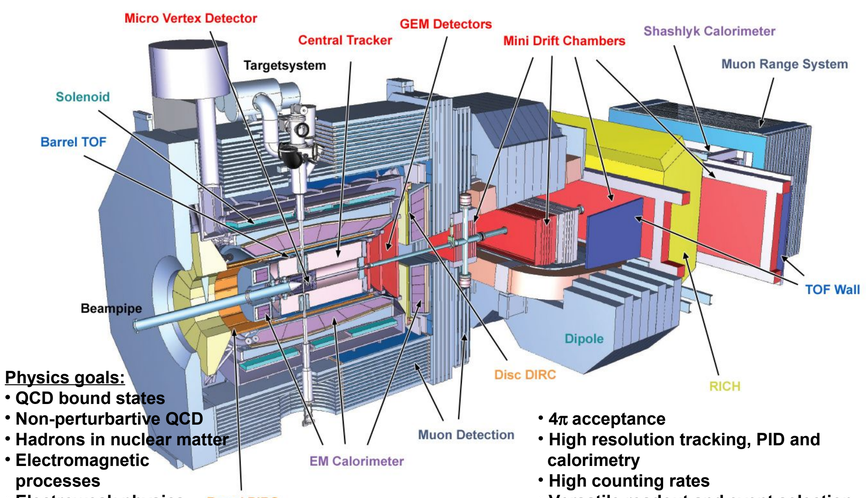
Optimization of the target system for the hypernuclear experiment at $\bar{P}$ANDA

S. Bleser[1], F. Iazzi[2], J. Pochodzalla[3], K. Rittgen[3], C. Sahin[3], A. Sanchez Lorente[1], M. Steinen[1]

[1]Helmholtz-Institut Mainz; [2]Politecnico di Torino and INFN, Sez. di Torino, Italy; [3]Institut für Kernphysik, Mainz

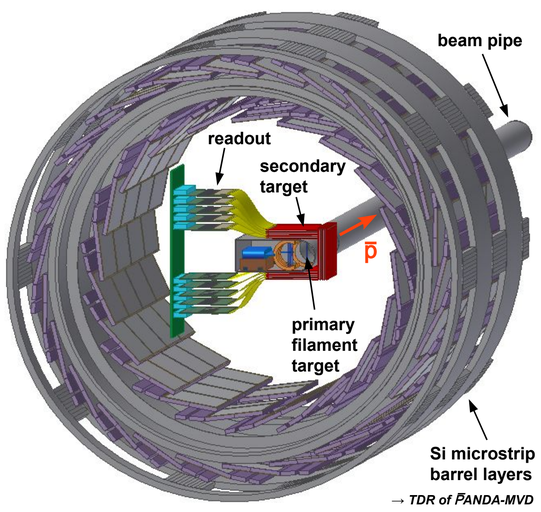
The $\bar{P}$ANDA spectrometer in standard configuration



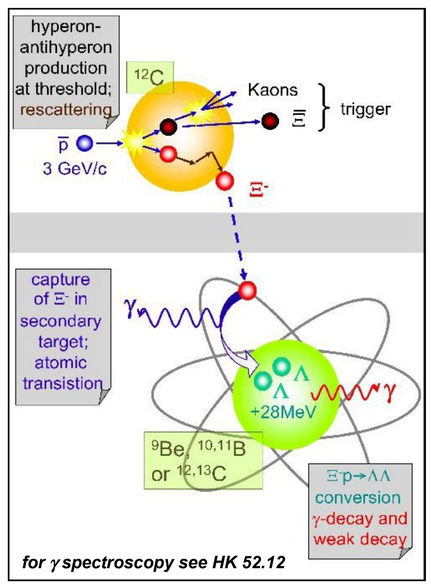
Physics goals:
- QCD bound states
- Non-perturbartive QCD
- Hadrons in nuclear matter
- Electromagnetic processes
- Electroweak physics
- Hypernuclear physics

