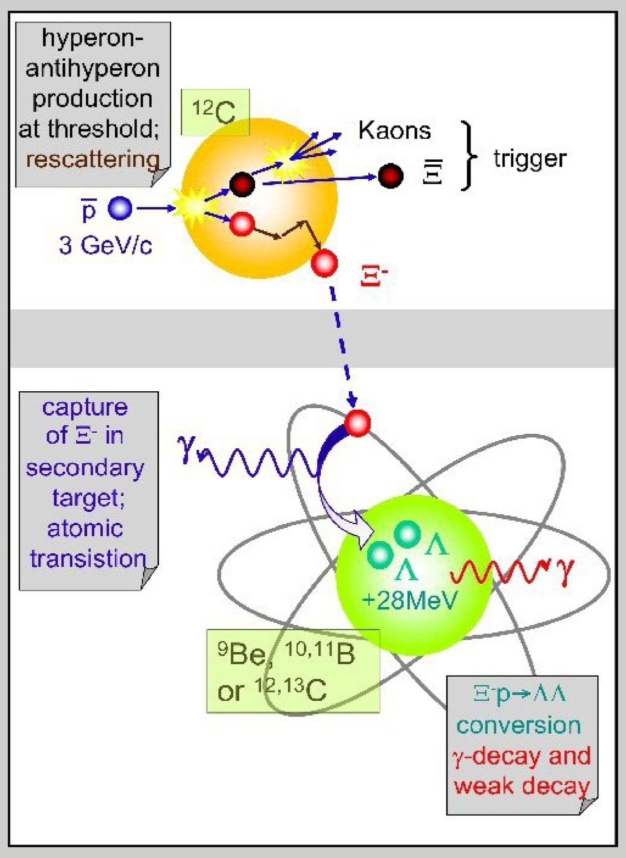
The secondary target for the hypernuclear experiment at $\bar{P}$ANDA *

