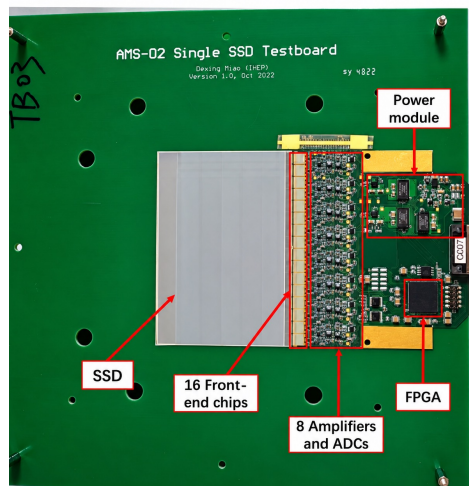
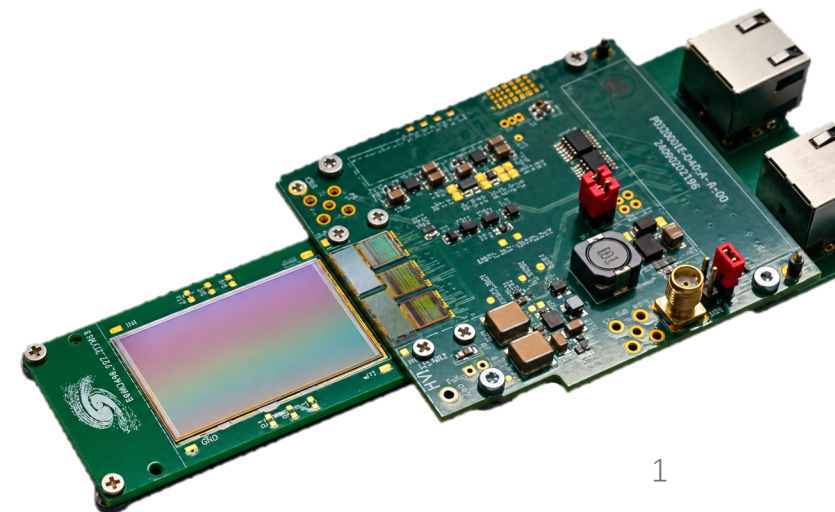


A lightweight low-cost silicon micro-strip system

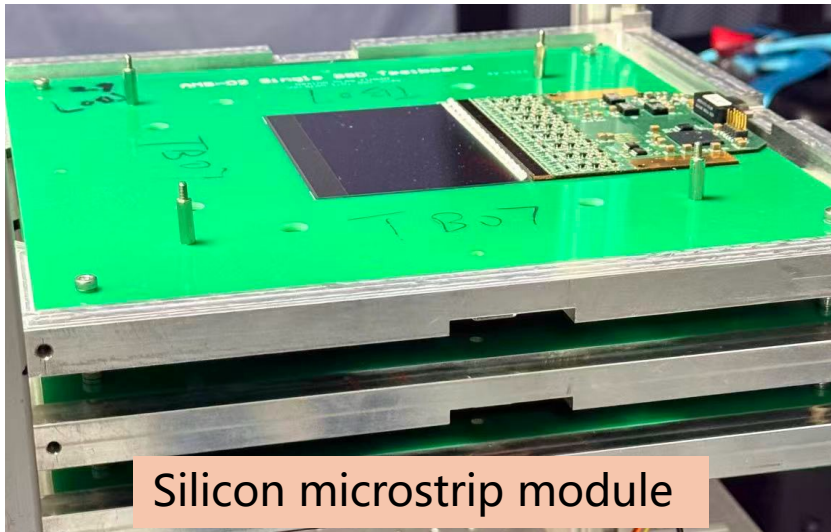
Kang Liu (刘康), Yiyang Pan (潘逸阳), Zijun Xu (徐子骏)

liuk94@ihep.ac.cn, IHEP

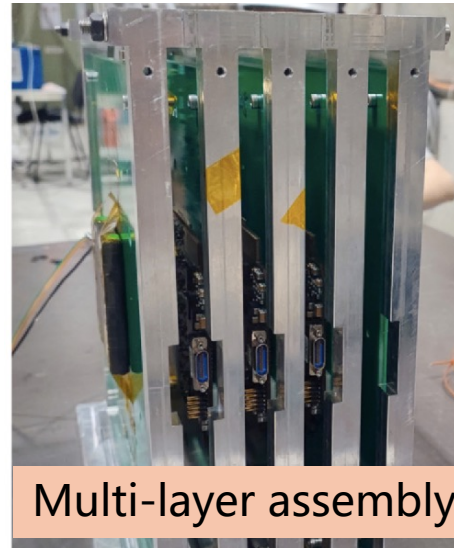
30 October 2026



- Beam tests are essential for detector R&D: efficiency, spatial & time resolution, uniformity...
- Silicon microstrip beam monitors offer:
 - **High-precision position measurements** $\sim 10 \mu m$
 - **Large-area coverage** $\sim 8 \times 11 cm^2$
 - **A low material budget** $\sim 320 \mu m$, reduce beam perturbations
 - **Nuclear charge identification** for heavy-ion beam tests