- 4π acceptance
- High resolution tracking, PID and calorimetry
- High counting rates
- Versatile readout and event selection
- Modular design

Hypernuclear detector setup in $\bar{P}$ANDA



→ *TDR of $\bar{P}$ANDA-MVD*



for γ spectroscopy see HK 52.12

Role of the primary and the secondary target

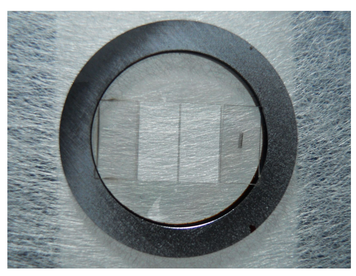
Primary carbon target

- production of low momentum Ξ^- hyperons in $\bar{p}$ + ^{12}C - reactions

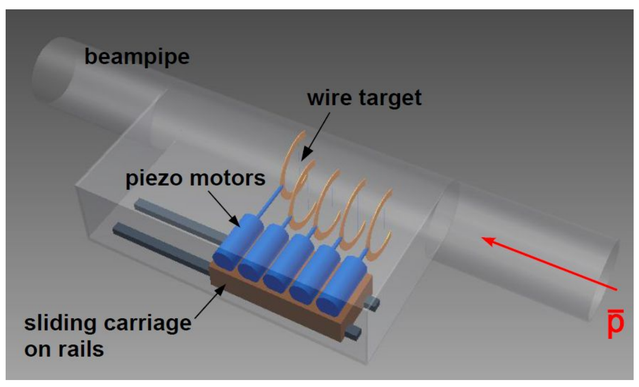
Secondary active sandwich target

- stopping of the Ξ^- hyperons
- atomic capture of Ξ^- within different absorber materials (^{9}Be, ^{10,11}B, ^{12,13}C)
- capture of Ξ^- by nuclei
- conversion of Ξ^- hypernuclei into double Λ hypernuclei ($\Xi^- p \rightarrow \Lambda\Lambda + 28$ MeV)
- tracking and identification of their weak decay products

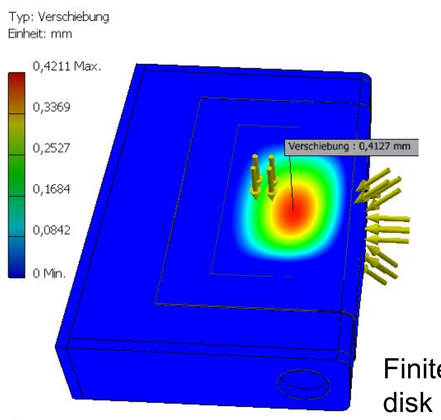
Primary target

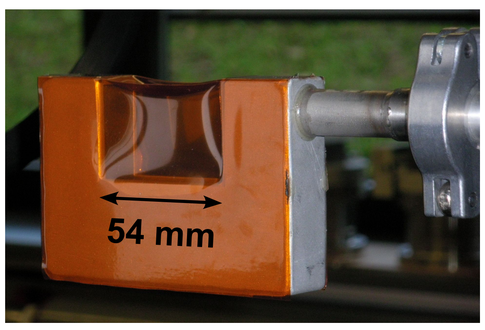


Picture of the carbon filament prototype (3 µm x 100 µm)



