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

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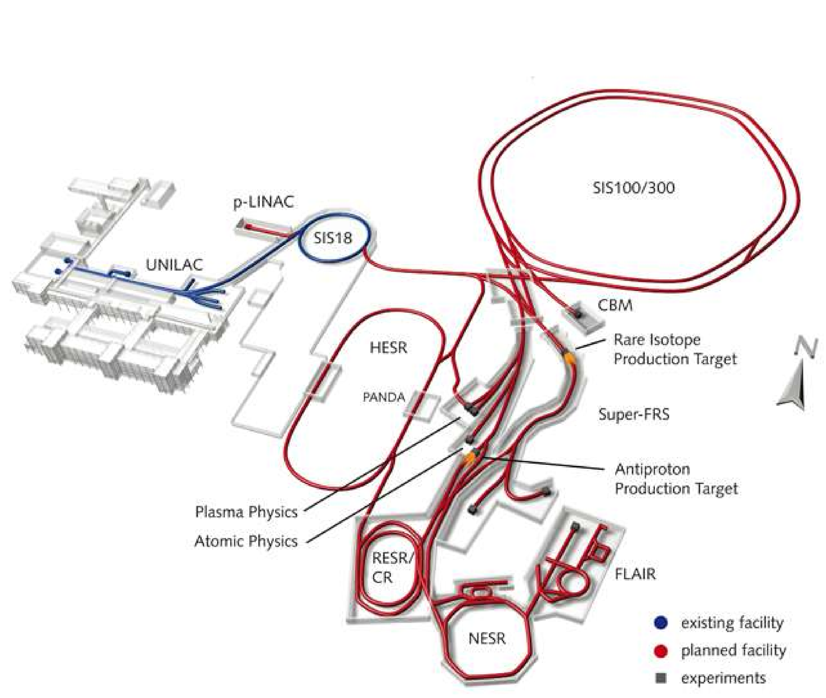
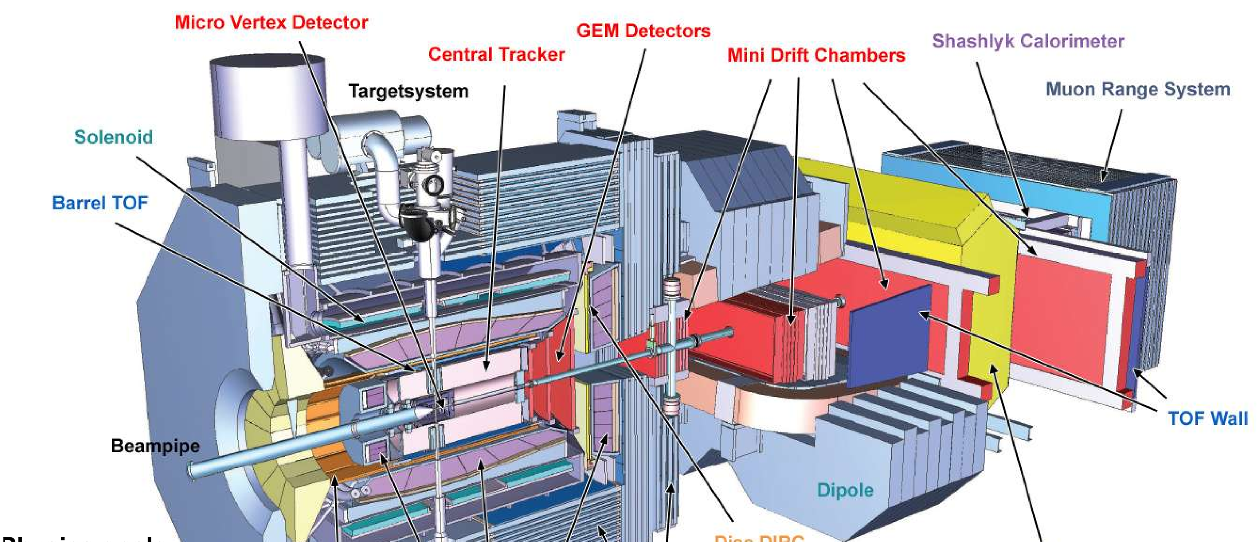
The future FAIR facility at GSI