S. Bleser[1], F. Iazzi[2], I. Kojouharov[3], J. Pochodzalla[1], A. Sanchez Lorente[1], M. Steinen[1]

[1]Mainz, [2]Turin, [3]GSI

Production and detection of double Λ hypernuclei at $\bar{P}$ANDA



Steps of the double hypernuclei production at the $\bar{P}$ANDA experiment

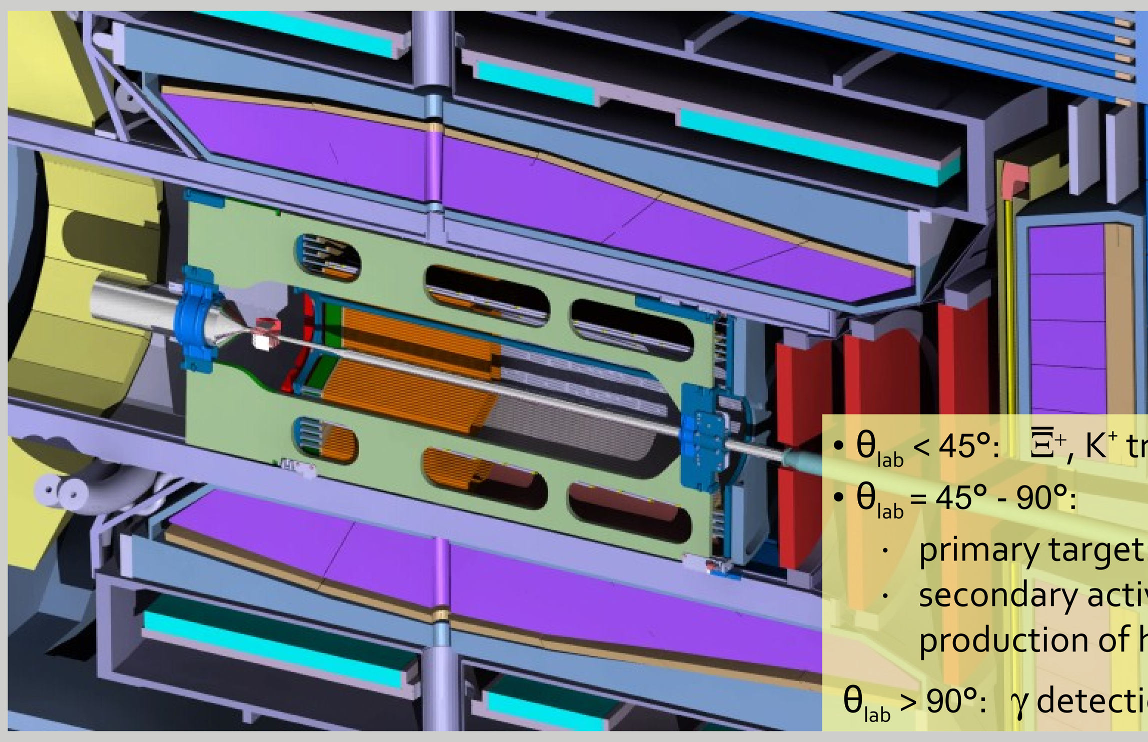
Primary carbon target

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

Secondary active sandwich target

- stopping of the Ξ^- hyperons