Design of a steerable and exchangeable wire target





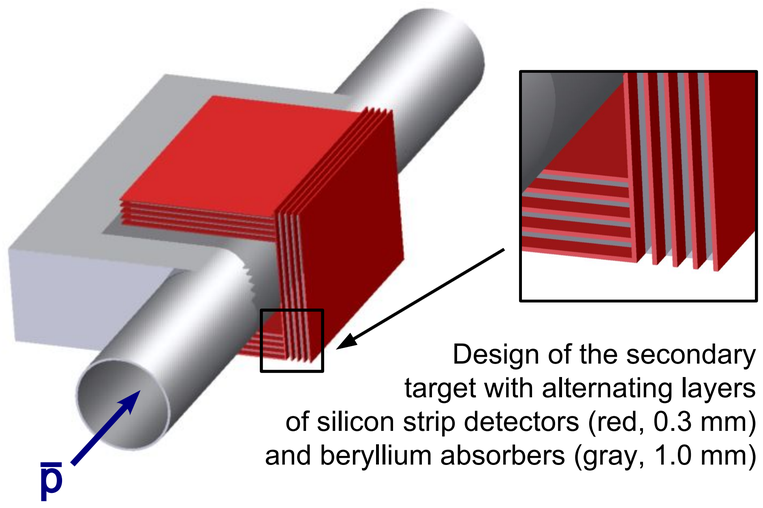
Finite element analysis of a 0.5 mm thick titan disk on an aluminium frame

First evacuated target chamber model with a thin wall thickness in the sensor area for less Ξ^- stopping:

75 µm Kapton foil glued on an aluminium frame

→ further stabilization necessary

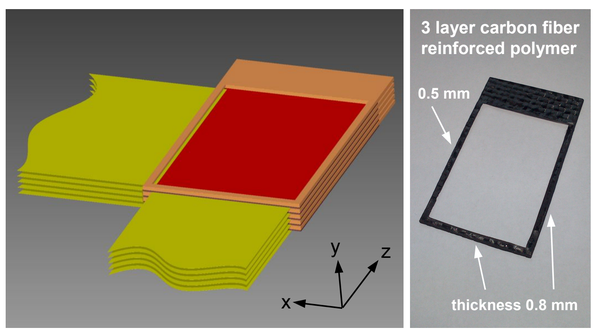
Secondary target

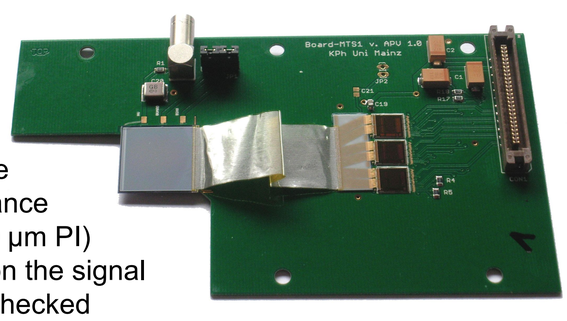


Design of the secondary target with alternating layers of silicon strip detectors (red, 0.3 mm) and beryllium absorbers (gray, 1.0 mm)

I: Cabling and support structures of one block

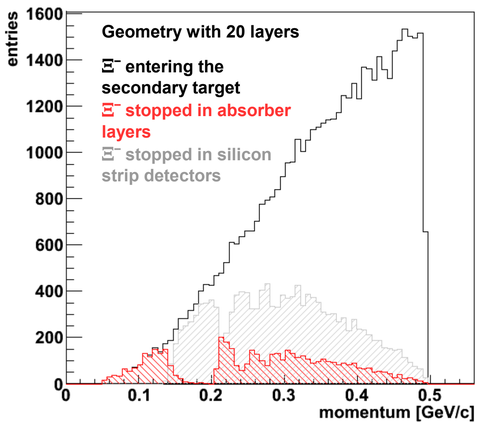
r: Prototype of a sensor support frame





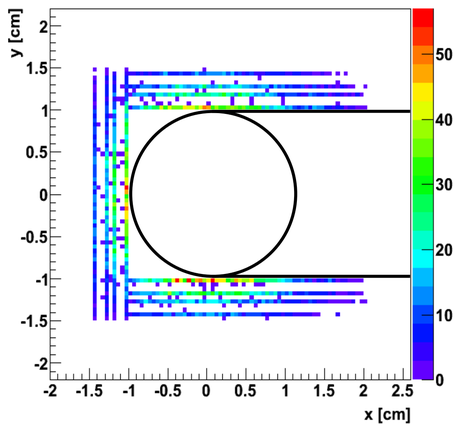
Testboard for Al-polyimide cable performance (10 µm Al + 10 µm PI)
→ influences on the signal have to be checked