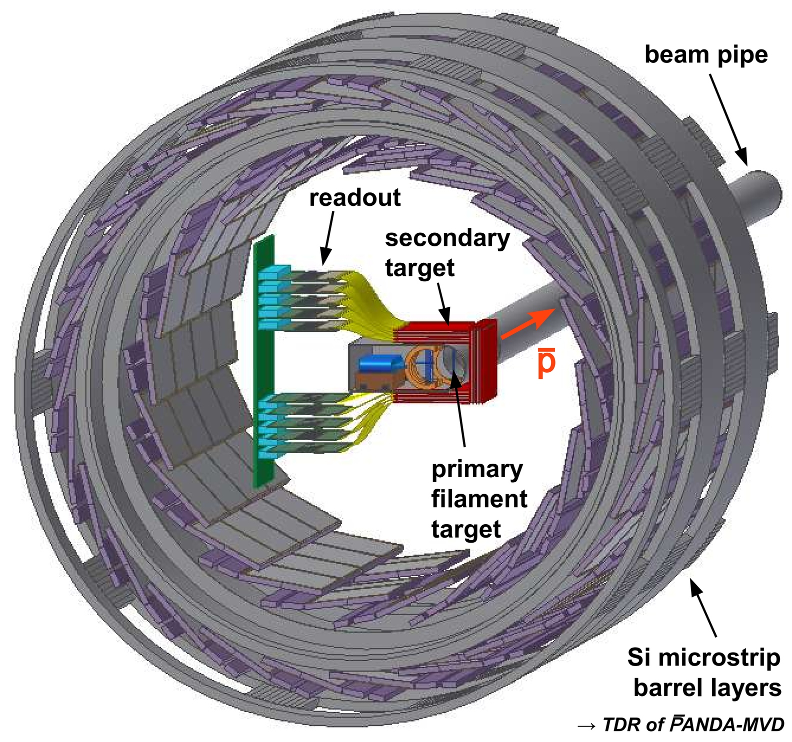
The $\bar{\text{P}}$ANDA spectrometer in standard configuration



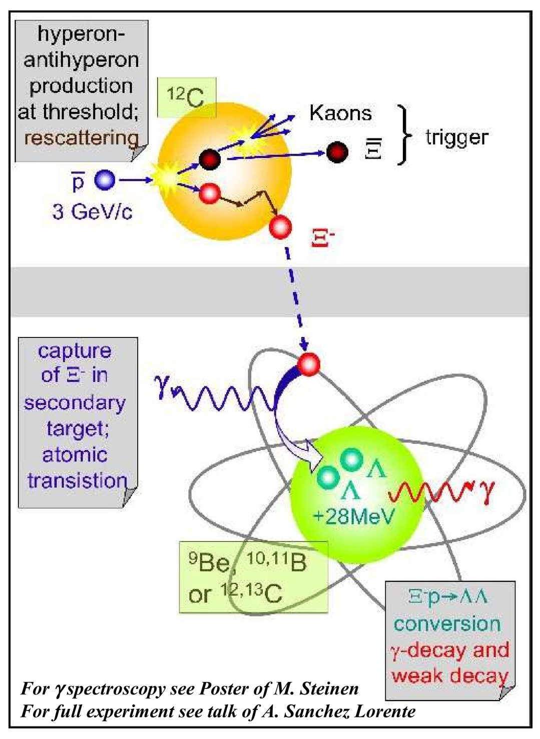
Physics goals:
- QCD bound states
- Non-perturbartive QCD
- Hadrons in nuclear matter
- Electromagnetic processes
- Electroweak physics
- Hypernuclear physics

