Simulations to Measure Hyperons using Lambda Disk

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Introduction

There are significant progress over the last few years in low energy nonperturbative regime of QCD. However, there are many unresolved phenomena like confinement of quarks, existence of glueballs in this regime of strong interaction physics [1]. The PANDA (Anti**p**roton **An**nihilation at **Da**rmstadt) experiment aims to probe those phenomena with the help of the high intensity cooled antiproton beams of FAIR (**F**acility for **A**ntiproton **I**on **R**esearch) facility at GSI, Darmstadt. One of the physics goal of PANDA is to study the hyperons, which has long lifetime. Therefore, it will decay after travelling a large distance compared to other particles. In this paper, we will present the feasibility study of putting a new sub detector named as lambda disks to track the charge decay product of hyperons.

PANDA Experiment

PANDA detector has been designed to cover the the full 4π acceptance, high energy and momentum resolution, precise tracking, particle identification.

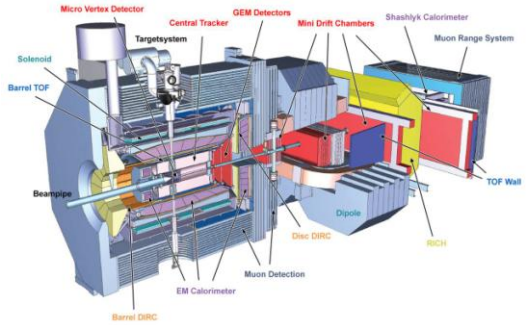

Fig.1 Experimental setup

The Detector is composed of two magnetic spectrometers- Target Spectrometer (TS) and Forward Spectrometer (FS). There are three sub detectors (MVD, STT, GEM) for tracking, Electromagnetic Calorimeter (EMC), a muon system and Cherenkov Detectors (RICH, DIRC) and a time-of-flight (TOF) system [2] as shown in the figure1.

Micro Vertex Detector (MVD) and Lambda Disk

The MVD is the innermost detector for the tracking of the charge particle in the Target Spectrometer. It has four barrel layers and six forward disks. It is composed of two different types of sensors- silicon hybrid pixel for innermost layers and double sided silicon strip detector for the outer layers. There is an idea to place subdetector named as lambda disk in the long detector free gap just before the GEM tracking detector. As a first approach we have started with the geometry of the outer layer of MVD forward disk which is made up of double sided strip detector. Therefore, there is a gap between beam pipe and outer layer of the strips. In this geometry, two such types of layers have been placed at 40 cm and 60 cm away from the interaction region as shown in the figure 2. As a next version of the geometry it has been planned to put double sided strip detector of different shape to fill the gap from the beam pipe to the outer layer in place of pixel sensors.

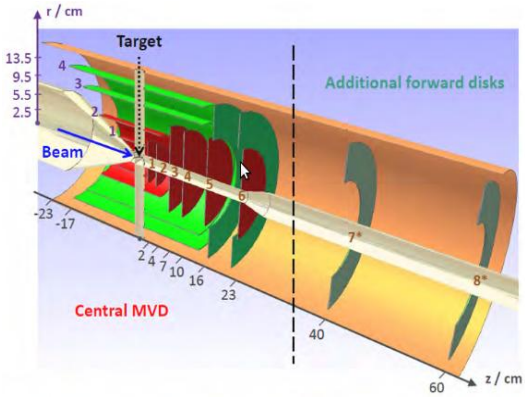

Fig.2 Micro Vertex Detector with lambda disks

Simulation

Simulation has been started to check the gain of a hyperon decay with these additional disks.
Simulation has been done for different charged particles (p, K^+, π^+, μ^-, e^-) to identify them using the Lambda disks which is shown in the figure 3.

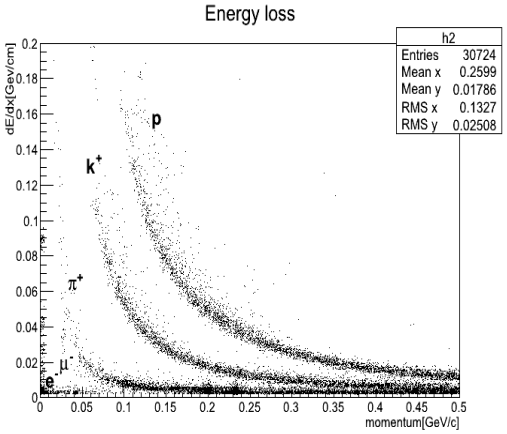

Fig.3 dE/dx vs Momentum.

At the same time one has to confirm that it should not affect the resolution of other decays which are the main motivations of the PANDA physics programme. On the other hand, another issue is the increase of material budget because of these two extra disk layers . One has to study in details that it should not increase the material budget in large amount. In this paper ongoing simulations related to lambda disks will be presented.

Outlook

After doing extensive simulations of hyperon decay and study of material budget with the optimized detector geometry, one has to convince about placing of lambda disks.

References

[1] PANDA Collaboration, Physics Performance Report for: PANDA-Strong Interaction Studies with Antiprotons, arXiv:0903.3905v1 [hep-ex],2009.

[2] PANDA Collaboration, Technical Design Report for the PANDA Micro Vertex Detector- Strong Interaction Studies with Antiprotons,2011,http://www.panda.gsi.de/.