Silicon microstrip module

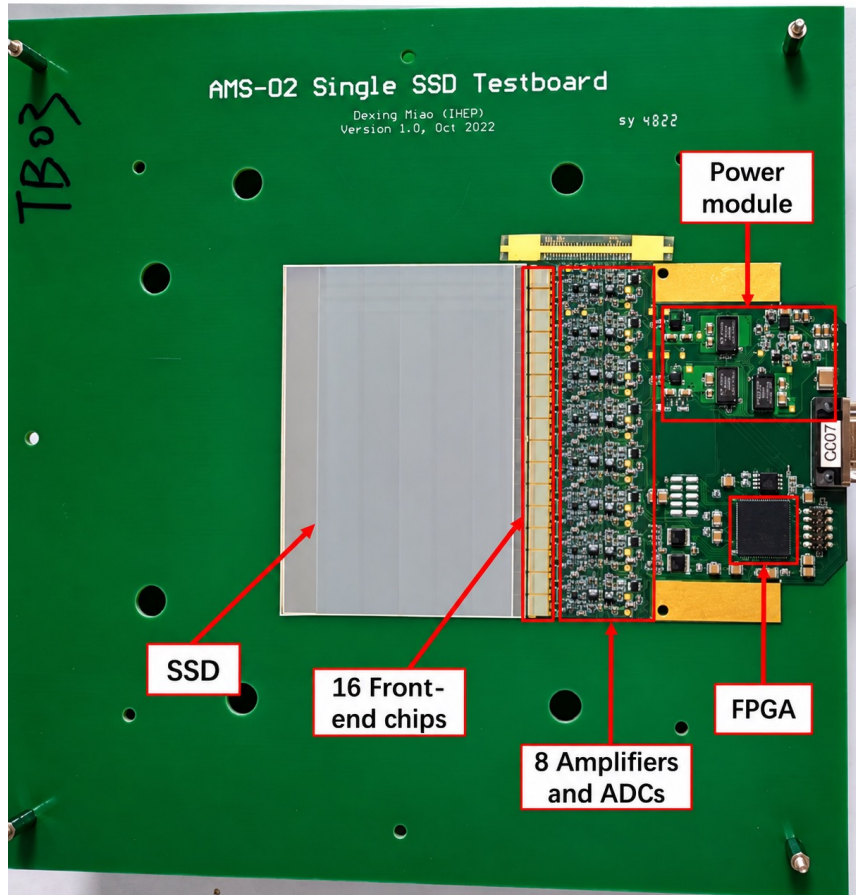


Multi-layer assembly

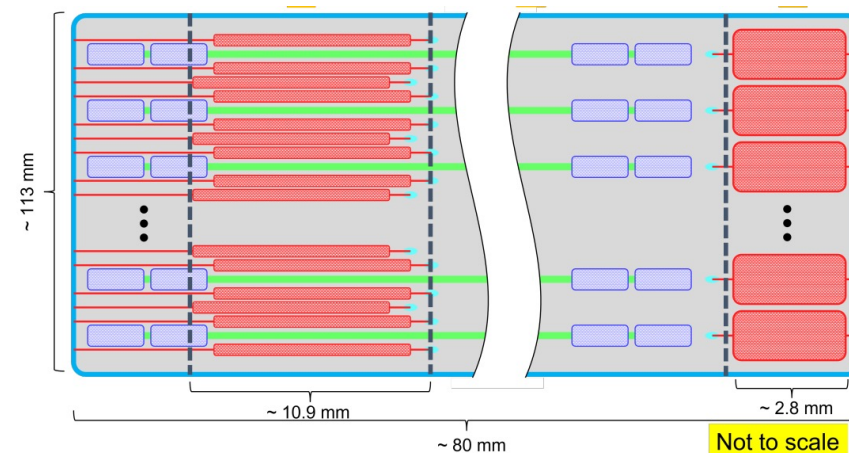


Light-tight enclosure

- Single-layer detector: SSD wire-bonded to a readout board equipped with IDE1140 front-end ASICs



- Active area: $11.3 \times 8 \text{ cm}^2$
- sensor thickness: $320 \mu\text{m}$
- Readout: 1024 AC-coupled channels
- readout pitch: $109 \mu\text{m}$
- Resolution: better than $10 \mu\text{m}$
- Triggered readout rate: $\sim 1 \text{ kHz}$

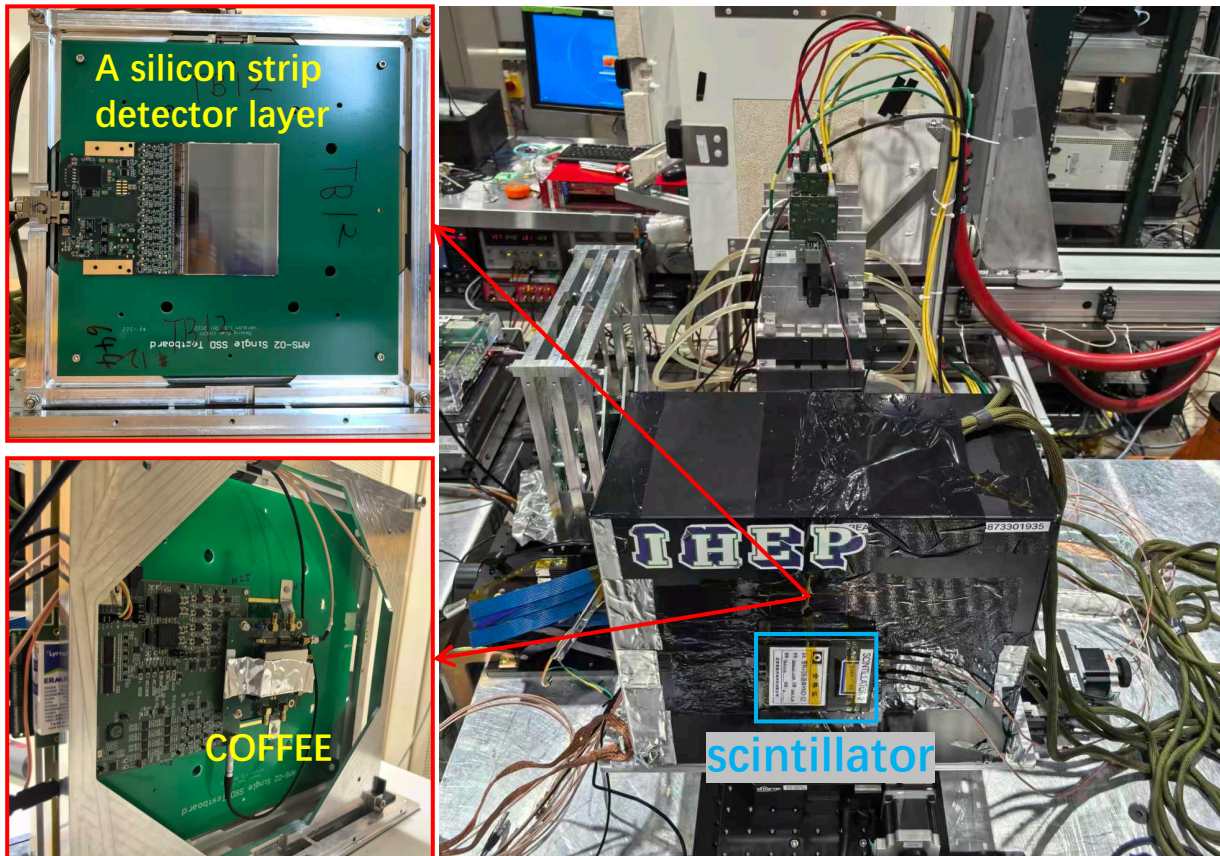
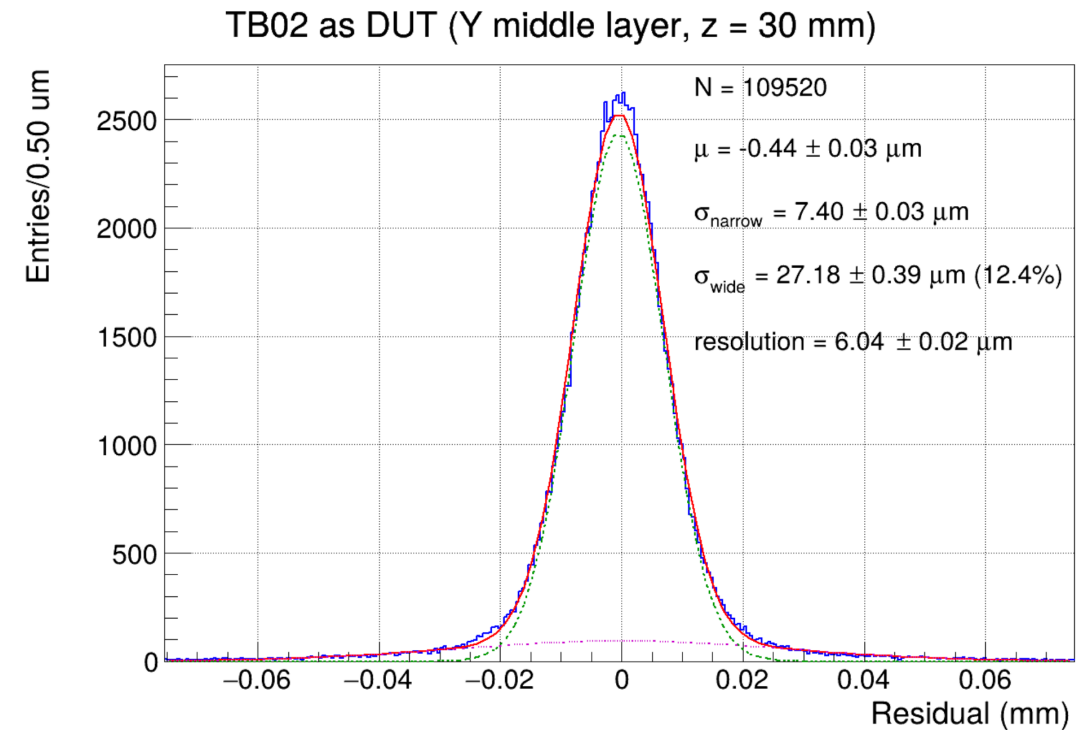