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

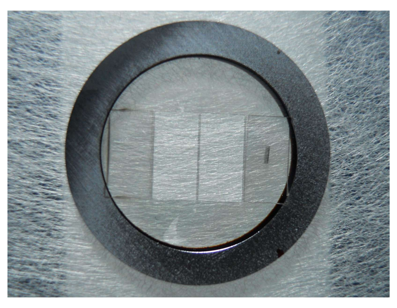
Hypernuclear detector setup in $\bar{\text{P}}$ANDA



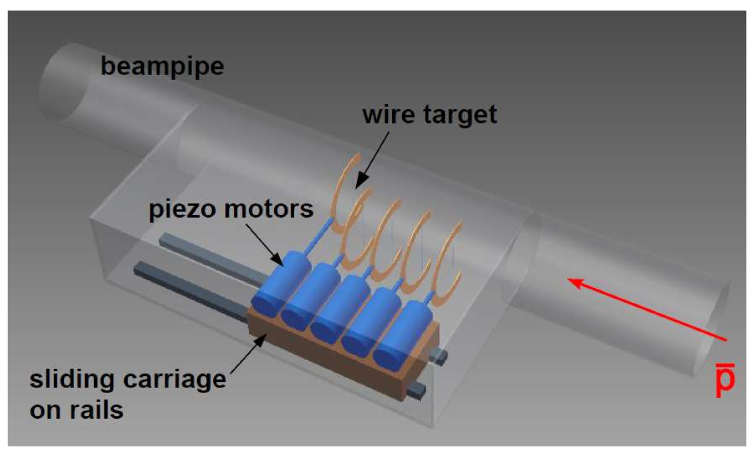
Role of the primary and the secondary target



Primary target

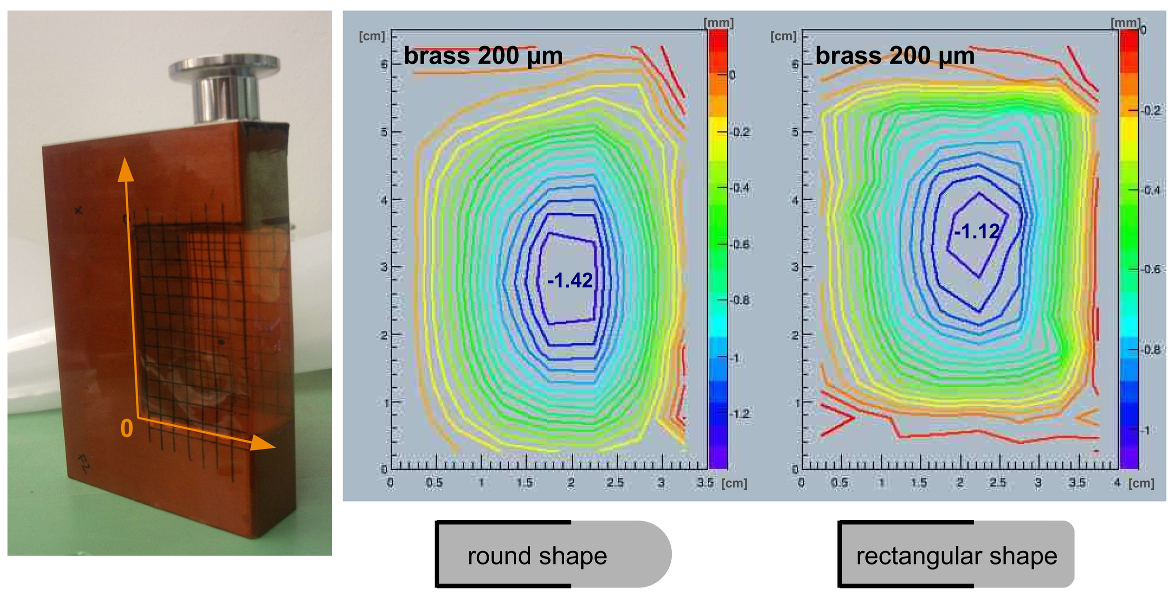


Picture of the carbon filament prototype (3 μm x 100 μm)



