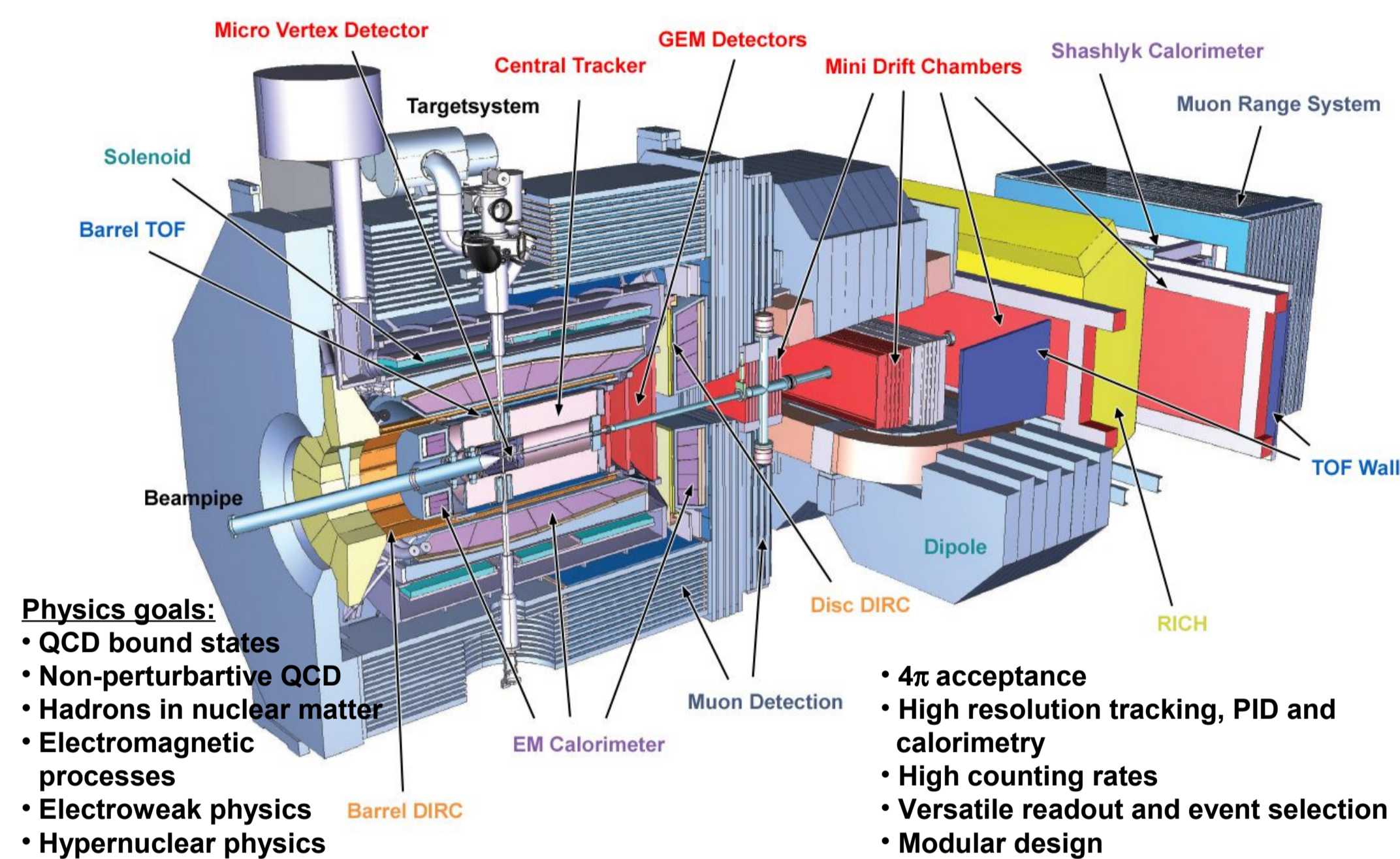# Optimization of the target system for the hypernuclear experiment at P̄ANDA

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The P̄ANDA spectrometer in standard configuration

