Study of MAPS prototypes for the ALICE ITS3 upgrade

Riccardo Ricci (University and INFN, Bologna and Salerno)

On behalf of the ALICE Collaboration

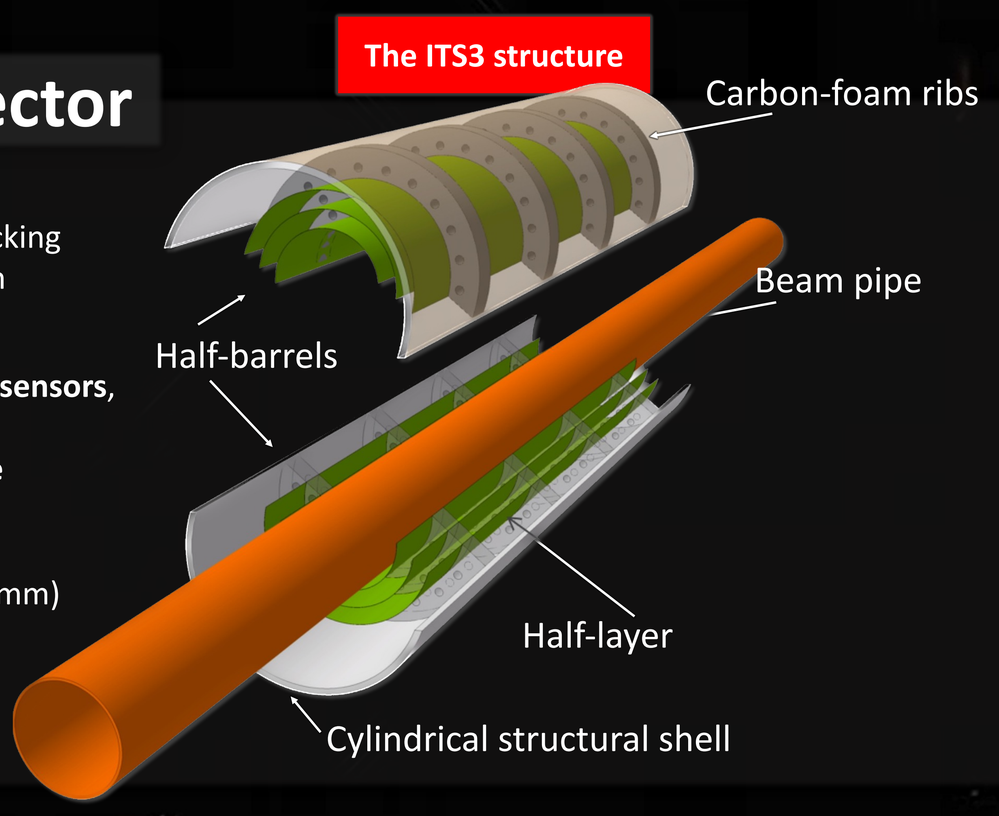
UNIVERSITÀ DEGLI STUDI DI SALERNO

UNIVERSITÀ DI BOLOGNA

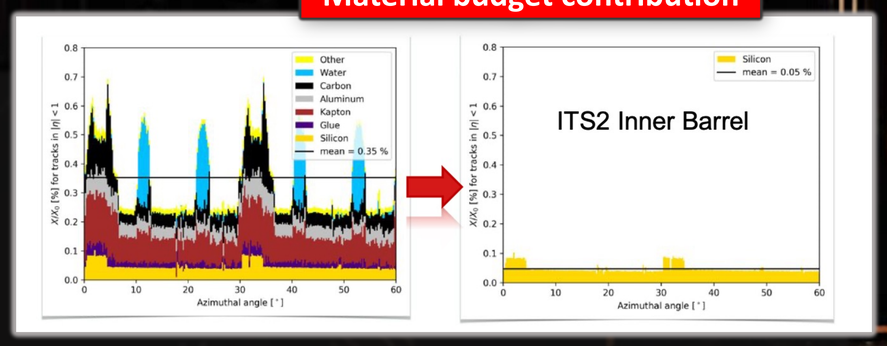
A bent vertex detector

- Replacing 3 innermost ALICE Inner Tracking System 2 (ITS2) with 6 sensors of ~26 cm lengths
- Built using **300 mm wafer-scale MAPS sensors**, fabricated using stitching
- **Thinned ≤ 50 µm when Si is flexible be**
- **Bent** to the target radii (18 mm,
  → **closer** to the interaction point thanks to the new beampipe at 16 mm)
- Mechanically held in place thanks to carbon foam ribs

