The Efficiency of the Microstrip Silicon Detector in the FOOT experiment

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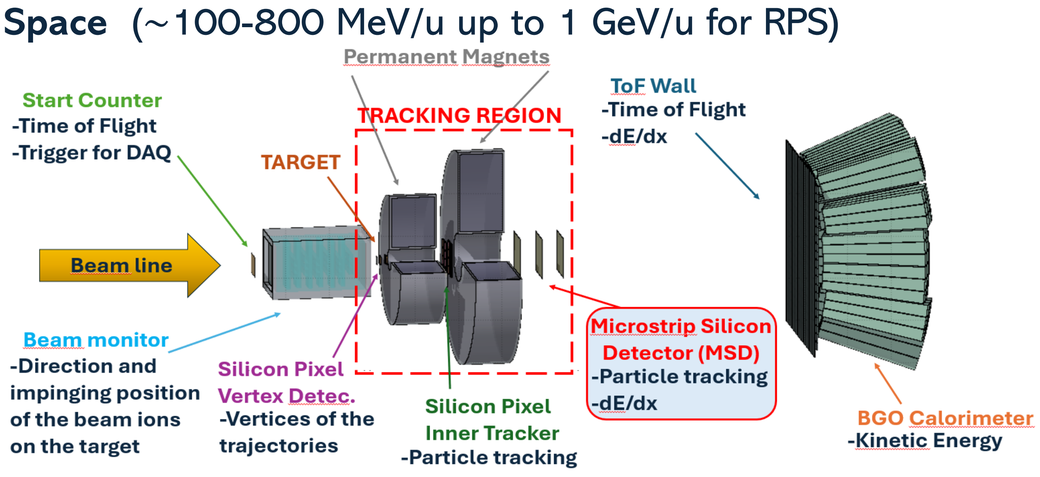
I. The FragmentatiOn Of Target (FOOT) experiment [1]

- **AIM:** measuring **elemental double differential fragmentation cross sections** w.r.t. emitted kinetic energy of the fragment and emission angle: $\sigma(d^2\sigma/(dE_{kin}d\Omega)) \geq 5\%$
- **APPLICATIONS: Hadrontherapy** and **Radioprotection in Space** (~100-800 MeV/u up to 1 GeV/u for RPS)



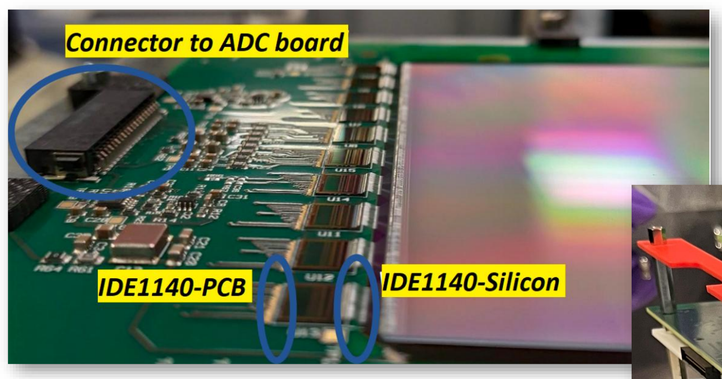
- **SETUPS:**

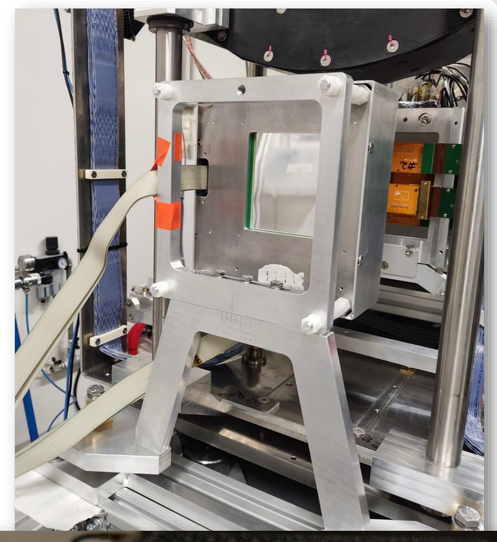
-Emulsion Spectrometer: ≥ 70° angular acceptance around the beam axis to detect Z ≤ 3 fragments