SSD
schematic
diagram

[D. Miao et al., NIM A 1092 \(2026\) 171778.](#)

Application to MAPS detectors development

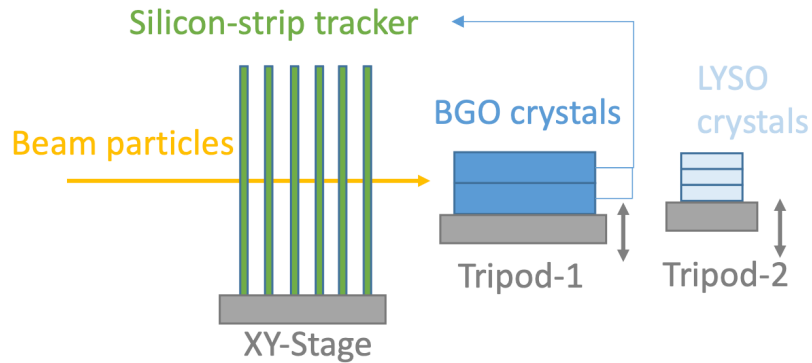
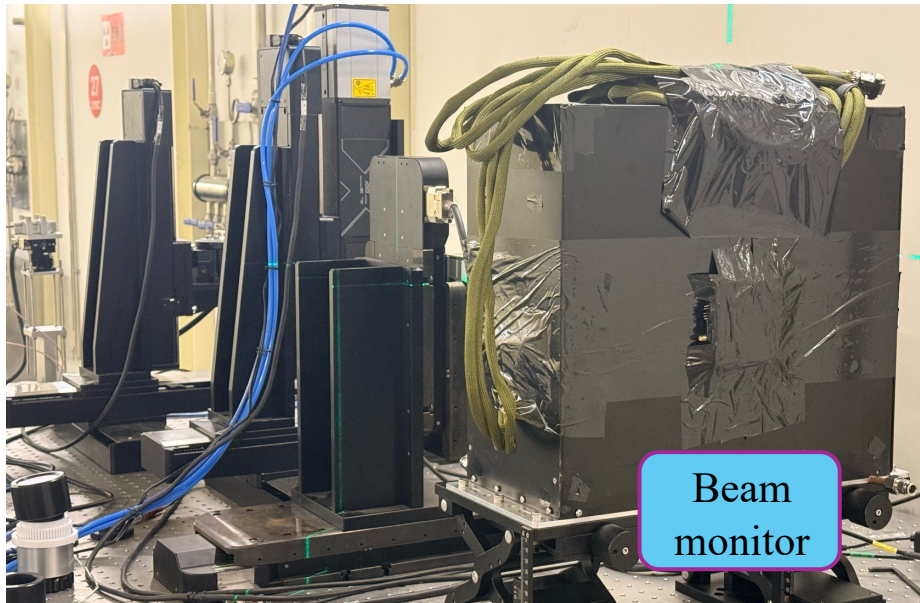
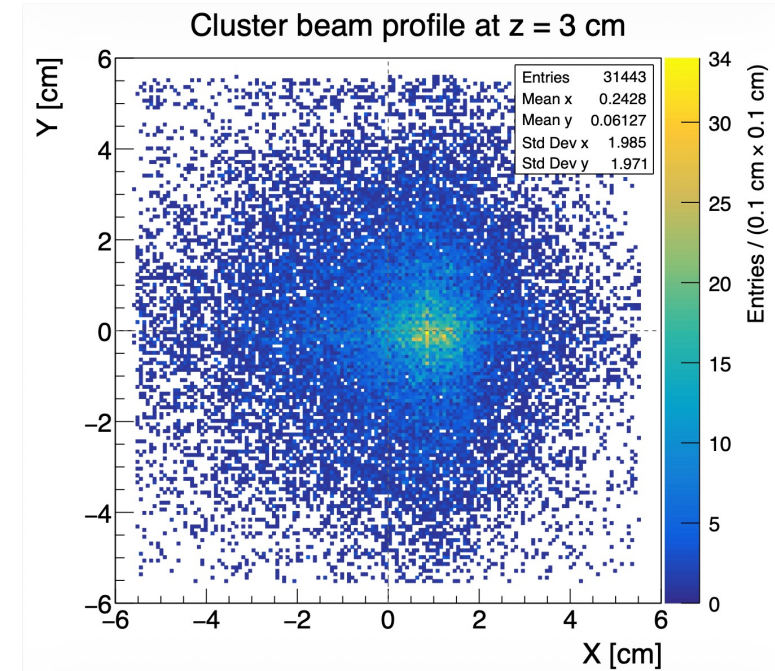
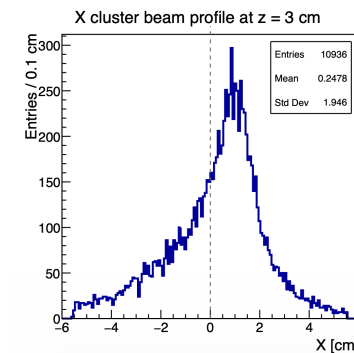
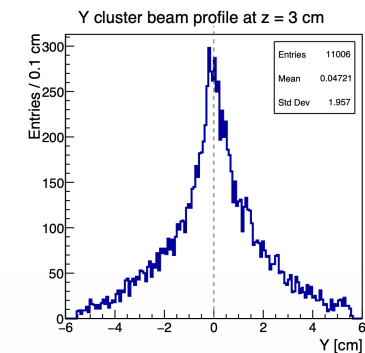
- COFFEE3 chip beam test at 13 May ~ 20 May 2026.
 - CERN SPS H6, 200 GeV hadron beam.
 - A 6-layer silicon strip detector beam monitor for tracking.



