The Silicon Microstrip Tracker for the Mini.PAN experiment

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Mini.PAN Project TRACKER goals

- Validate a novel cosmic ray measurement instrument concept
- Develop a fine pitch silicon strip detector for the advanced option of the Strip X Detector
- Design and produce large pitch Strip Y detector
- Design and produce low noise and low power ASIC chips for Strip X detectors
- Develop ASIC chips for Strip Y detectors, with large dynamic range, multi-range readout, trigger output and good time resolution
- Design, produce and space qualify tracker modules

Mini.PAN Silicon TRACKER

- Three Tracker Modules. Each module made of:
  - Two Strip-X detectors with 25µm readout pitch, providing a 2µm spatial resolution, read-out by 32 IDEAS VA1140 → 2048 readout channels
  - One Strip-Y detector with 400µm readout pitch, providing 115µm spatial resolution read-out by one high dynamic range VATA GT7.2 chip → 128 readout channels
- Thin silicon strip sensor: 150µm
- Pitch adapter to fan-out to bonding pads directly implemented on the silicon wafer with double metal layer
- Low noise ASIC and analog readout
- Robust module design and assembly
- Thermal/mechanical system that ensures stability during operation
- Tracker power consumption 8W

PAN Silicon sensors characteristics

- Device type: High-speed AC-readout / double metal
- Silicon type: n-type, Phosphor-doped
- Crystal orientation: <100>
- Strip thickness: 115±5 µm
- Front and back side metal: Al
- Full depletion voltage: Max. 50 V

Strip X properties:

- X sensor overall size: 5900x20 µm × 5900x20 µm
- Active area: 51200 µm × 51200 µm
- Number of Strips: 2048
- Strip pitch: 25 µm
- Strip width: 13 µm
- Readout AL width: 10 µm
- Readout PAD pitch: 96 µm

Strip Y properties:

- Y sensor overall size: 5900x20 µm × 5900x20 µm
- Active area: Circular with D=15200 µm
- Number of Strips: 128
- Strip pitch: 400 µm
- Strip width: 380 µm
- Readout AL width: 15 µm
- Readout PAD pitch: 91.2(2)lines/µm

Space Qualification –Mechanical Tests

A Mechanical Tracker Module was built for space qualification with dummy X and Y sensors, respectively

The setup @ CERN, T9 beam line
- Particles: π
- Momentum: 10 GeV/c
- Six Strip-X detectors

Preliminary results of the momentum resolution for 10 GeV/c π⁻:
The tracks displacement due to bending is of the order of a few channels on the last station

Reference:
M. Duranti, Development of a Penetrating particle ANalyzer for high-energy radiation measurements in deep space and interplanetary missions, This Conference

Acknowledgements: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862044.

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