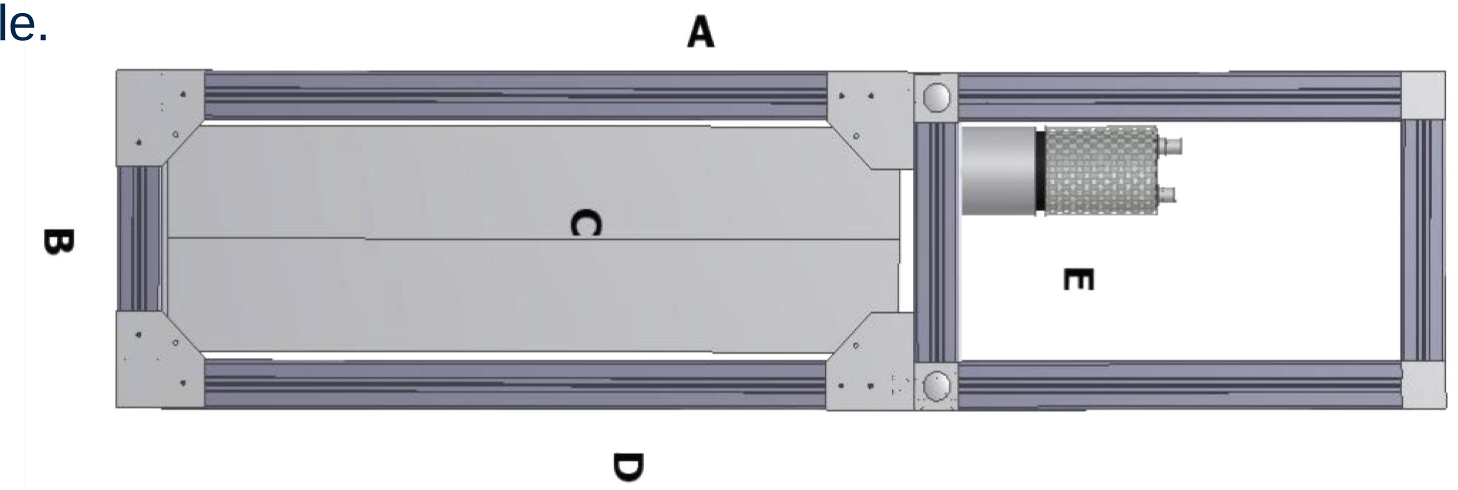


Fig 5: The prototype as used at the GSI test-beam in Aug ’09. The bar on side **A** was Suprasil®-1 & the bar on side **D** was a totally absorbing dummy.

•Unwanted reflections were suppressed using an absorbent material.

•Simulations examining the effect of variation of fraction of absorbed light at boundaries **A**, **B** and **D** were conducted.

•The **observed** data clearly varies from moderate absorption, **η=0.5**, and total absorption, **η=1.0**, cases.

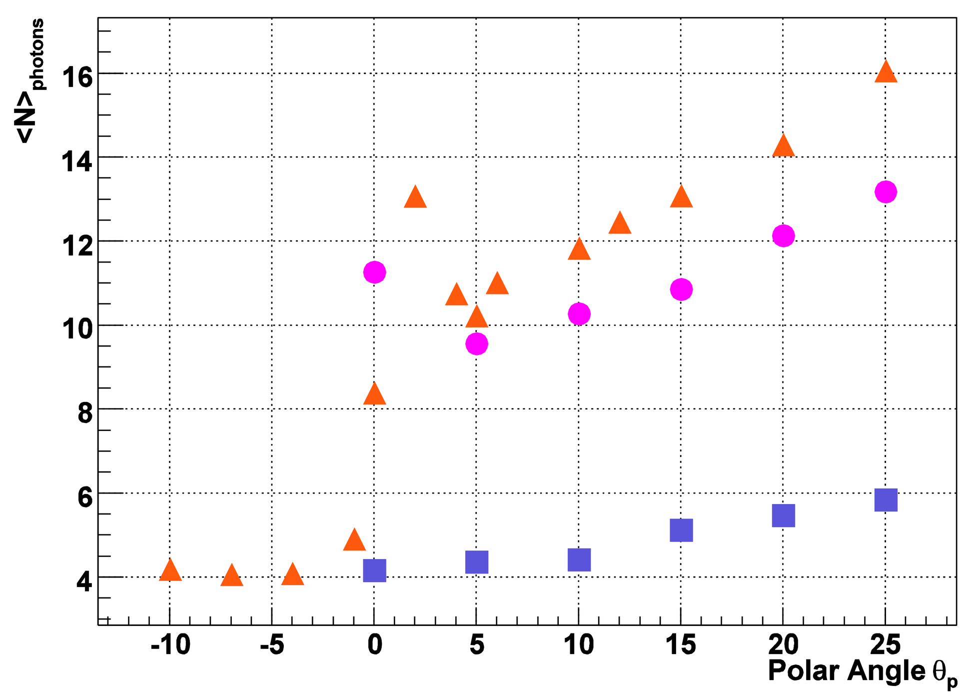


Fig 6: **Observed** photons compared with **moderate** suppression and **total** suppression

•The observed data will also be used to constrain parameters in future work leading to more accurate simulations and better guided experiments.

## Future Prototype Programme

Continuation of the stepwise approach to the FLDD prototype leads naturally to a well defined outlook for research and development:

•Determine accurately the effectiveness of Lithium Fluoride as a passive chromatic dispersion correction element.

•To test the performance of various lightguide solutions and expand that method for quality control of future lightguides.

•To develop an advanced prototype incorporating both Lithium Fluoride and lightguides for future test beam time.

•Long term gluing stability studies will be carried out to prove the assumptions in segmented disc design.

Achieving these will highlight the true performance of the FLDD design and its suitability for the PID requirements of PANDA.

## Acknowledgements

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## Bibliography

[1] P. Glässel, The Limits of the Ring Image Cherenkov Technique *Nuc. Meth. Instr. A,* **433** (1999), pp 17-23.

[2] Carsten Schwarz *et al.*, This Conference