The ITS3 structure

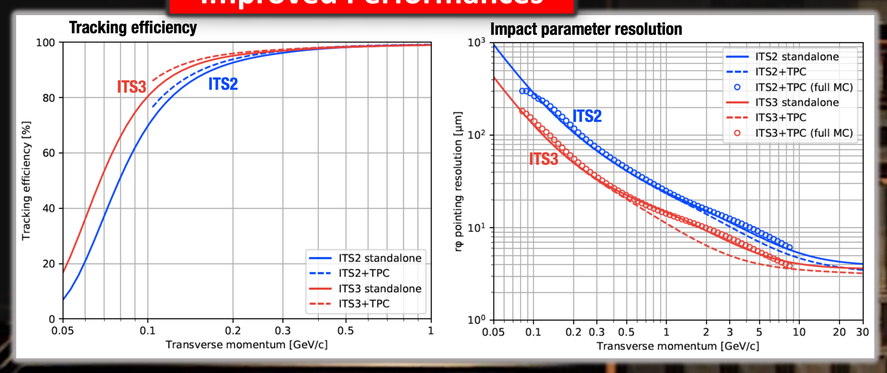


Material budget contribution



- Extremely **low material budget**: 0.02-0.04% X0

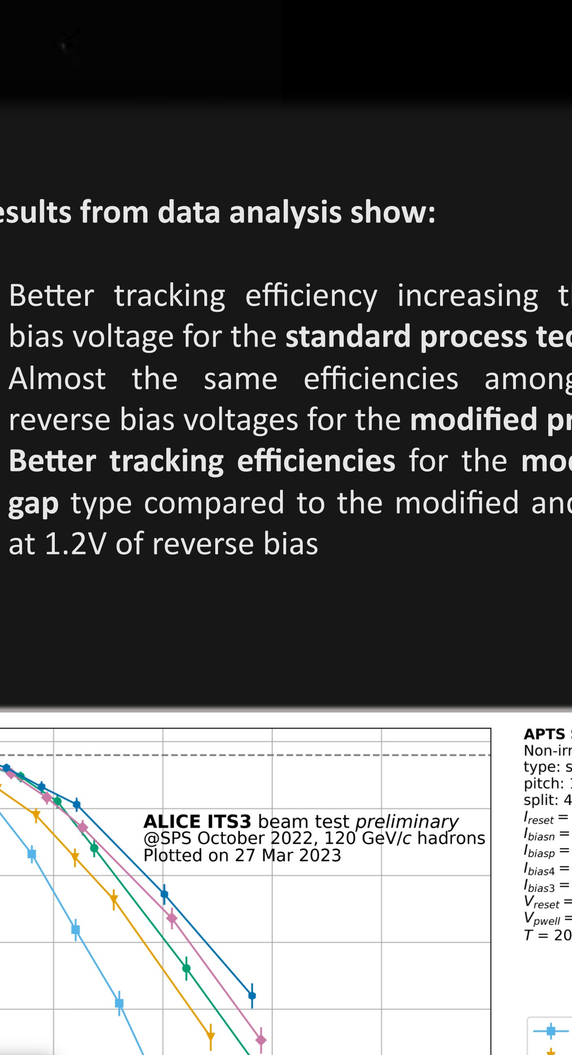
Improved Performances



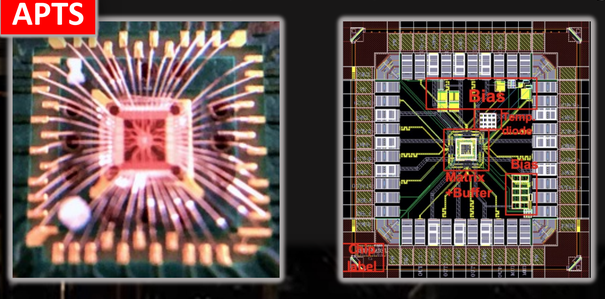
New MAPS sensor prototypes

- APTS (Analog Pixel Test Structure)
- Based on **MAPS** and **65 nm CMOS** technology
- **4x4 pixels** matrix, **16 analog outputs**
- 50 µm thick
- Can operate at different back bias voltages (from 0 to -4.8 V)
- Different chip variants for characterization purposes:
  - 3 sensor flavors depending on the
  - Charge collection process:

  Standard, Modified, Modified with gap

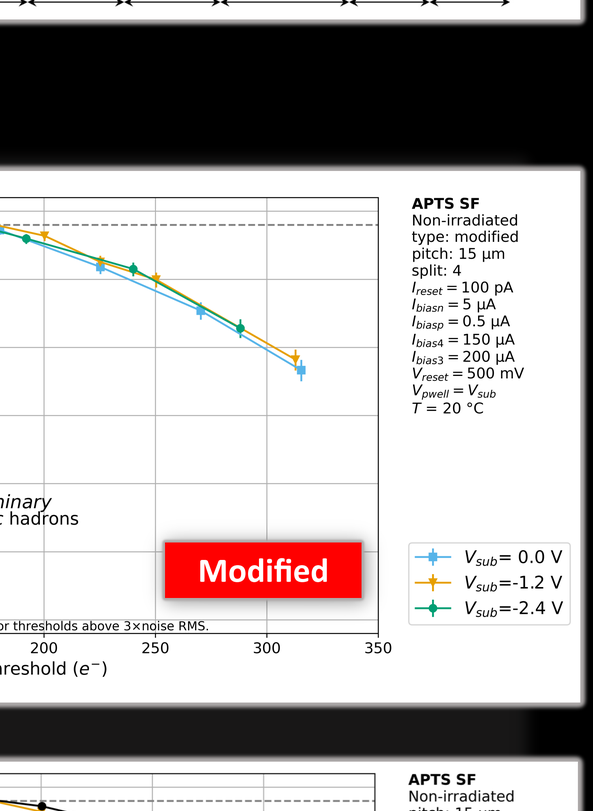


APTS

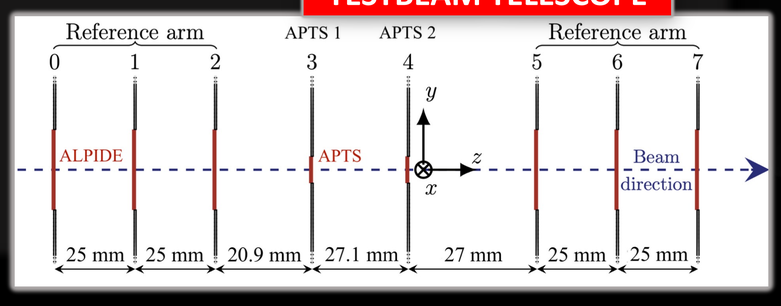


Test-beams

- Characterisation campaign in laboratory and under ionising particle beam
- Telescope: 6 reference ALPIDE chip planes for track reconstructions
- Goal: measure efficiency and spatial resolution performances of APTS



TESTBEAM TELESCOPE



Efficiency results

- **Data analysis** performed using ***Corryvreckan***

  (https://gitlab.cern.ch/corryvreckan/corryvreckan):
  - Software written in C++
  - Used for test beam data reconstruction and analysis
  - It performs offline event building also in high complexity data-taking conditions

Results from data analysis show:

- Better tracking efficiency increasing the reverse bias voltage for the **standard process technology**
- Almost the same efficiencies among different reverse bias voltages for the **modified process**
- **Better tracking efficiencies** for the **modified with gap** type compared to the modified and standard, at 1.2V of reverse bias