Micro Vertex Detector, Central Tracker, GEM Detectors, Mini Drift Chambers, Shashlyk Calorimeter, Targetsystem, Solenoid, Muon Range System, Barrel TOF, Beampipe, TOF Wall, Dipole, Disc DIRC, RICH, Muon Detection, EM Calorimeter, Barrel DIRC
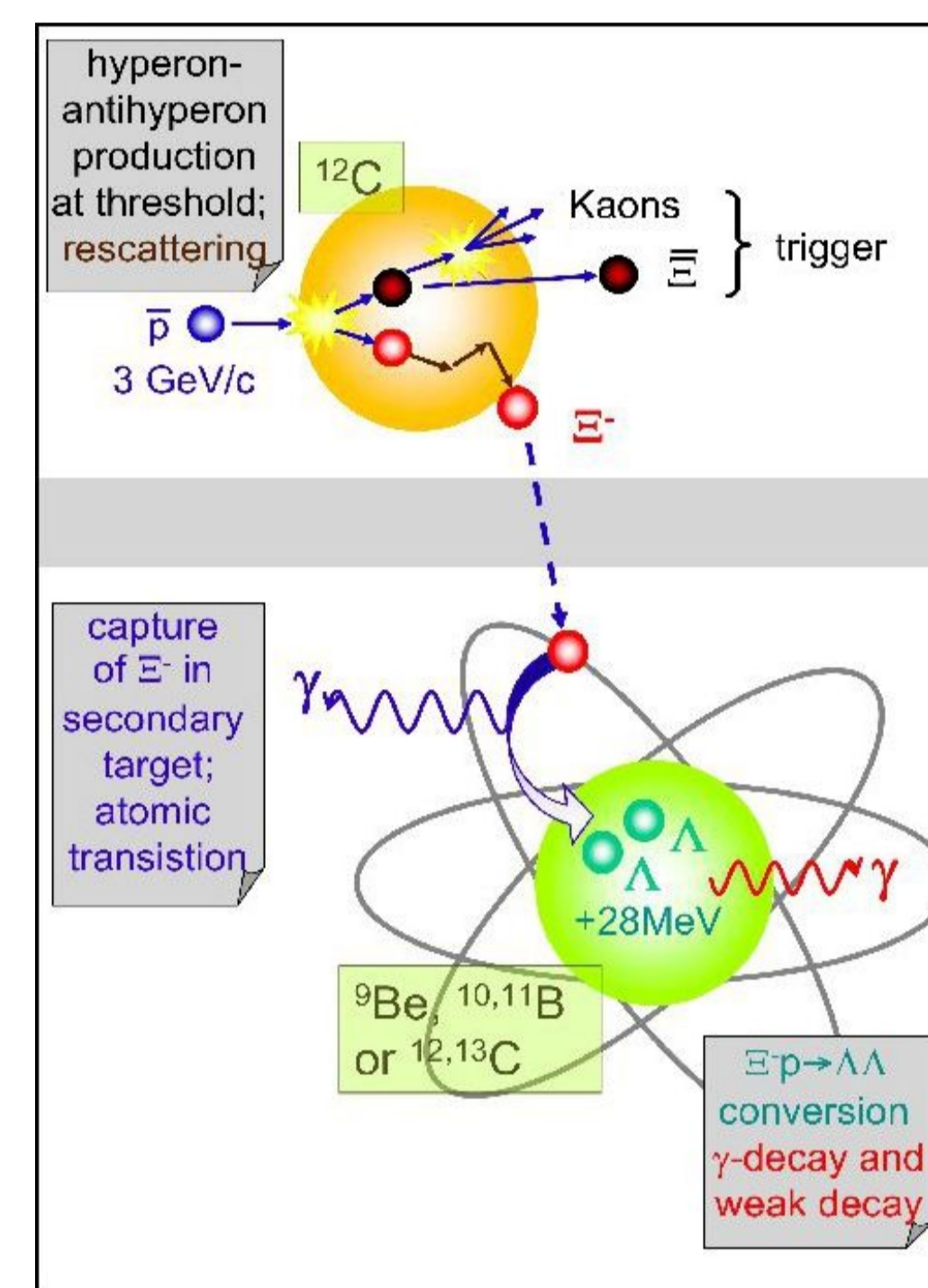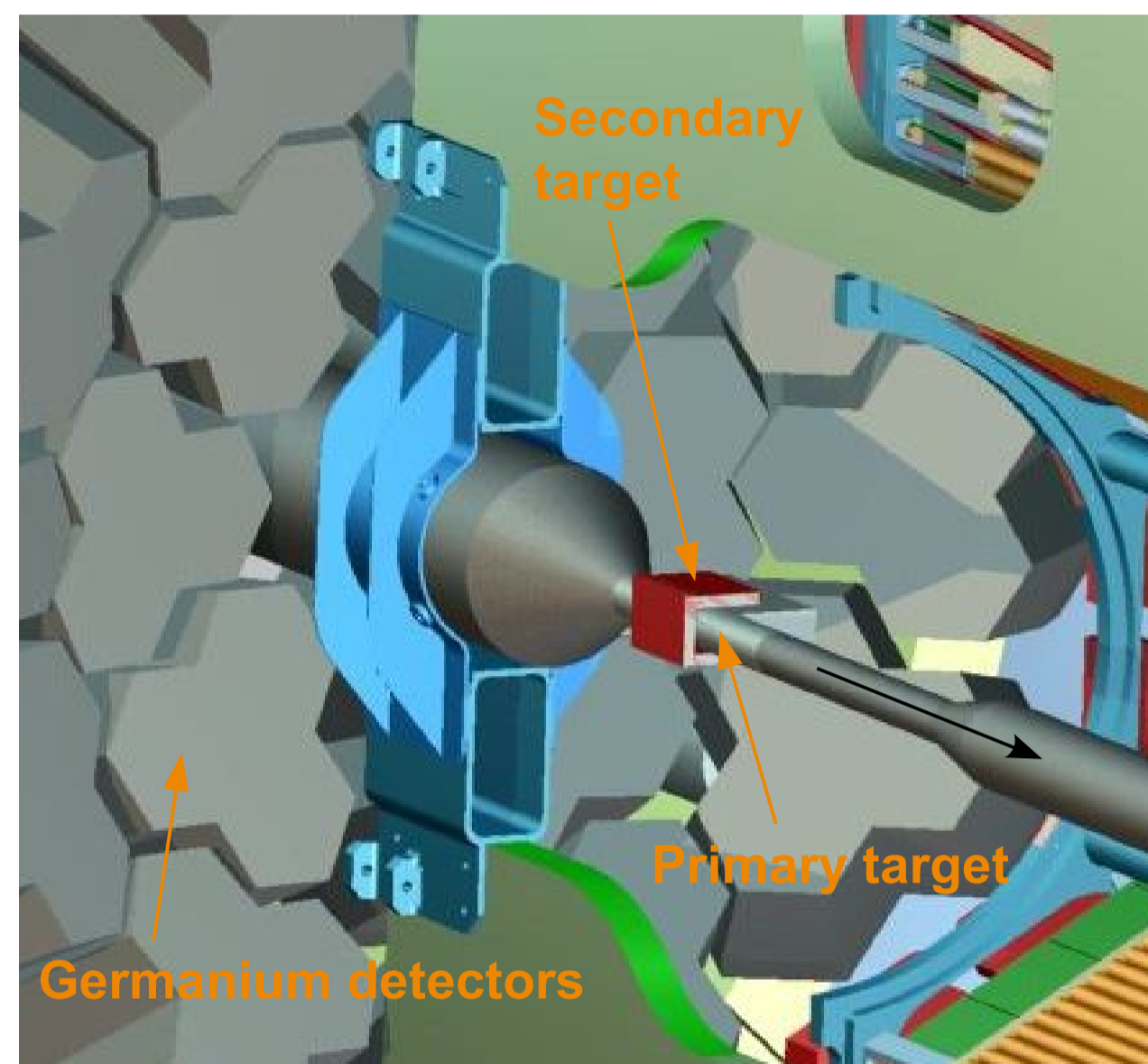
Physics goals:
• QCD bound states
• Non-perturbative QCD
• Hadrons in nuclear matter
• Electromagnetic processes
• Electroweak physics
• Hypernuclear physics