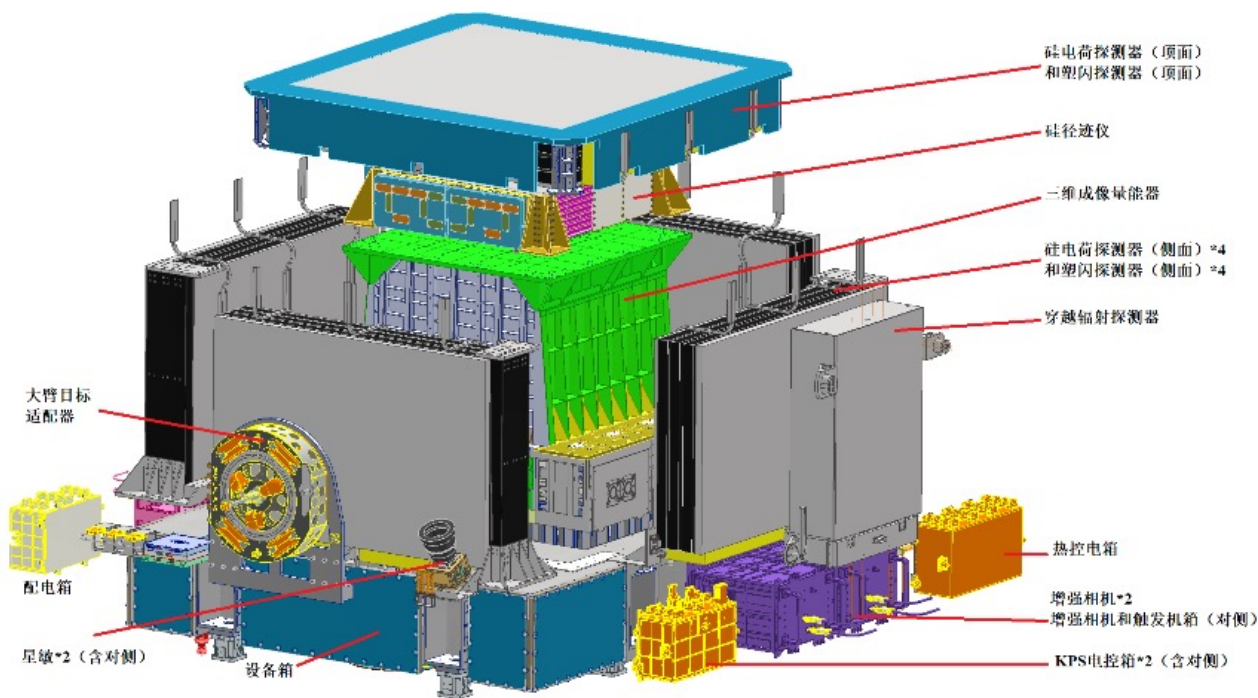
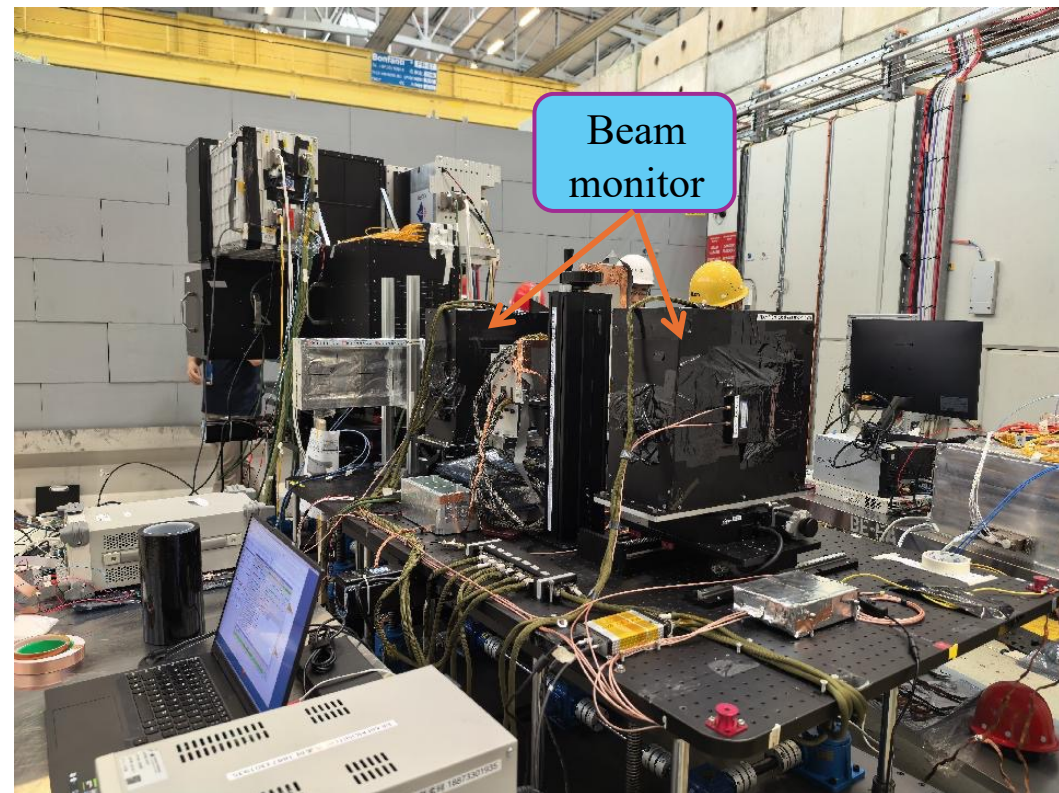
- Spatial resolution better than $8 \mu\text{m}$.