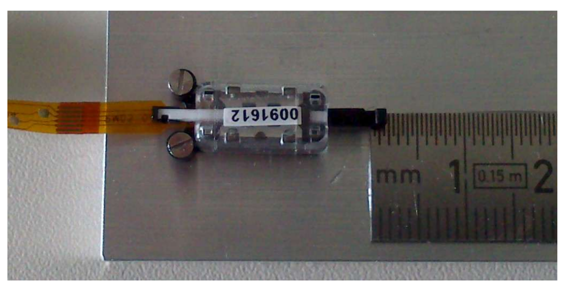
Design of a steerable and exchangeable wire target using piezo motors

Stability tests of target chambers with different shapes, materials (brass, Ti, AlMg, Kapton) and thicknesses under vacuum:
a compromise between low bending and minimal energy loss as well as photon absorption has to be found

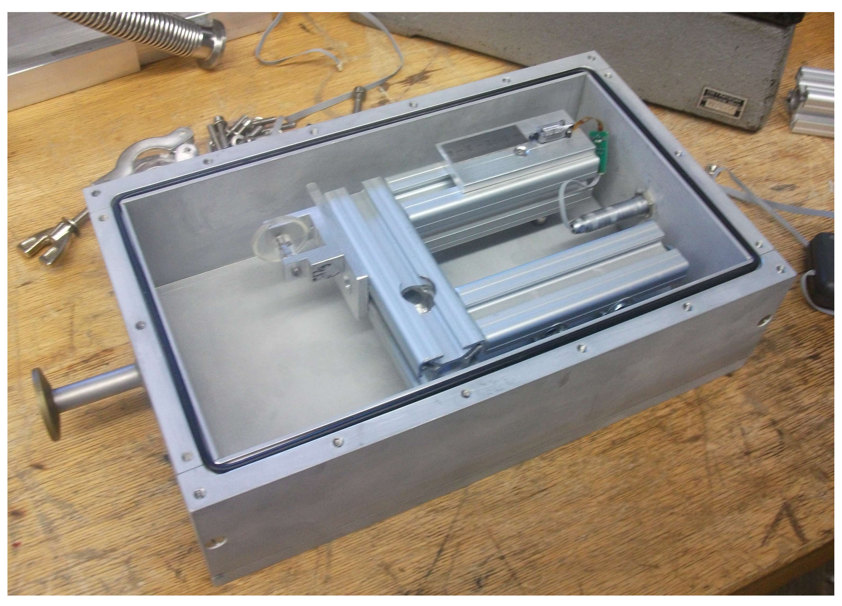


Lowest bending for material titanium (1.22 mm, 200 μm round) and rectangular shape without material fatigue after 10 cycles

