ALICE ITS upgrade for LHC Run 3
Commissioning in the laboratory

D. Colella on behalf of the ALICE Collaboration

ALICE in Run 3

Physics motivations

- High precision measurements of rare probes over broad $p_T$ range
- Heavy-flavour mesons and baryons down to very low $p_T$
- Charmonium and Bottomonium states
- Dileptons and low-mass mesons
- Light (anti)-nuclei and hypernuclei

Data taking strategy

- Very low S/B ratio prevents selection with hardware trigger
- Large minimum bias data sample through continuous readout
- Improve tracking efficiency and resolution at low $p_T$
- Preserve Particle Identification (PID)

Upgrade strategy

- New silicon trackers ITS 2 (midrapidity, MFT (forward rapidity)
- New TPC readout chambers (GEMLs) and electronics
- New Fast Interaction Trigger (FIT) detector
- Fast readout for other detectors (TOF, TRD, Muon spectrometers, ZDC, ...)
- New Online plus Offline system (3’ project)

ITS 2 project

Main targets

- Primary and secondary vertex reconstruction
- Access low $p_T$ tracking

Detector requirements

- Improve impact parameter resolution
- Reduce distance from IP to first layer → new beam pipe
- Reduce material budget and pixel size
- Improve tracking efficiency and $p_T$ resolution at low $p_T$
- Increase granularity → from 6 to 7 layers all pixels
- Increase readout capabilities

ITS 1 (Run 1/Run 2)

Inner Barrel
- 48 staves
- 9 ALPIDE chips on 1 row per stave
- chip thickness: 50µm
- stave length: 293 mm
- distance from IP: (min) 22 – (max) 42 mm

Outer Barrel
- 54 staves in ML + 90 staves in OL
- ML: 56 ALPIDE chips on 2 rows per stave
- OL: 9 ALPIDE chips on 2 rows per stave
- chip thickness: 100µm
- stave length: 843 – 1473 mm
- distance from IP: (min) 184 – (max) 394 mm

Detector components and status

7-layer barrel geometry based on ALPIDE chips

- Inner Barrel (IB): 3 layers
- Outer Barrel (OB): 4 layers
- r coverage: (min) 22 – (max) 394 mm
- η coverage: (min) 1.3 – (max) 2.5
- 12.6 Gigapixels
- Total active area ~ 10 m²

Commissioning in Laboratory

Commissioning organization

- Fully equipped clean-room at CERN (Bld. 167) for layer assembly and commissioning → Same backend system that will be used in the experiment (Cooling plant, Power and Readout racks, Trigger and DAQ system)
- Commissioning of the detector in laboratory completed in December 2020
- Verification of detector performance and long stability of parameters before installation inside the cavern
- Commissioning shifts 24/7 started in July 2019 → 3 daily teams with 2 shifters + 1 shift leader

Inner Barrel

- Threshold Tuning (Figure A): Adjustment of frontend parameters to equilibrate the charge threshold archiving uniform detector response; threshold stability over time → Really good threshold uniformity
- Fake-hit rate (Figure B): threshold is a tradeoff between detector efficiency and fake-hit rate → measured fake-hit rate below $10^{10}$ hits/pixel/event → Extremely quiet detector
- Alignment study (Figure C): correlation in the three layers of the clusters produced by cosmic tracks

Outer Barrel

- Stability test (Figure D):
  - Slight variations in the voltage applied to the chips require multiple runs [5-10] to detect all hot pixels → Room for powering procedure improving
  - Noise performance very good
  - Negligible threshold variations over time → Detector stable over time

Contact: domenico.colella@ba.infn.it

TIPP2021 - 26 May 2021

* Politecnico and INFN, Bari ITALY