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

Hypernuclear detector setup in P̄ANDA

Secondary target, Primary target, Germanium detectors

hyperon-antihyperon production at threshold; rescattering
^{12}C, Kaons, trigger, p̄ 3 GeV/c, Ξ⁻

capture of Ξ⁻ in secondary target; atomic transition

^{9}Be, ^{10,11}B or ^{12,13}C

ΛΛ +28MeV

Ξ⁻p → ΛΛ conversion γ-decay and weak decay

Role of the primary and the secondary target

Primary carbon target
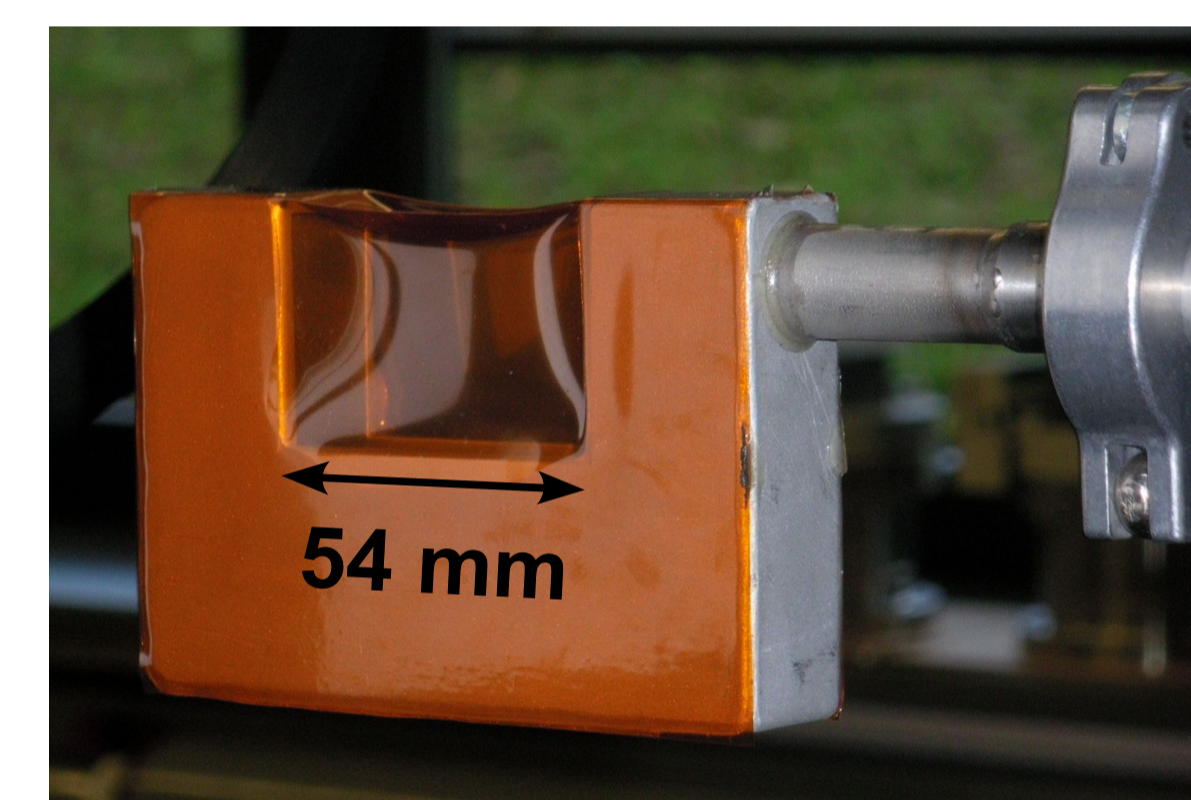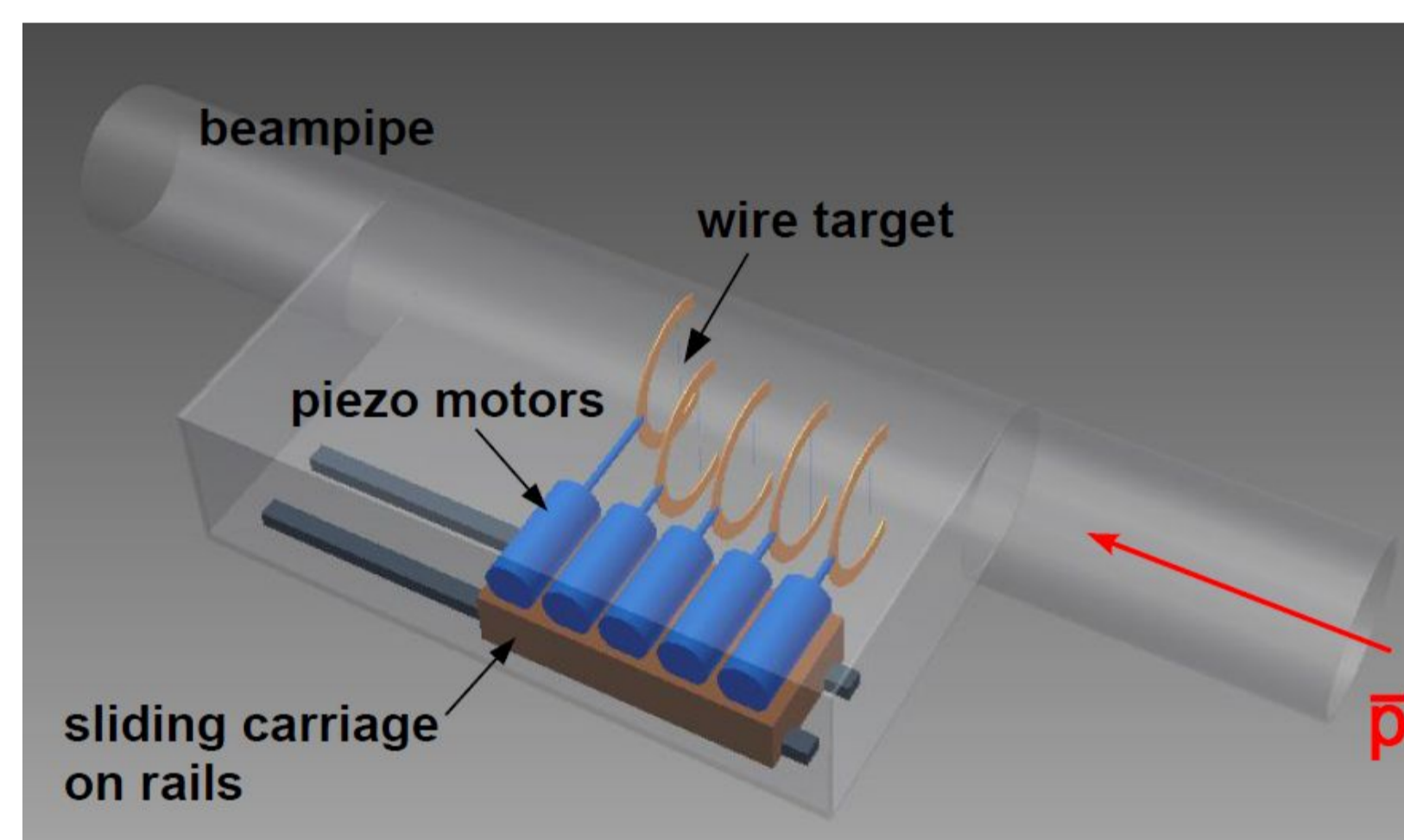• production of low momentum Ξ⁻ hyperons in p̄ + ^{12}C - reactions