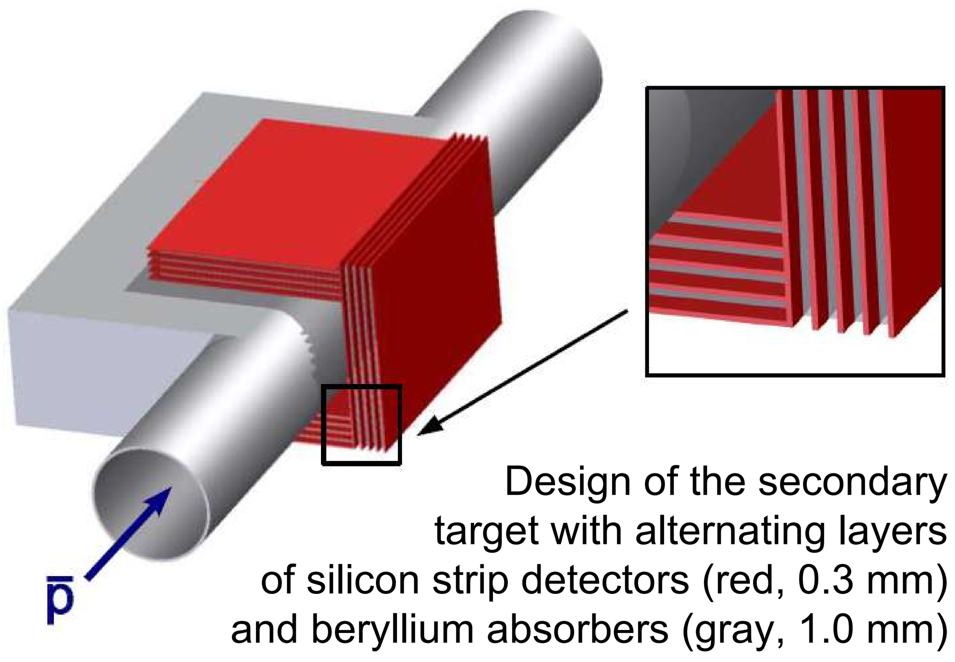
Piezo motor and vacuum chamber with holding frame:



- proper running in vacuum proved for some weeks
- dynamic force confirmed at 0.15 N and holding force is even 0.88 N
- no influence of a magnetic field of 1.3 T
- measured average step size: 0.95 μm

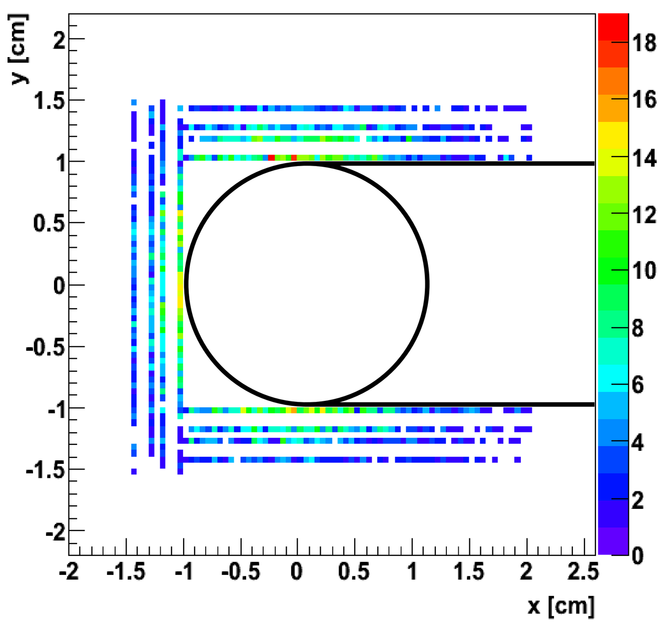


Secondary target



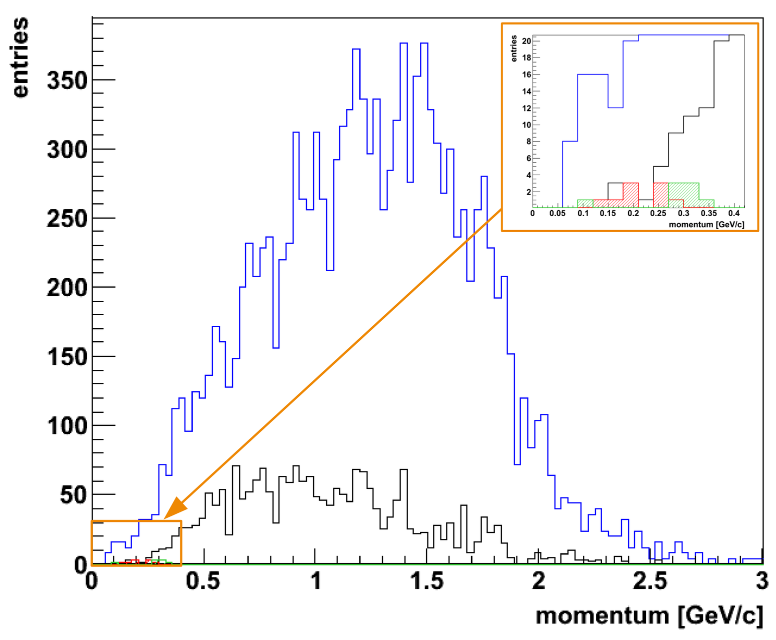
Design of the secondary target with alternating layers of silicon strip detectors (red, 0.3 mm) and beryllium absorbers (gray, 1.0 mm)