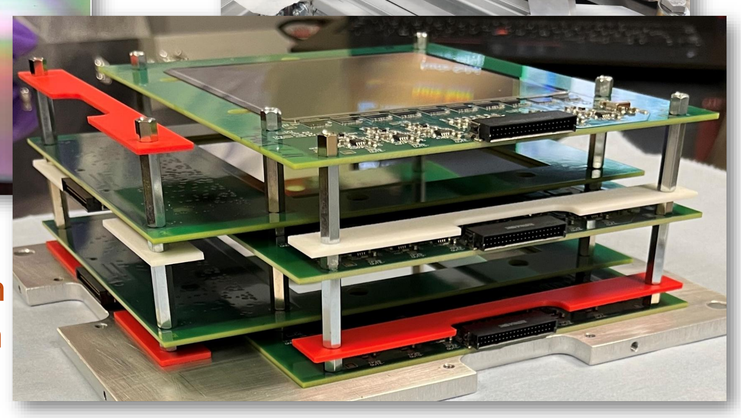
-Magnetic Spectrometer (in figure): 10° angular acceptance to detect Z ≥ 2 fragments

II. The Microstrip Silicon Detector (MSD)

- **3 planes**
- **2 single-sides sensors per plane (X-Y views)**
- Each sensor: ~ **10 x 10 cm², 150 µm thickness**
- 1920 strips per sensor (**50 µm implant pitch**)
- **640 read strips per sensor**
  (1 readout strip - 2 floating strips)
- **Each sensor read by 10 chips** (IDE1140 ASIC)





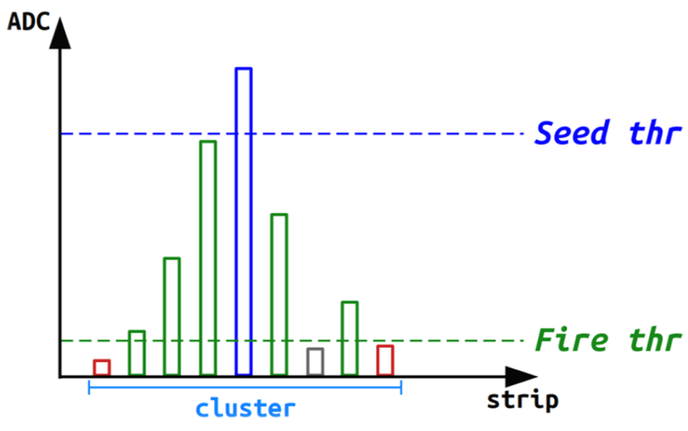


- Intrinsic spatial resolution:
  - for single-strip cluster ~ 43 μm
  - for multi-strip cluster ~ 14 μm
- Charge sharing

III. MSD Clustering

Double thresholds algorithm:
- **Seed Thr to identify a cluster**
- **Fired Thr to determine the cluster size**