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 (Ξ⁻p → ΛΛ + 28 MeV)
• tracking and identification of their weak decay products

Primary target
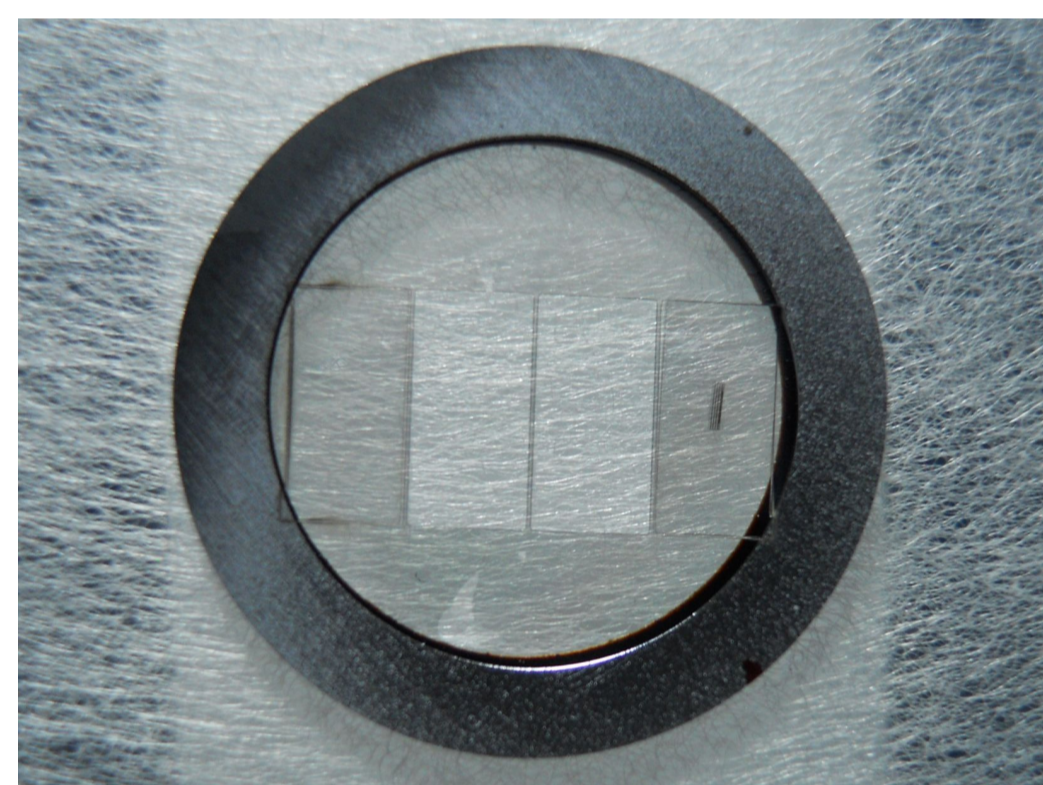
Picture of the carbon filament prototype (thickness 3 µm, width 100 µm)