- atomic capture of Ξ^- within different absorber materials (^{9}Be, ^{10,11}B or ^{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

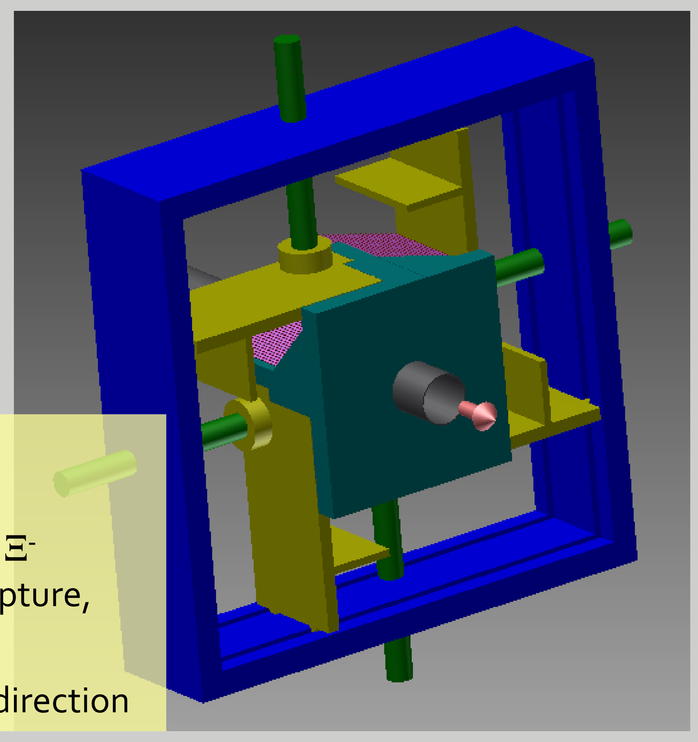
The hypernucler setup in the $\bar{P}$ANDA-detector



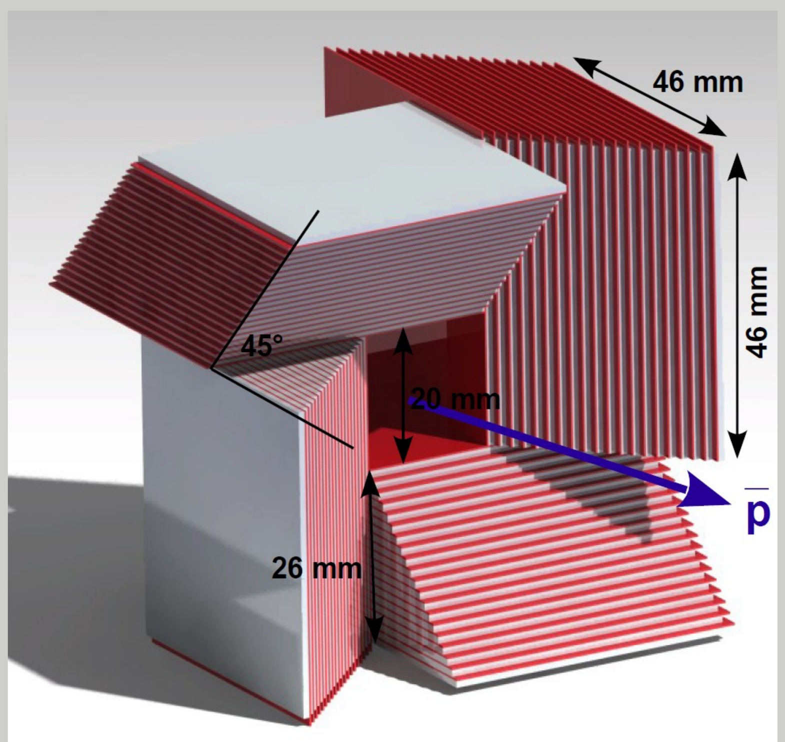
- θ_{lab} < 45°: Ξ^+, K^+ trigger ($\bar{P}$ANDA)
- θ_{lab} = 45° - 90°:
  - primary target: $\bar{p}$ + ^{12}C → Ξ^+ + Ξ^-
  - secondary active target: Ξ^- capture, production of hypernuclei