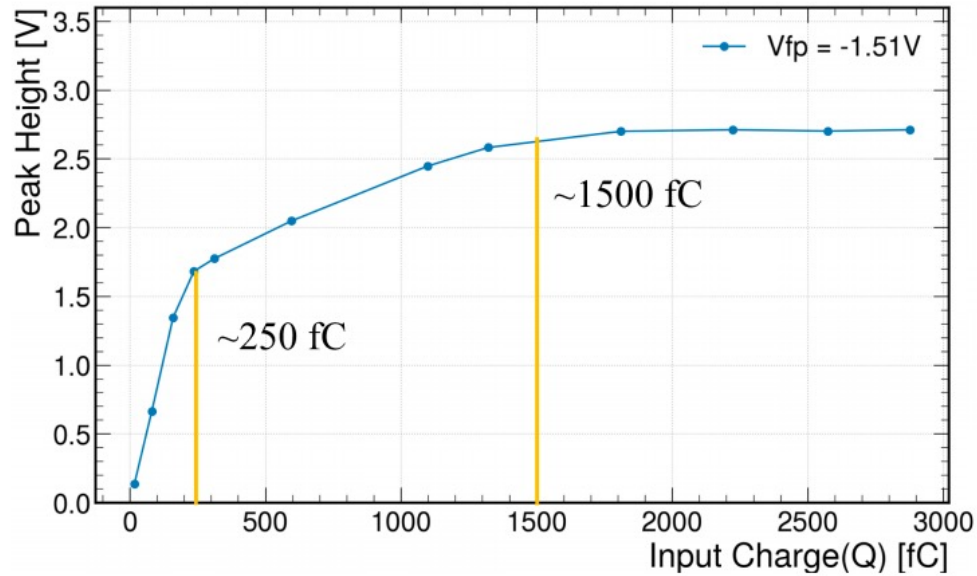
Beam-profile measurements at HEPS

- The 6 GeV electron beam in the HEPS storage ring could be used for beam tests.
- Beam profile measured using six layers of silicon microstrip detectors.



- Provide tracking information for High Energy cosmic-Radiation Detection (HERD) calorimeter, silicon detector, and scintillating fiber detector.
- Identify nuclear charge (Z) event by event in mixed ion beams.

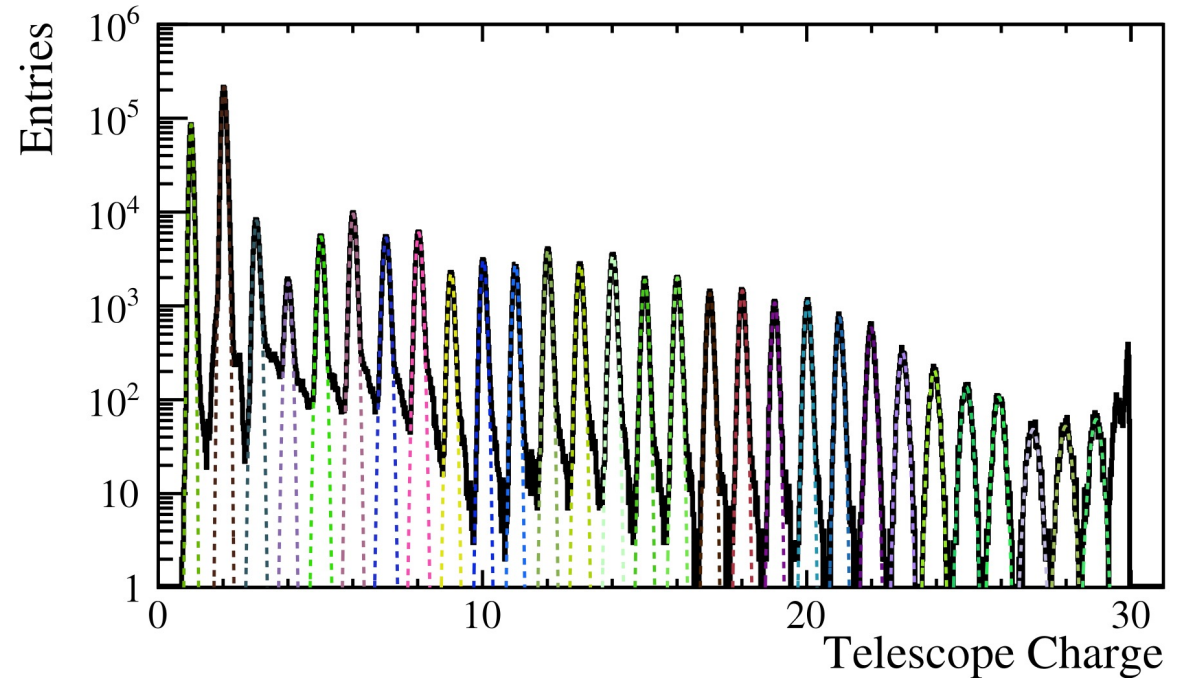




[D. Miao et al., NIM A 1092 \(2026\) 171778.](#)