beampipe, wire target, piezo motors, sliding carriage on rails, p̄

Design of a steerable and exchangeable primary target using piezo motors

54 mm

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

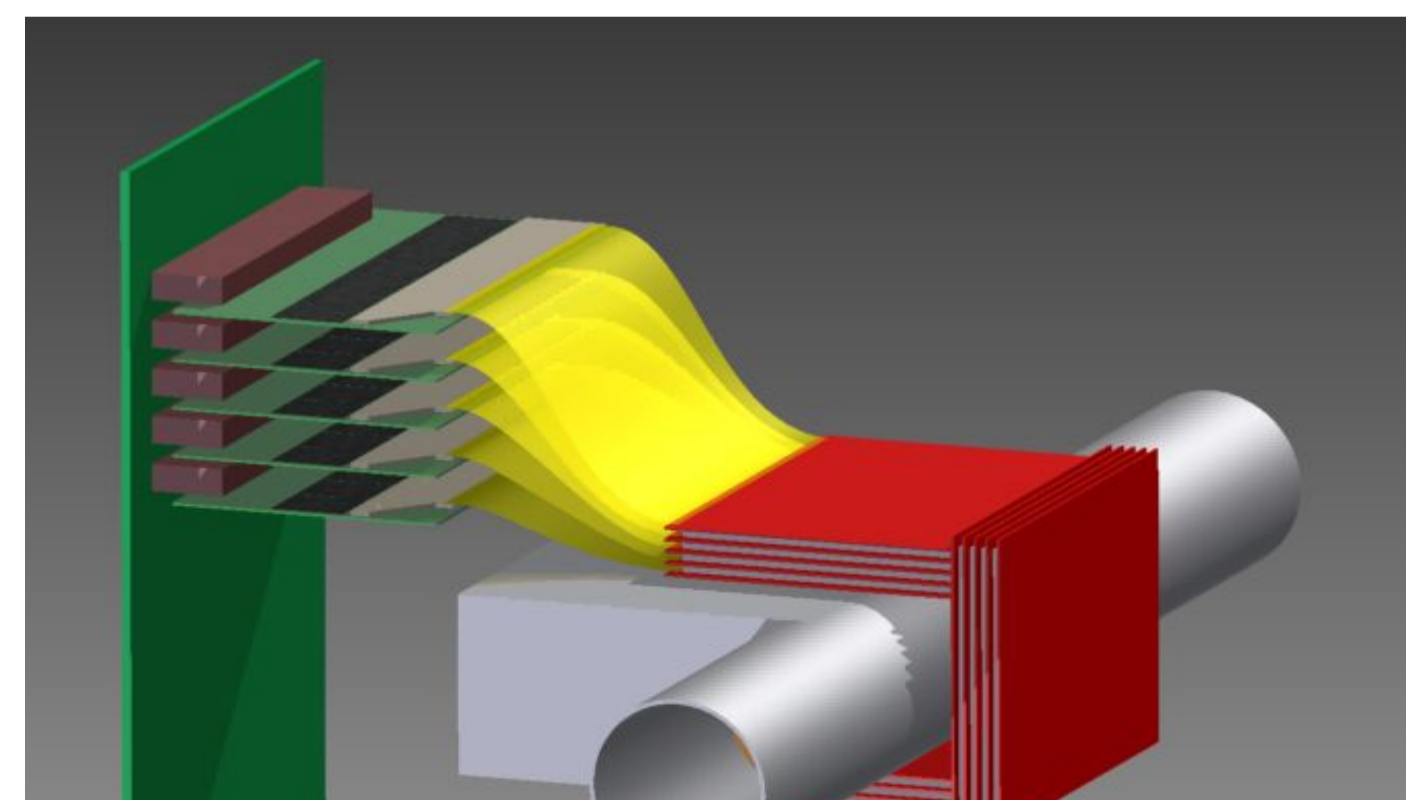75 µm Kapton foil glued on an aluminium frame
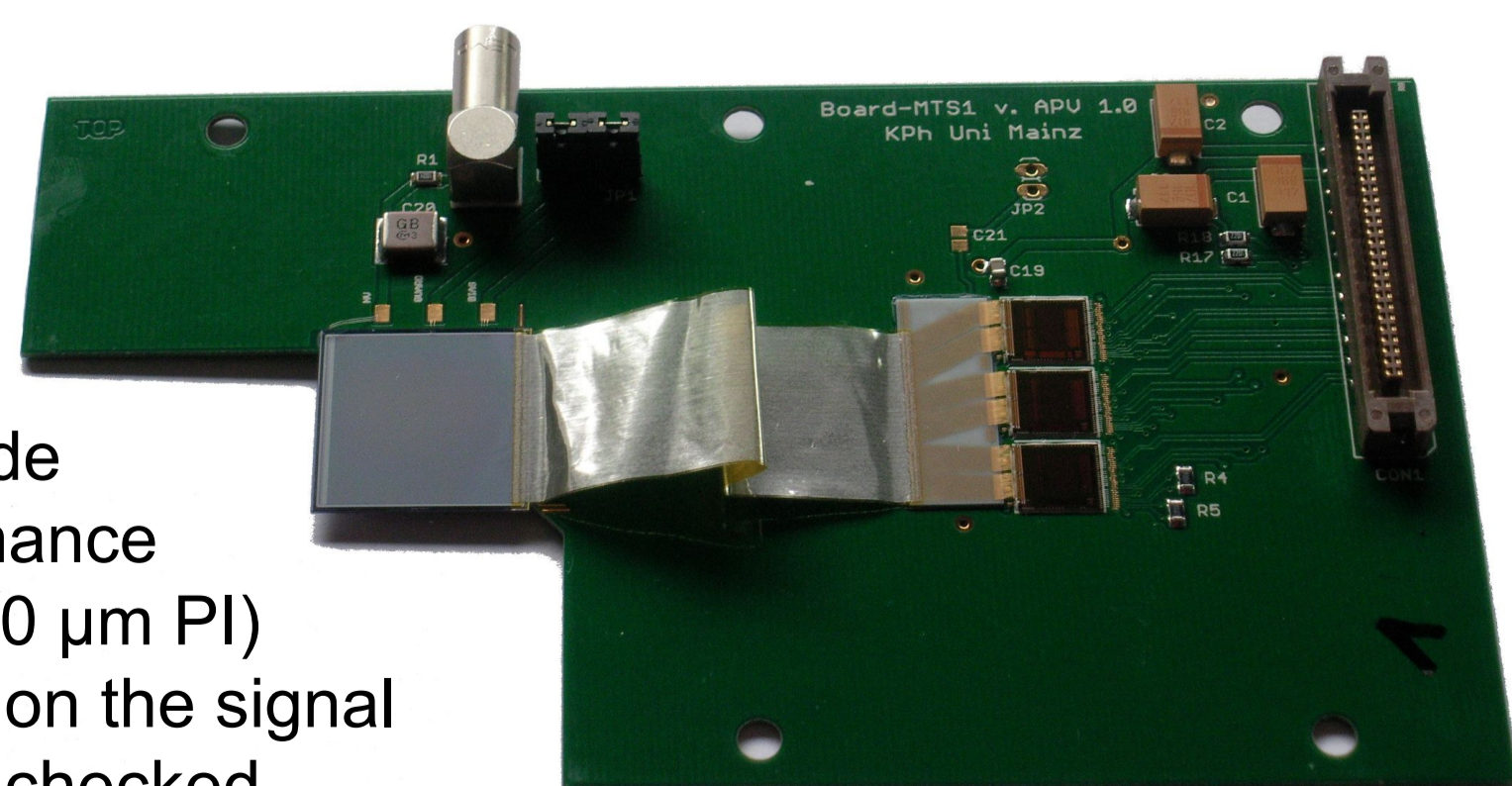
→ further stabilization necessary