Simulation of 200,000 Ξ^- in the uniform momentum range from 0.1 to 1.0 GeV/c by the box generator



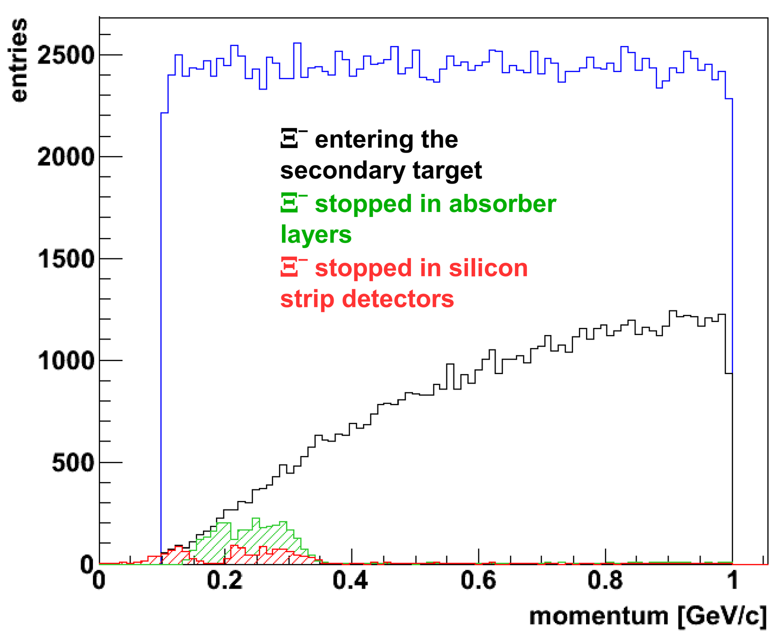
Stopped Ξ^- in the four absorber layers of the three blocks: 1.5% of the generated Ξ^- are stopped in beryllium

Momentum distribution of Ξ^- from GiBUU simulations and their results after stopping in the secondary target