➤ IDE1140 front-end ASIC: 64-channel analogue readout with three charge-response regions:

- Linear: $Q \leq 250 \text{ fC}$ $\sim Z \leq 8.$
- Sublinear: $250 \text{ fC} < Q \leq 1500 \text{ fC}$ $\sim 8 < Z \leq 19.$
- Saturation: $Q > 1500 \text{ fC}$ $\sim Z > 19.$

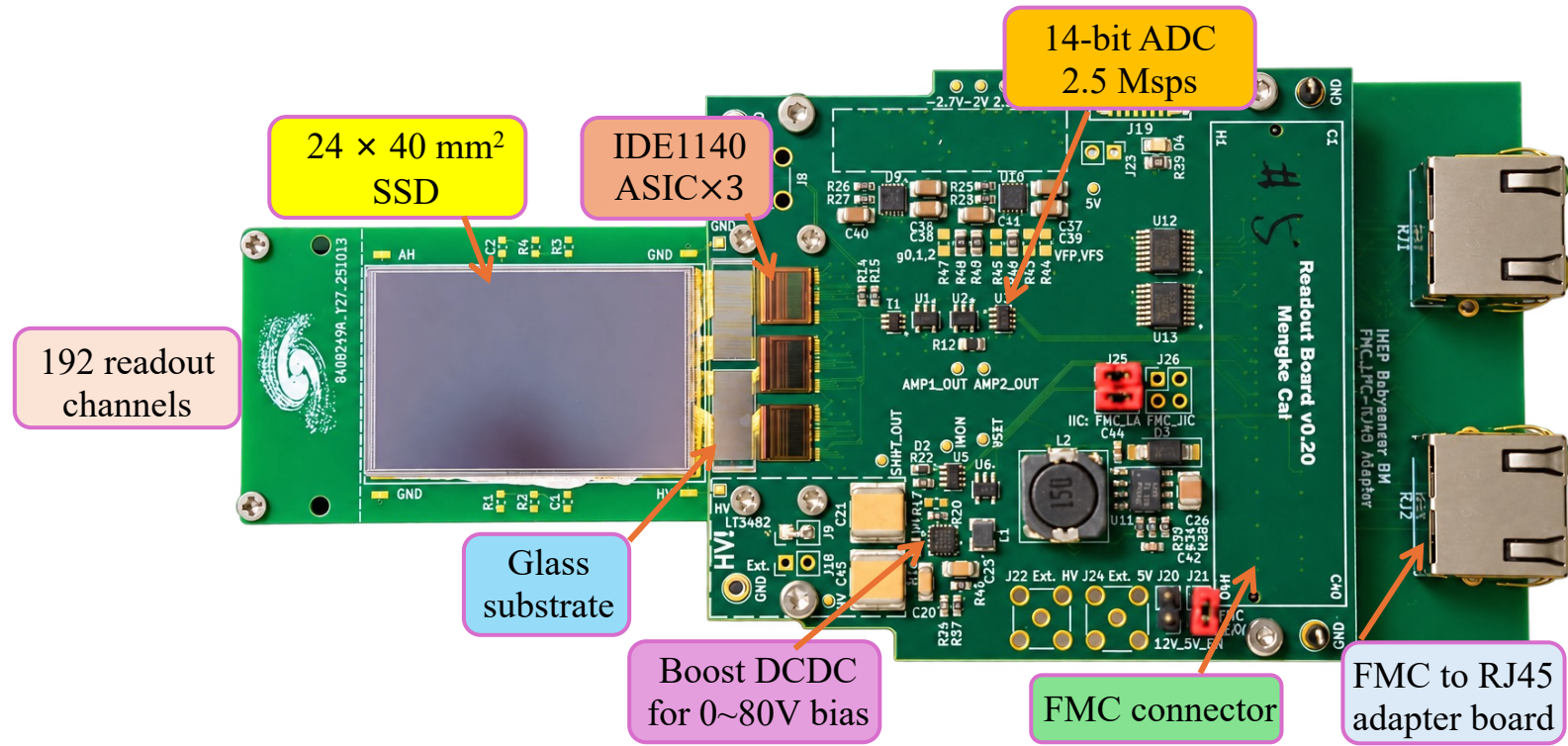


- Heavy-ion beam test at CERN SPS
- The maximum cluster value from each silicon microstrip layers is selected, and the square root of their mean is calculated
- Each peak corresponds to a different element