Secondary target

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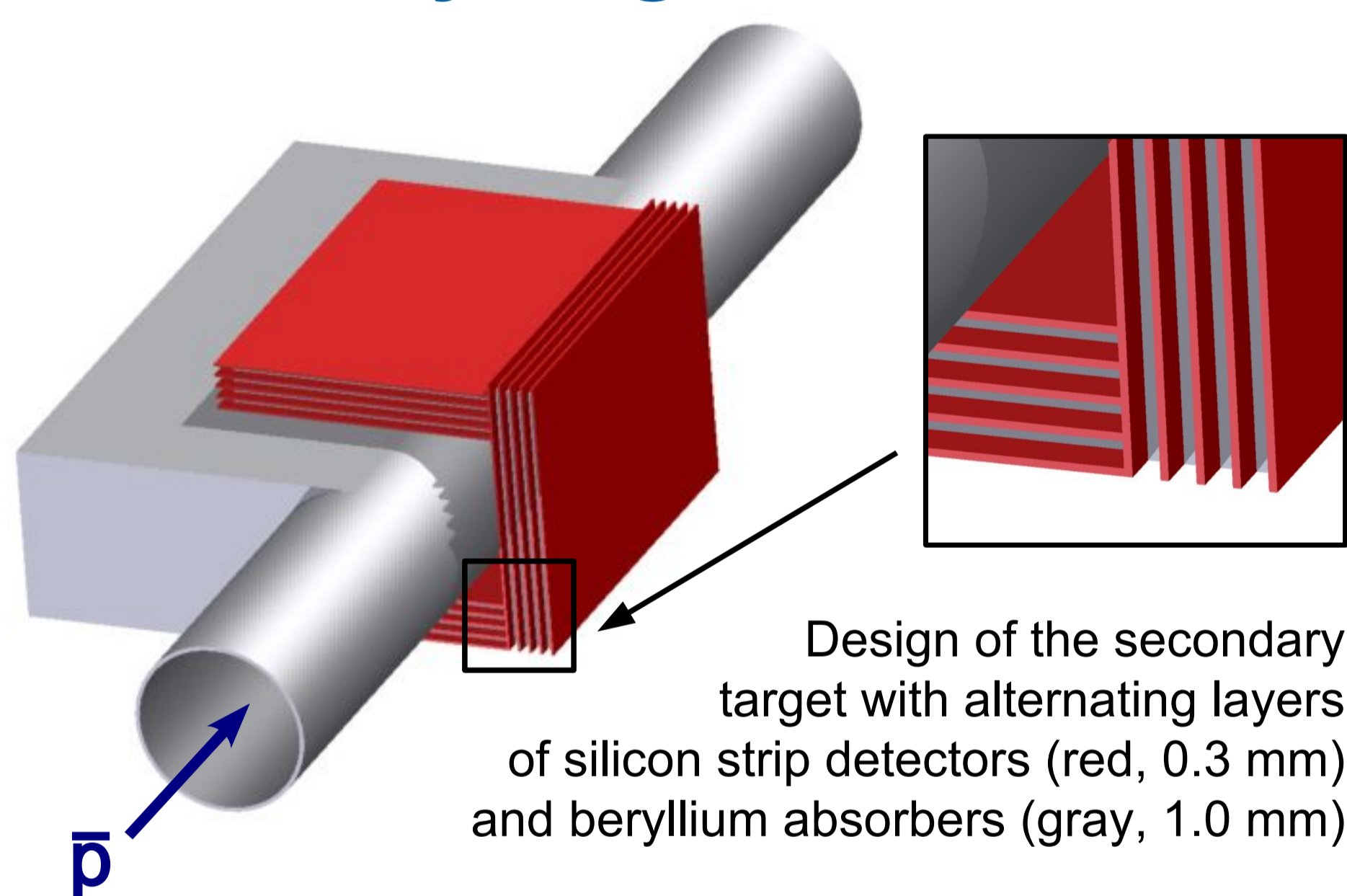
Design of the secondary target with alternating layers of silicon strip detectors (red, 0.3 mm) and beryllium absorbers (gray, 1.0 mm)

Momentum distribution of stopped Ξ⁻ at the entrance of the secondary target

Geometry with 20 layers
Ξ⁻ entering the secondary target
Ξ⁻ stopped in absorber layers
Ξ⁻ stopped in silicon strip detectors

entries / momentum [GeV/c]

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

y [cm] / x [cm]

Stopped Ξ⁻ in the four absorber layers of the three blocks

Si, Be

entries / layer

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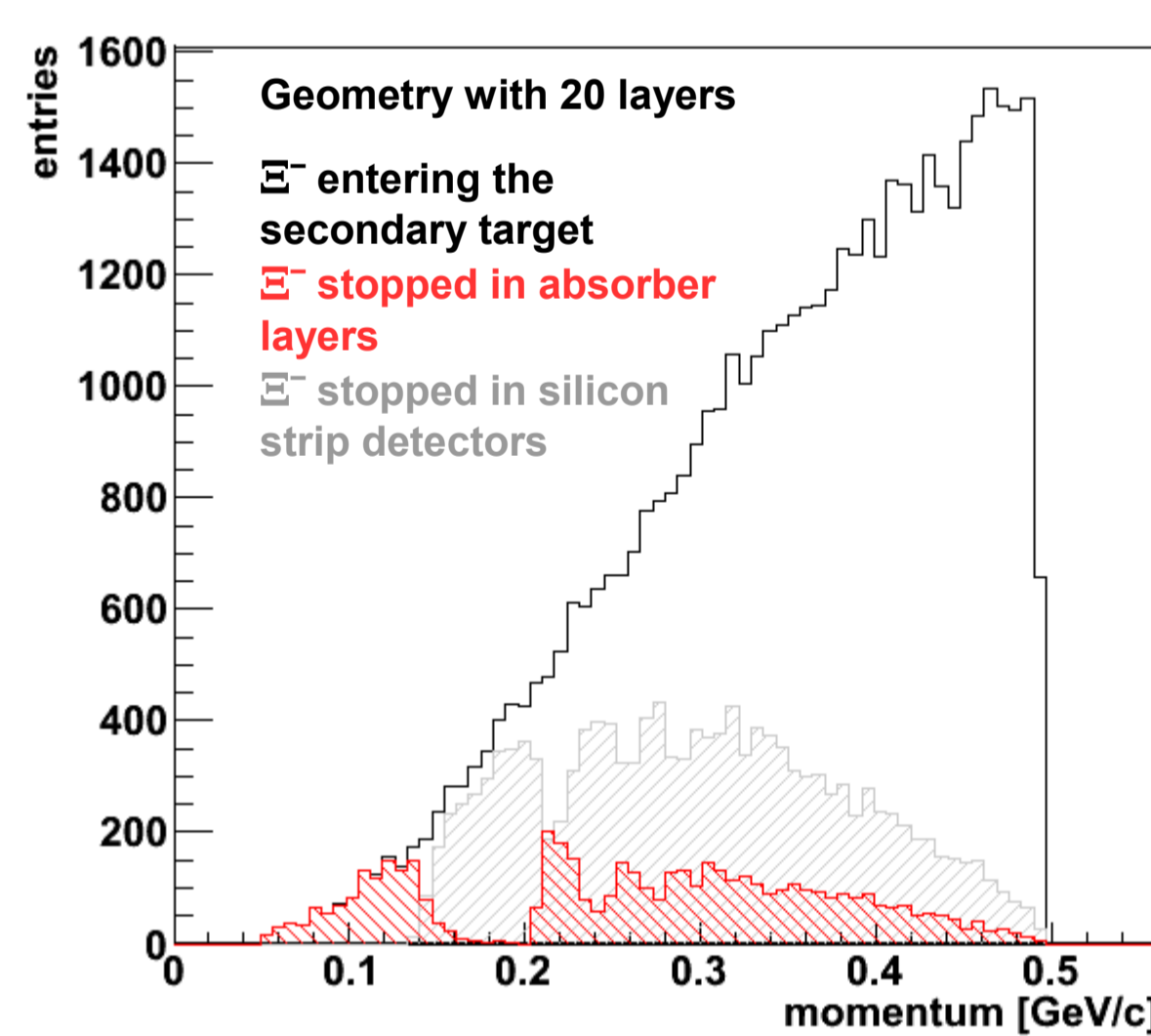