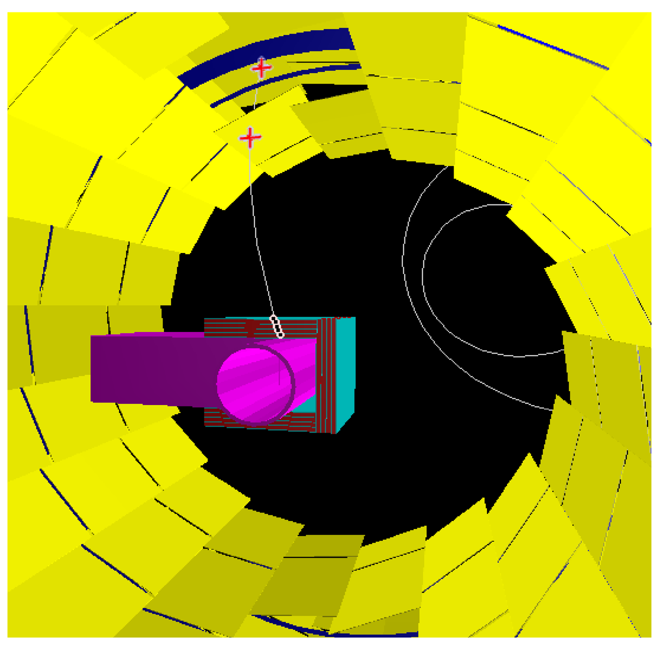


0.07% of the generated Ξ^- are stopped in beryllium

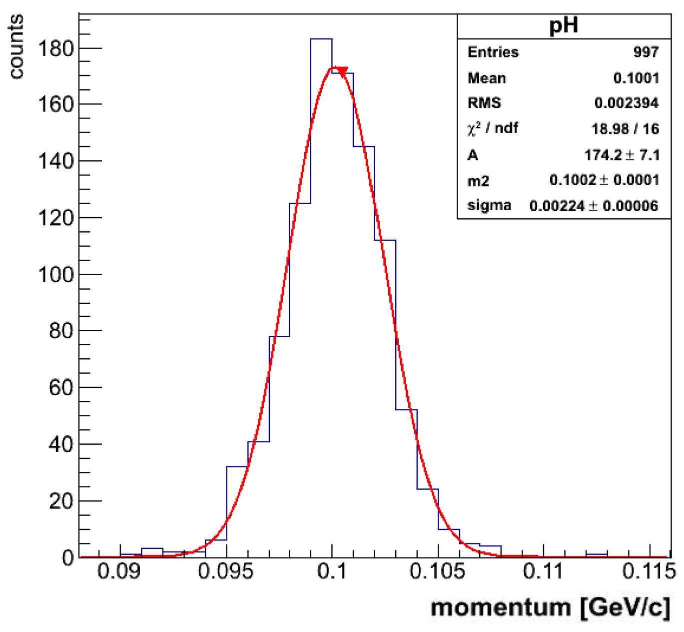
Momentum distribution at the vertex and of stopped Ξ^- at the entrance of the secondary target

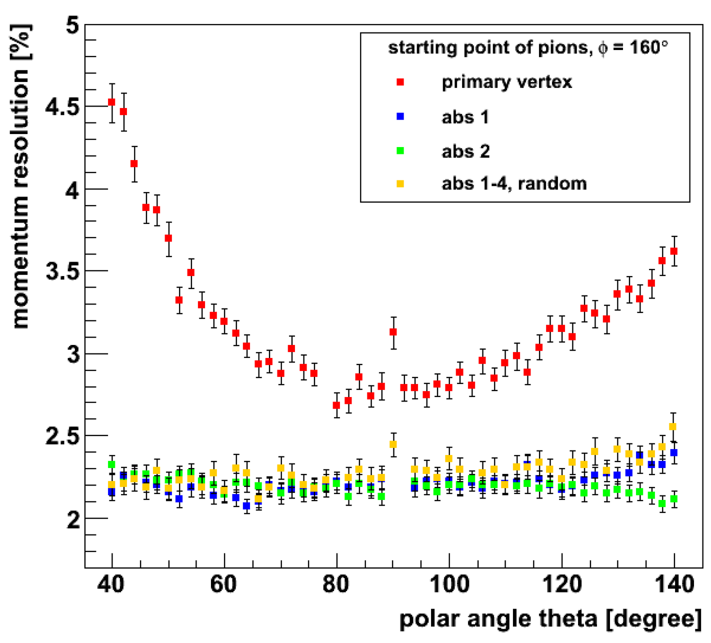


Only Ξ^- in the momentum range from 0.1 to 0.4 GeV/c can be stopped



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 in the secondary target based on the GEANE package combined with a generic Kalman filter
→ momentum resolution sufficient to separate π-π pairs from the different dominant double Λ hypernuclei
→ further optimization with simple event generator

HadronPhysics2 Study of Strongly Interacting Matter

bmb+f Großgeräte der physikalischen Grundlagenforschung

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