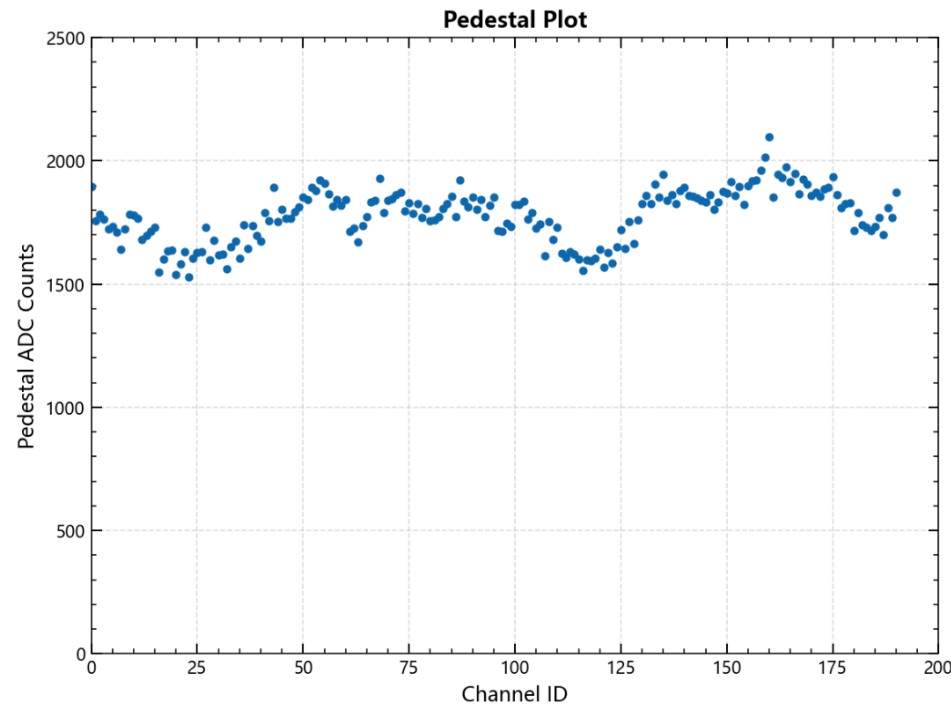
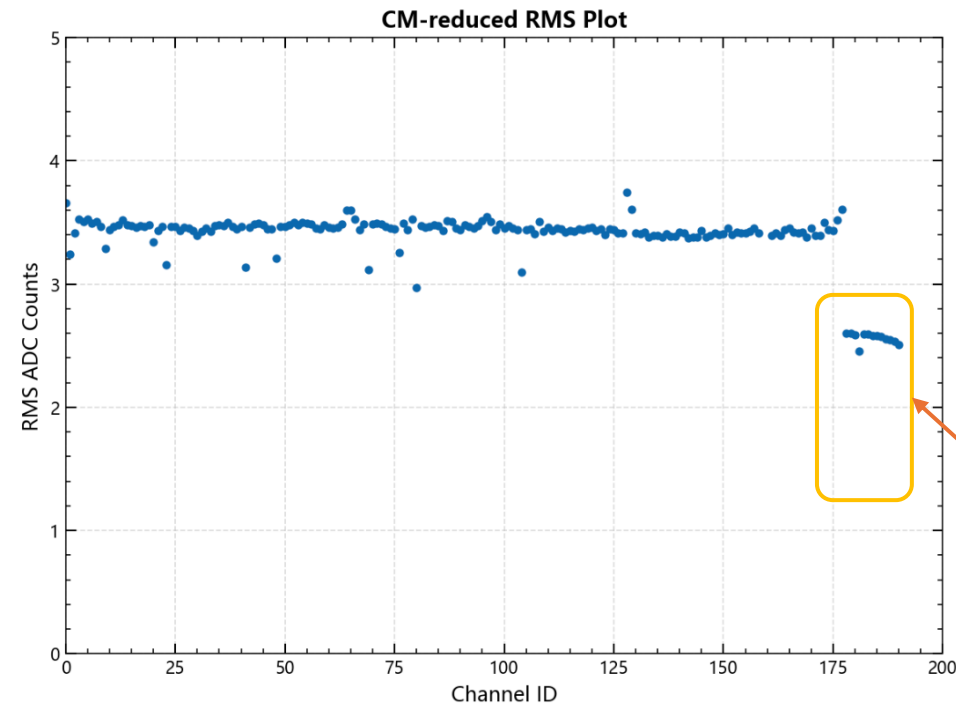
Mini silicon strip detectors development

➤ Compact and low-cost system for:

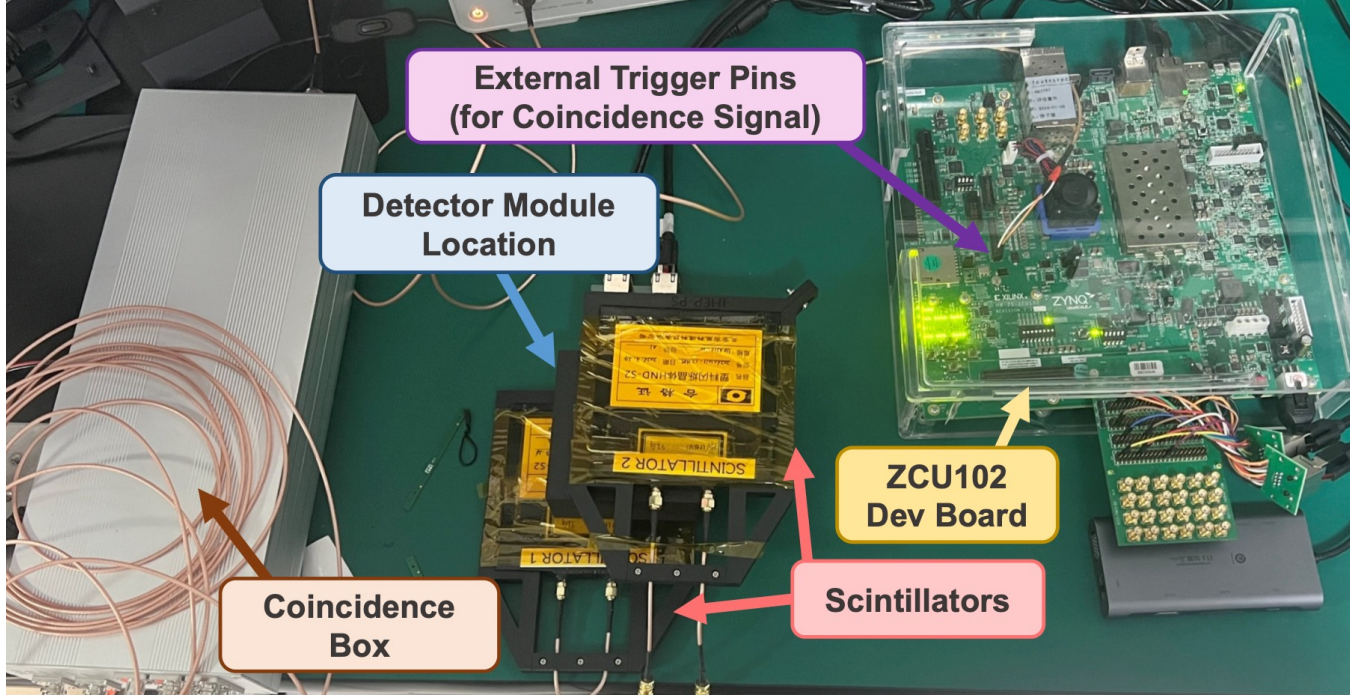
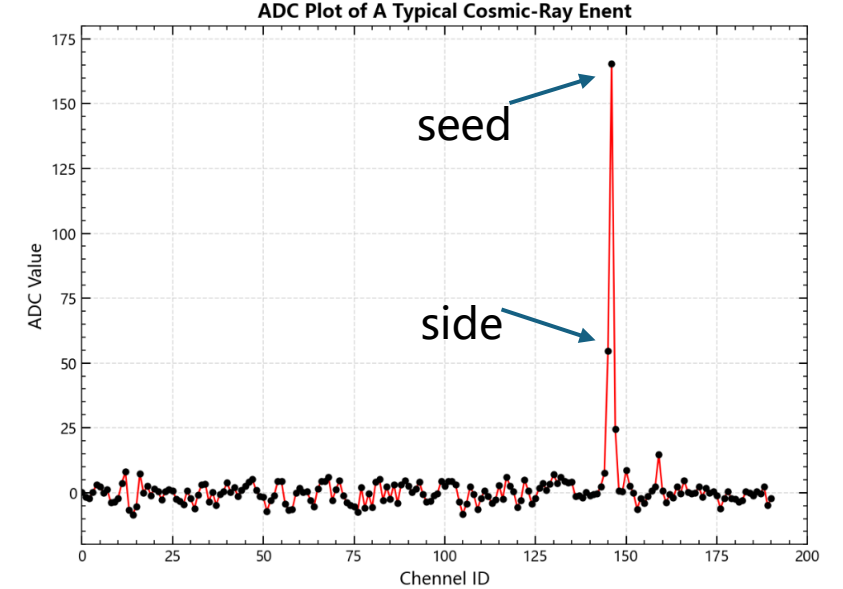
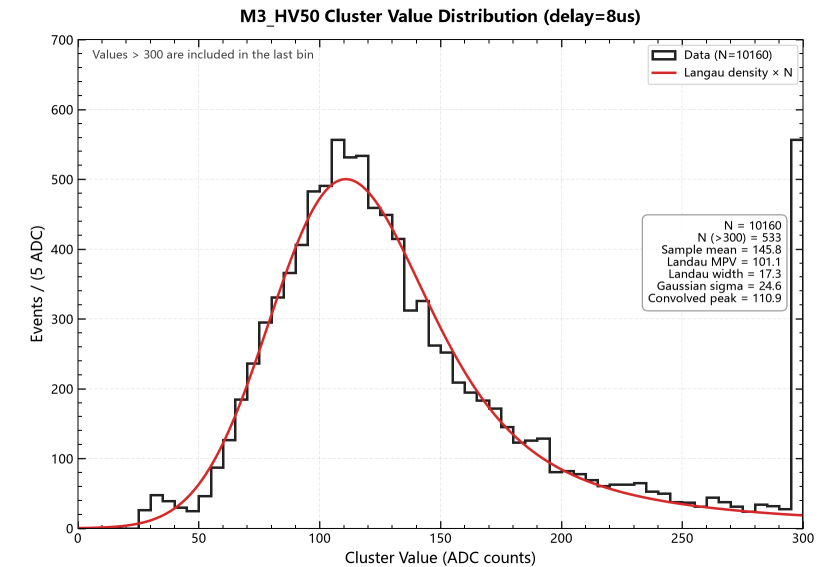
- Beam tests
- Cosmic-ray measurements
- Hands-on semiconductor detector education