Design of the secondary target and its readout electronics

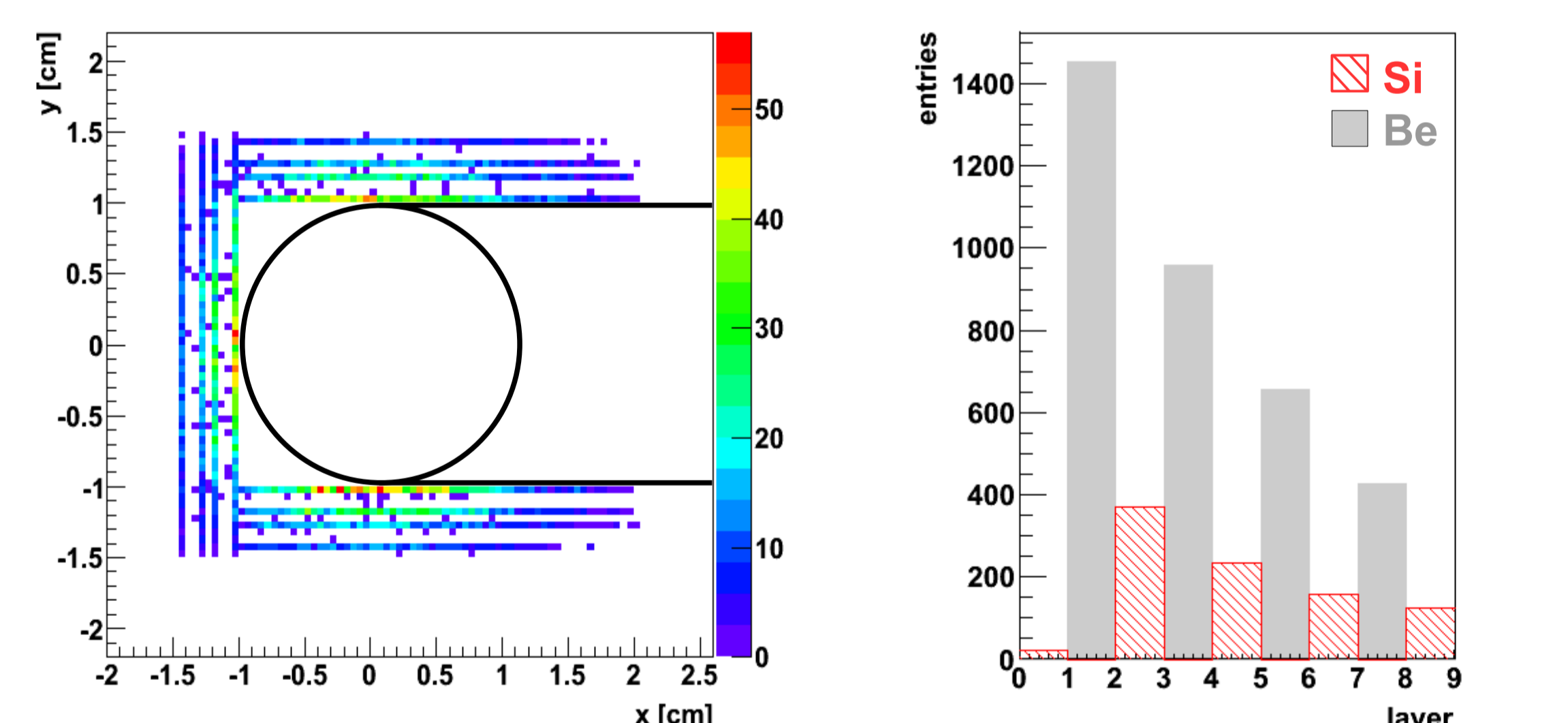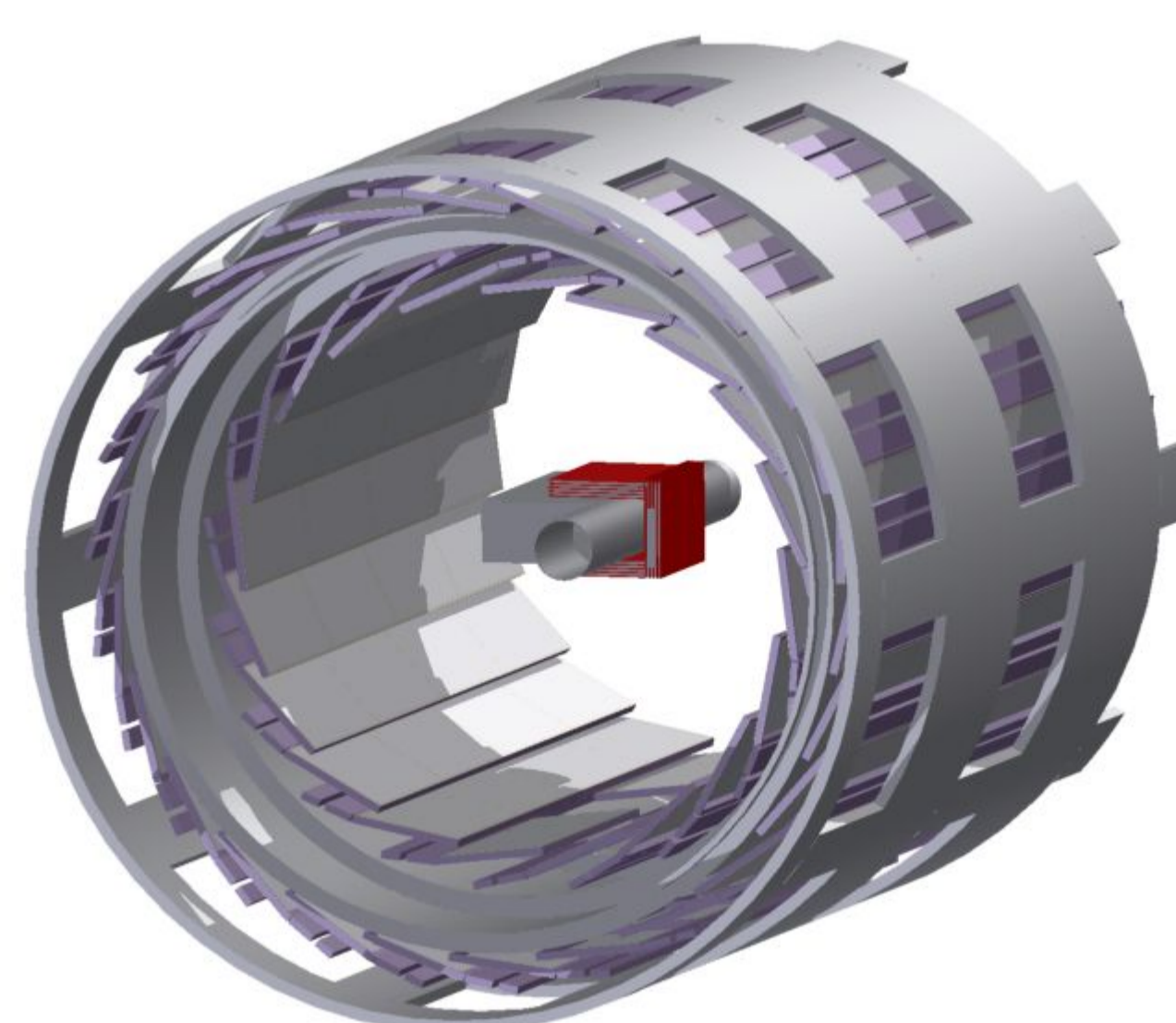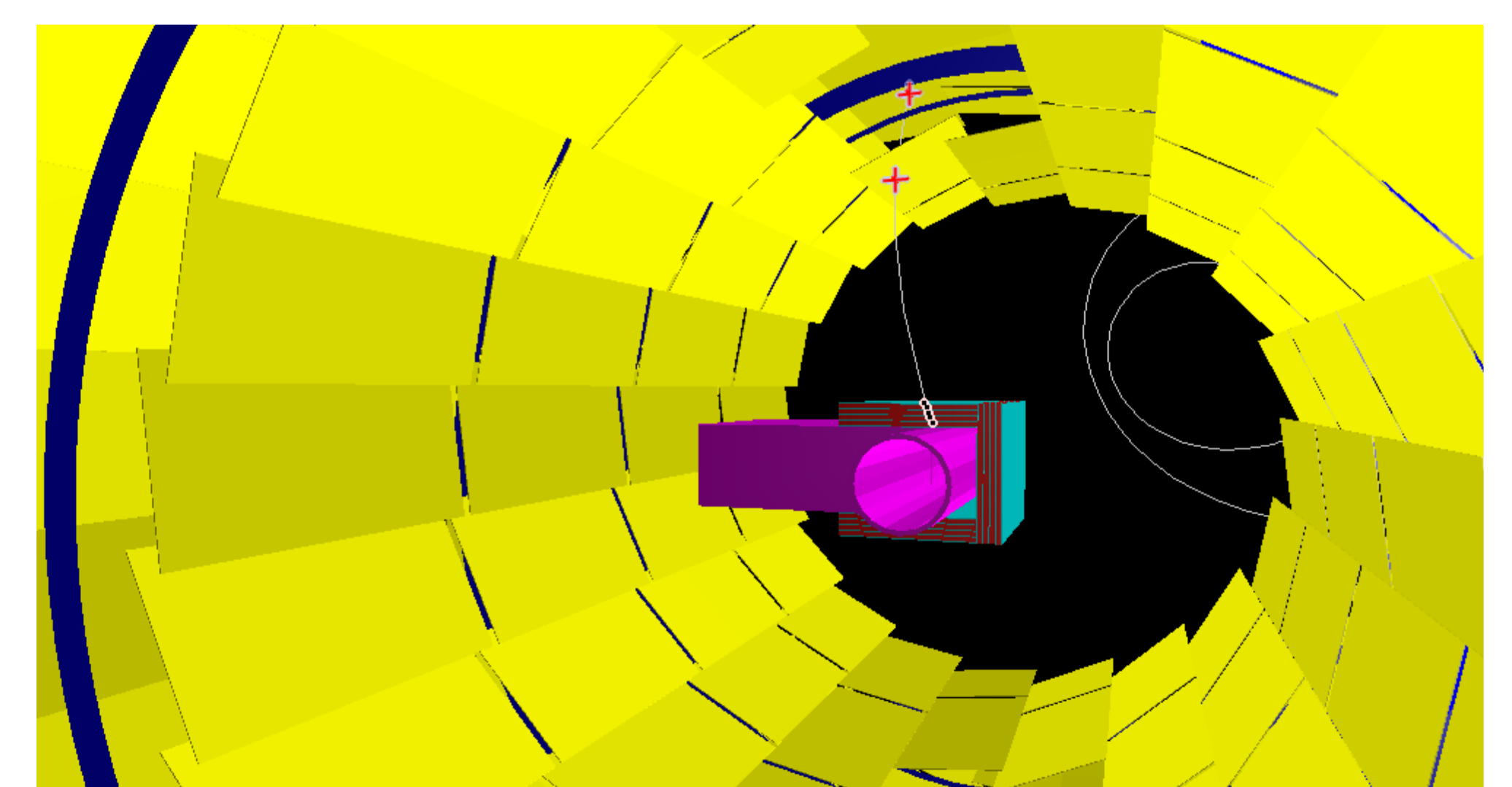Testboard for Al-polyimide cable performance (10 µm Al + 10 µm PI) → influences on the signal have to be checked

Secondary target with two additional layers of double sided silicon strip detectors for a better resolution of pion tracks

Simulated pion track (100 MeV/c initial momentum in a magnetic field of 1 T) crossing the sensors of the secondary target (black dots) and the two outer detector layers (red cross) → geometry has to be optimized for a momentum resolution ≤2%