Momentum distribution of stopped Ξ^- at the entrance of the secondary target

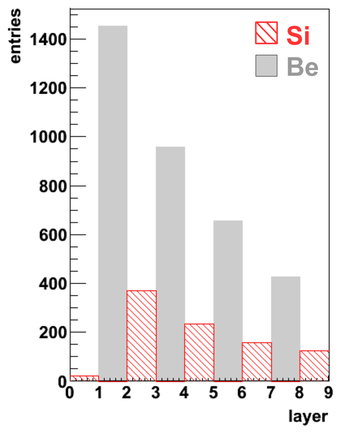


Only Ξ^- in the momentum range from 100 to 500 MeV/c can be stopped

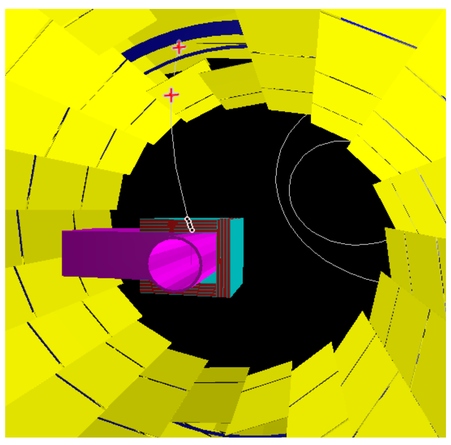
Simulation of 200,000 Ξ^- in the uniform momentum range from 100 to 500 MeV/c by box generator



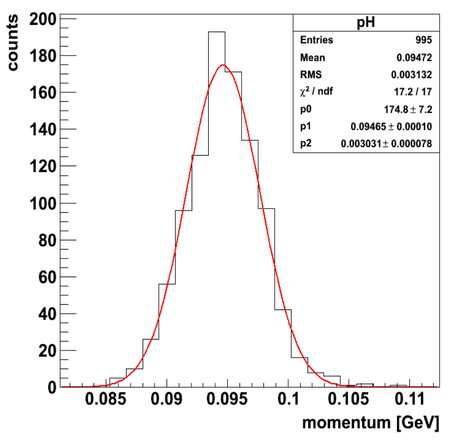
Stopped Ξ^- in the four absorber layers of the three blocks

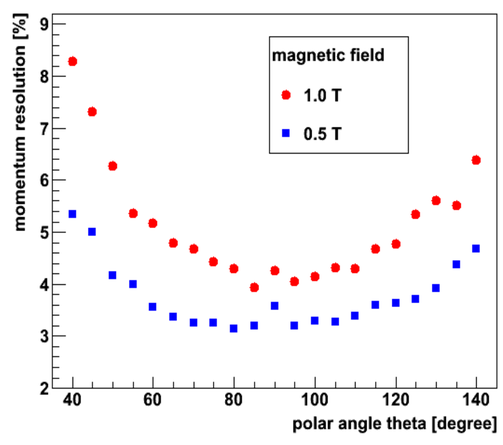


Stopped Ξ^- in the secondary target: 5.2% of the generated Ξ^- are stopped in beryllium



Simulated pion track (100 MeV/c) crossing the sensors of the secondary target (black dots) and the two outer detector layers (red cross)





Reconstruction of low momentum pions based on the GEANE package combined with a generic Kalman filter. Momentum uncertainties appear due to not optimal error treatment of the energy loss → further modifications needed and the geometry has to be optimized for a momentum resolution ≤ 2%

HadronPhysics2 Study of Strongly Interacting Matter

bmb+f Großgeräte der physikalischen Grundlagenforschung

In gemeinsamer Trägerschaft des
GSI Helmholtzzentrums für Schwerionenforschung, Darmstadt und der Johannes Gutenberg-Universität Mainz