θ_{lab} > 90°: γ detection in backward direction

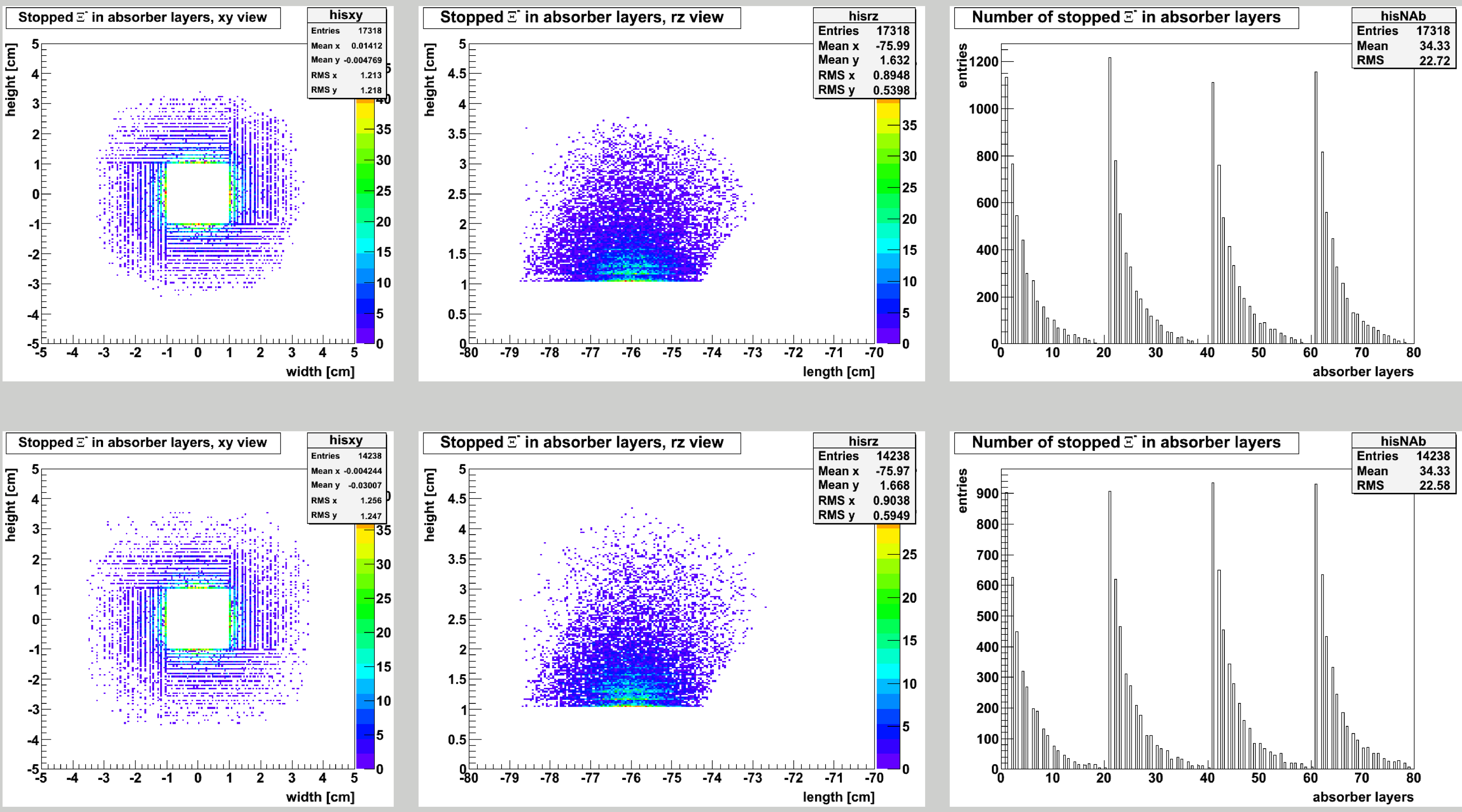
Holding frame for the secondary target



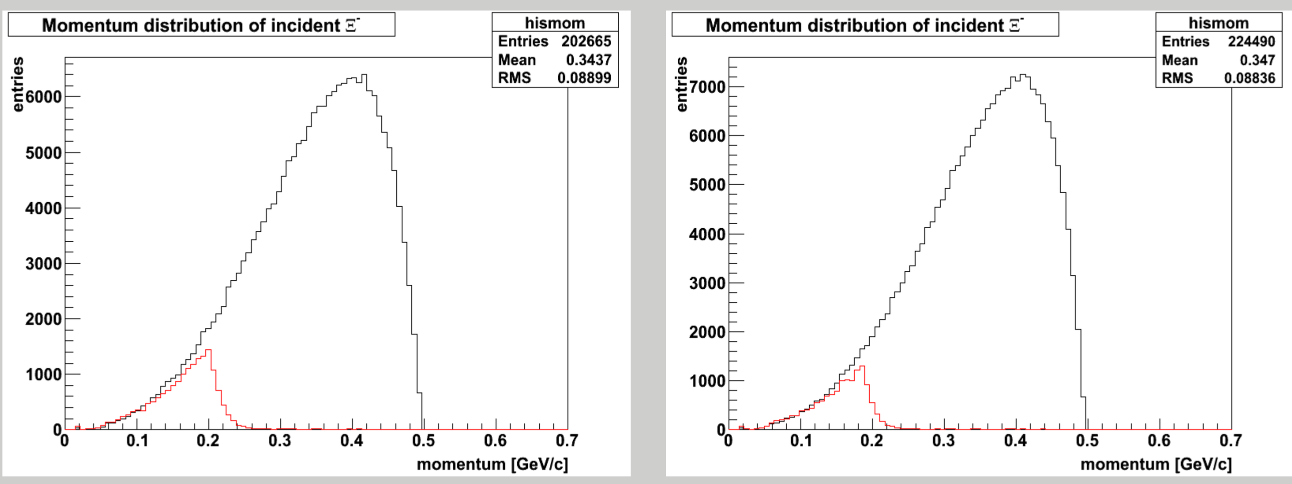
Design of the secondary target



To achieve the requirements the secondary target will be composed of alternating silicon microstrip detectors and light absorber material. Its dimension is determined by the lifetime of Ξ^- hyperons. Generated kaons in Ξ^+ annihilations in the primary target are emitted in an angular range between 0°-40° so this area is left open. The kaons will be detected in the standard $\bar{P}$ANDA-detector and used as signature for the reaction $\bar{p}\,p \rightarrow \Xi^+ + \Xi^-$.