*** Thresholds setting can be performed via tracking or with a stand alone method [2].**

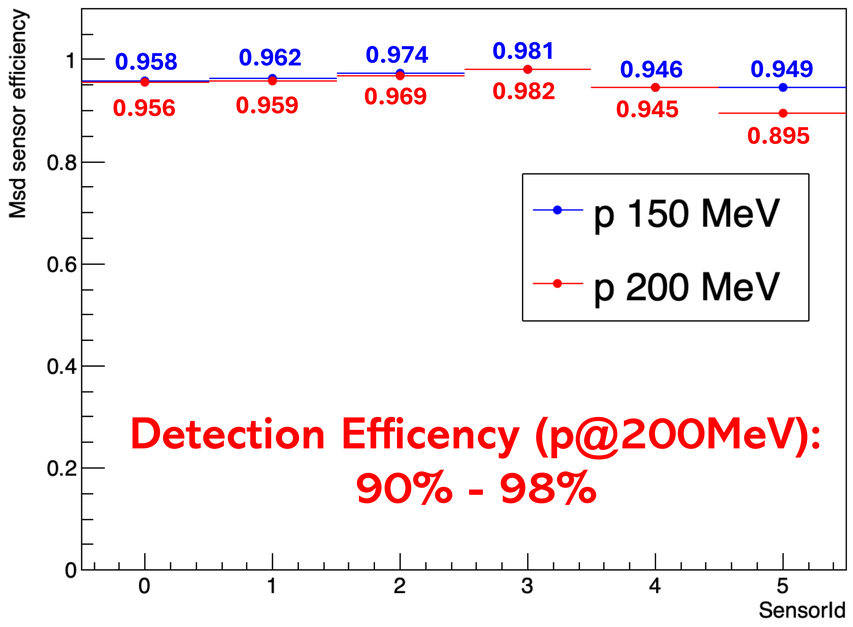


IV. MSD Sensor Efficiency

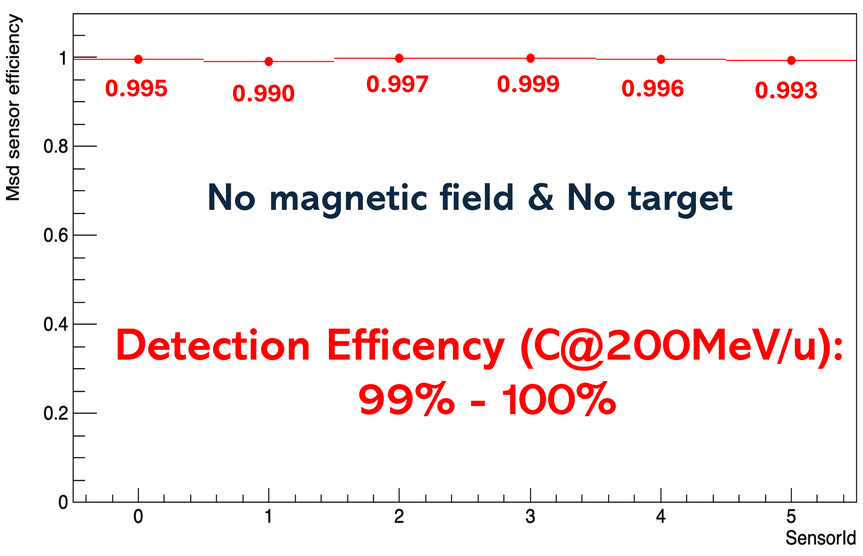
Computed via global tracking of the FOOT experiment.

- **Seed Threshold = 3.5**
- **Fired Threshold = 1.5**

→ Protons @ 100MeV and 200MeV



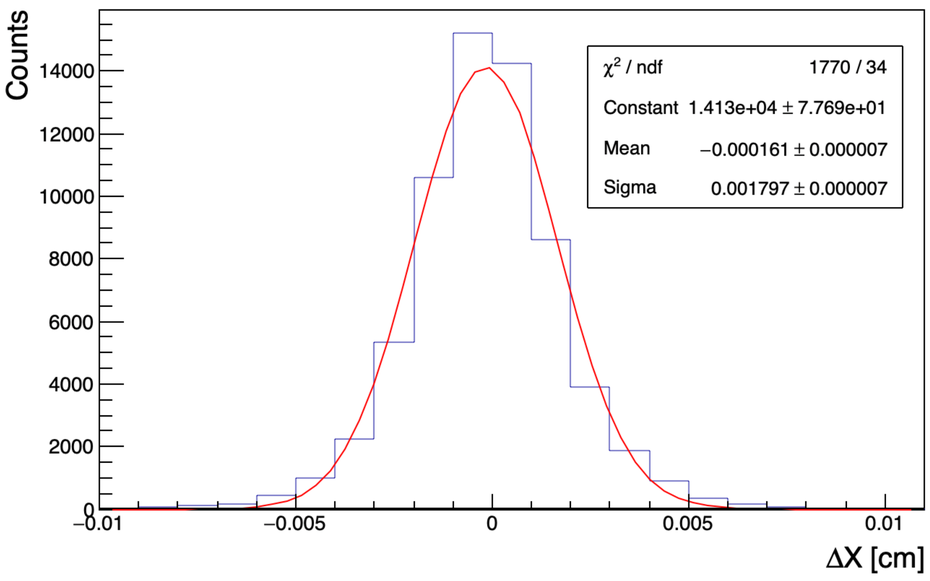
→ Carbon ions @ 200MeV/u



V. MSD Spatial Resolution

Computed via global tracking of the FOOT experiment.

MSD Sensor 2



Spatial Resolution ~ 18 μm

FOOT data-taking campaigns

- **GSI 2021** (Darmastd, DE)
- **HIT 2022** (Heidelberg, DE)
- **CNAO 2022, 2023, 2024, 2025** (Pavia, IT)

References:

[1] G. Battistoni, M. Toppi, V. Patera, The FOOT Collaboration, *Measuring the Impact of Nuclear Interaction in Particle Therapy and in Radio Protection in Space: the FOOT Experiment*, Frontiers in Physics, vol. 8, 2021. doi: 10.3389/fphy.2020.568242.

[2] S. Mazzolani, I. Mattei, L. Servoli, The FOOT Collaboration, New method for clustering thresholds determination in Microstrip Silicon Detector, Journal of Instrumentation, vol. 21, 2026. doi: 10.1088/1748-0221/21/04/C04048.