- **Measurement conditions:** sensor biased at 50 V, with 20,000 events acquired in auto-trigger mode
- **RMS noise:** evaluated after common-mode correction
- **Common-mode reduction:** event-by-event baseline shifts estimated separately for each ASIC using a median-based method



- Setup: single module at 50 V
- Trigger: coincidence of two scintillators
- Clustering: 5σ seed and 3σ side thresholds
- Cosmic-ray results: peak around 100 ADC

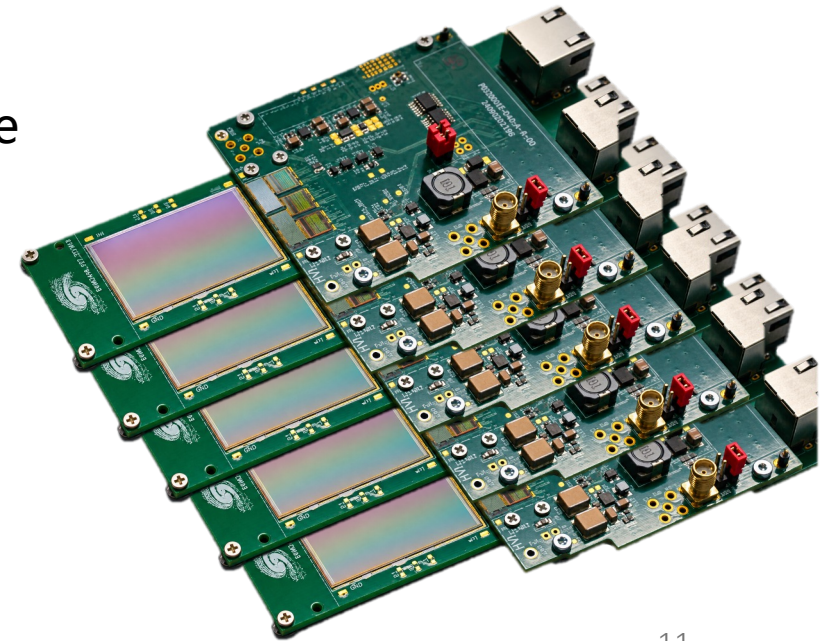


➤ Summary

- Silicon microstrip detectors offer high spatial resolution, low material budget, scalable coverage and nuclear charge identification, with established applications in beam tests
- A compact mini silicon microstrip detector has been developed

➤ Outlook

- Build multiple identical modules and integrate them into a detector system.
- Extend applications to beam tests, cosmic-ray detection, future tracking systems and hands-on detector education.
- Support R&D on Chinese-developed silicon strip readout ASICs and FPGA/SoC platforms.



Thanks!

- The raw ADC value comprises a channel **pedestal**, an event-dependent **common-mode** offset, **noise**, and **signal**:

$$ADC_i = Pedestal_i + CM_i + Noise_i + Signal_i$$

- **Pedestal**: the mean baseline ADC value of each channel, used for baseline subtraction.
- **Common-mode correction**: event-by-event baseline shifts estimated separately for each ASIC using a median-based method.
- **RMS noise**: the standard deviation of each channel's ADC values across pedestal events, evaluated after common-mode correction.
- After pedestal and common-mode noise subtraction, the corrected strip response retains the particle signal and residual noise.
- **Backup**