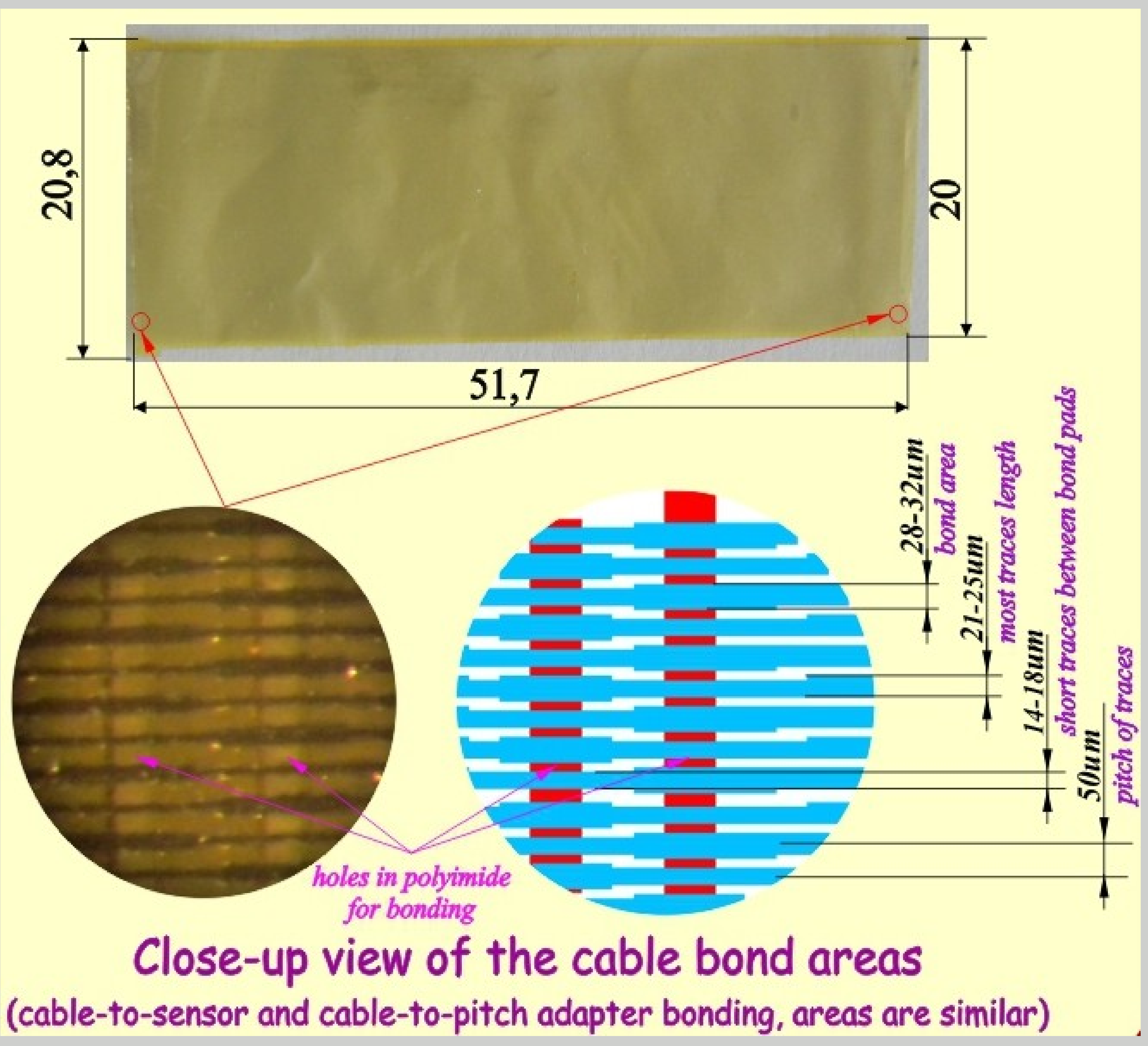


Momentum distributions of Ξ^- hyperons entering the active volume (black curves) and of the stopped Ξ^- in the absorber materials carbon and beryllium (red curves). Only Ξ^- hyperons with a momentum below 250 MeV/c in angles from 40° to 90° and in a radius of up to 20 mm will be stopped before decaying.



Stopped Ξ^- hyperons in twenty 1.0 mm thick carbon absorbers (at the top) and twenty 1.0 mm thick beryllium absorbers (below) from 200,000 Ξ^- hyperons generated isotropically with a momentum range of 0.1 GeV/c to 0.5 GeV/c.
According to the expectation the number of stopped Ξ^- hyperons differs for carbon and beryllium. So the absorber thickness of the layers has to be adjusted depending on the material.
As the three varied views show most of the Ξ^- will be stopped at the entrance of the passive volume. As a consequence the number of absorber layers can be reduced.

Hardware development



Close-up view of the cable bond areas
(cable-to-sensor and cable-to-pitch adapter bonding, areas are similar)

Flexible microcables

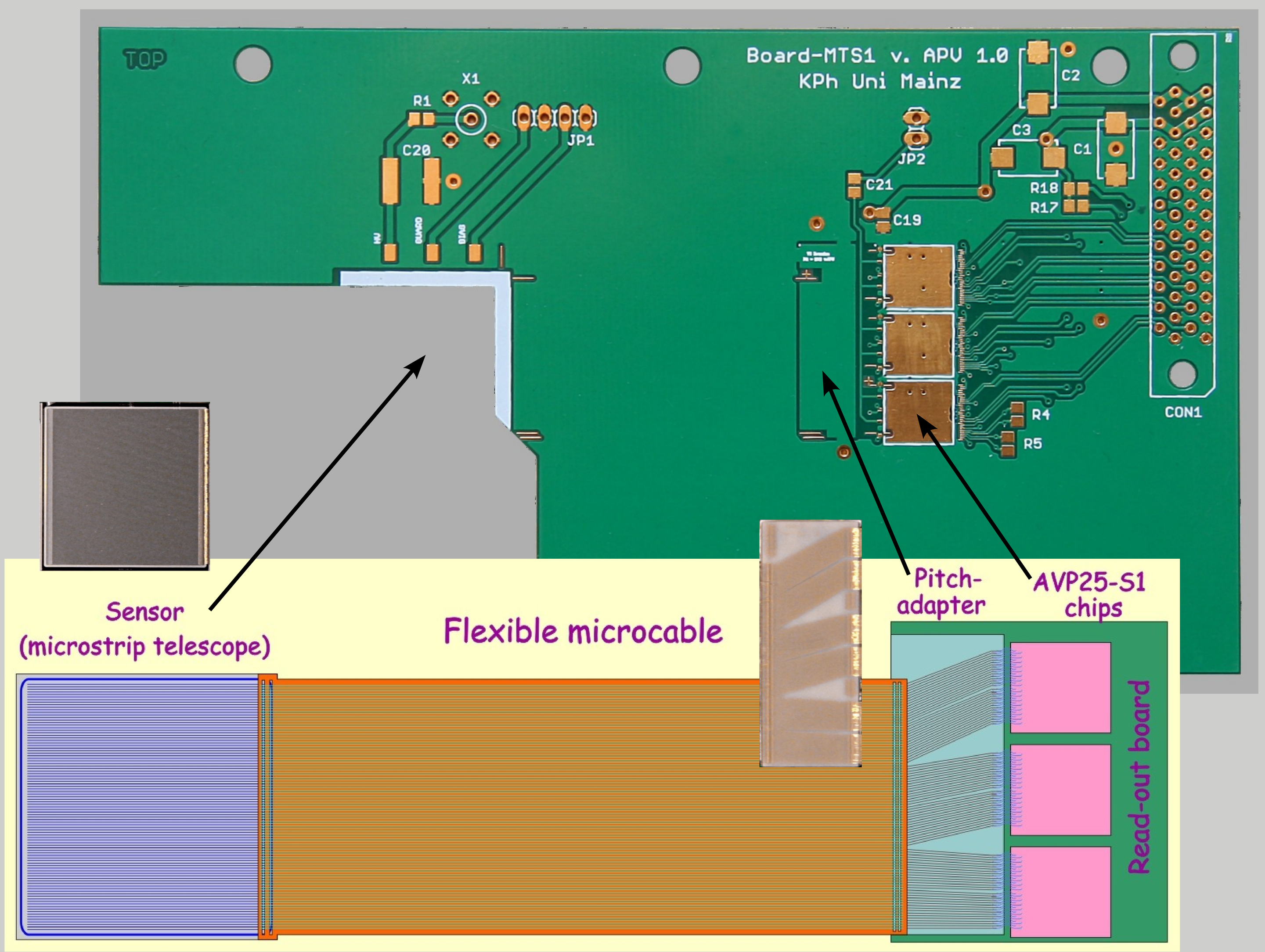
Development of ultra-thin flexible cables in cooperation with SE SRTIIE made of foiled dielectric FDI-A-20 (Al 10 µm, Pi 10 µm) to route the signals from the silicon strip sensors to the readout chips by assuring low material budget.

Readout board for cable testing

Mounting of the sensor-cable-pitch adapter assembly to test the cable performance. Readout by 3 APV25-S1 chips with 128 channels each.

Sensor-cable-pitch adapter assembly

Cable with 384 traces connected to silicon strip detector via tab-bonding on the left hand side and to a pitch adapter (50 µm to 44 µm) on the right hand side.
Mock-up in progress by SE SRTIIE.



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