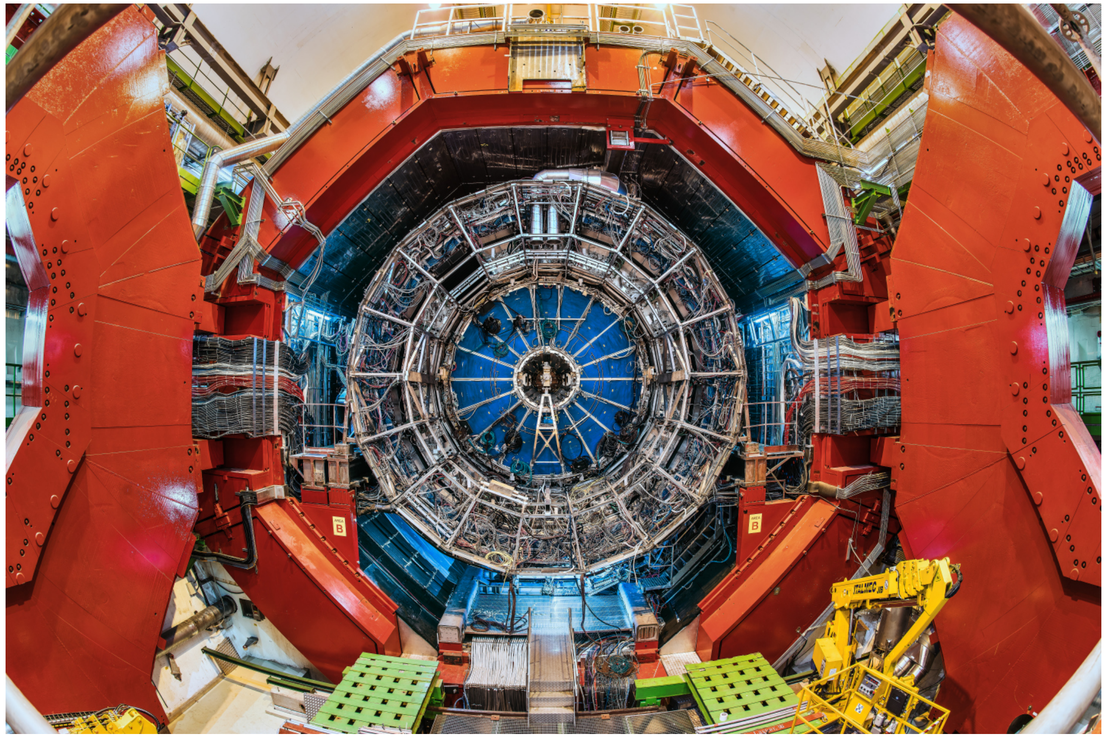
ALICE status update

Marco van Leeuwen, Nikhef and CERN

CERN Korea Committee meeting
28 October 2024



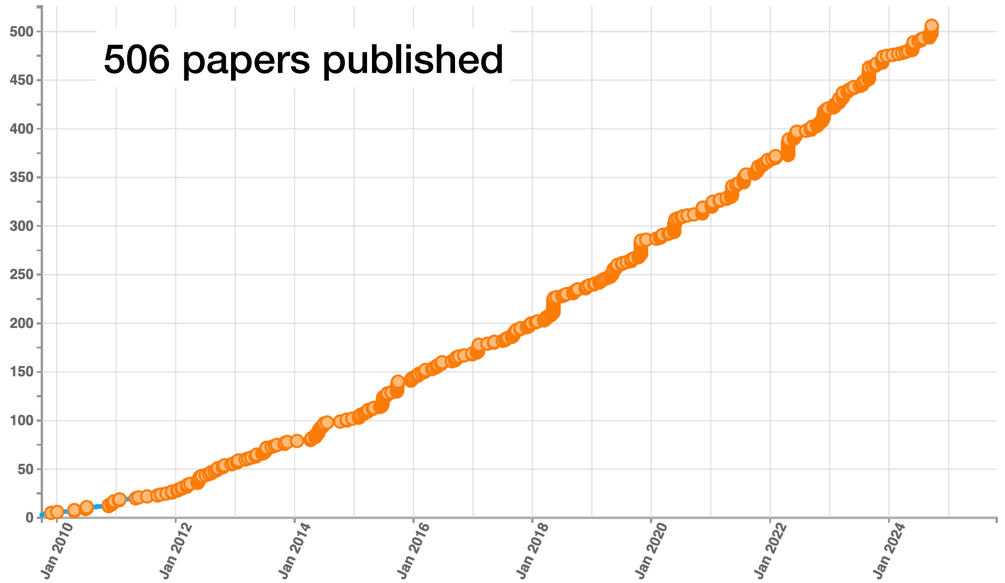
ALICE collaboration

Collaboration composition

- 1069 authors, 1944 members
- 157 member institutes, 24 associate
- 40 countries

New member institute:

- University of Silesia, Poland



New associate member institutes

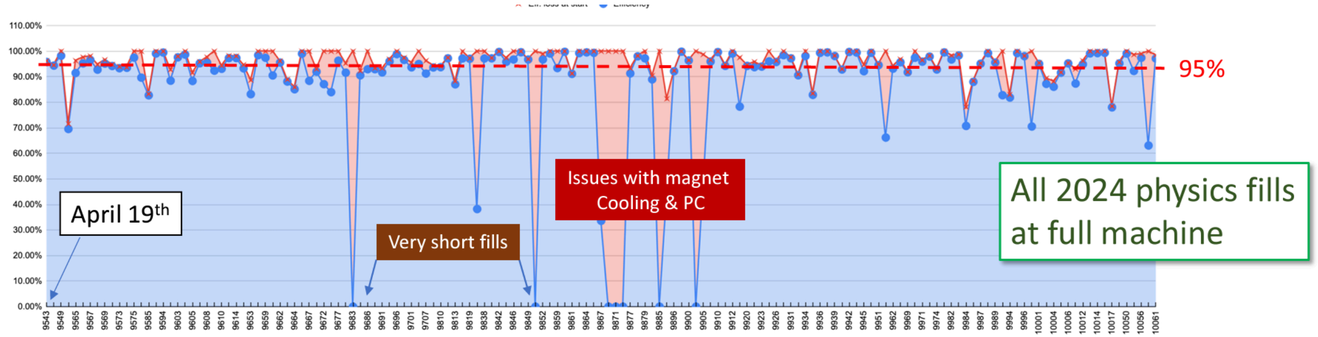
- INFN Genova, Italy — ALICE 3 magnet design
- Kumamoto University — FoCal readout

New associate member institutes — step towards full membership

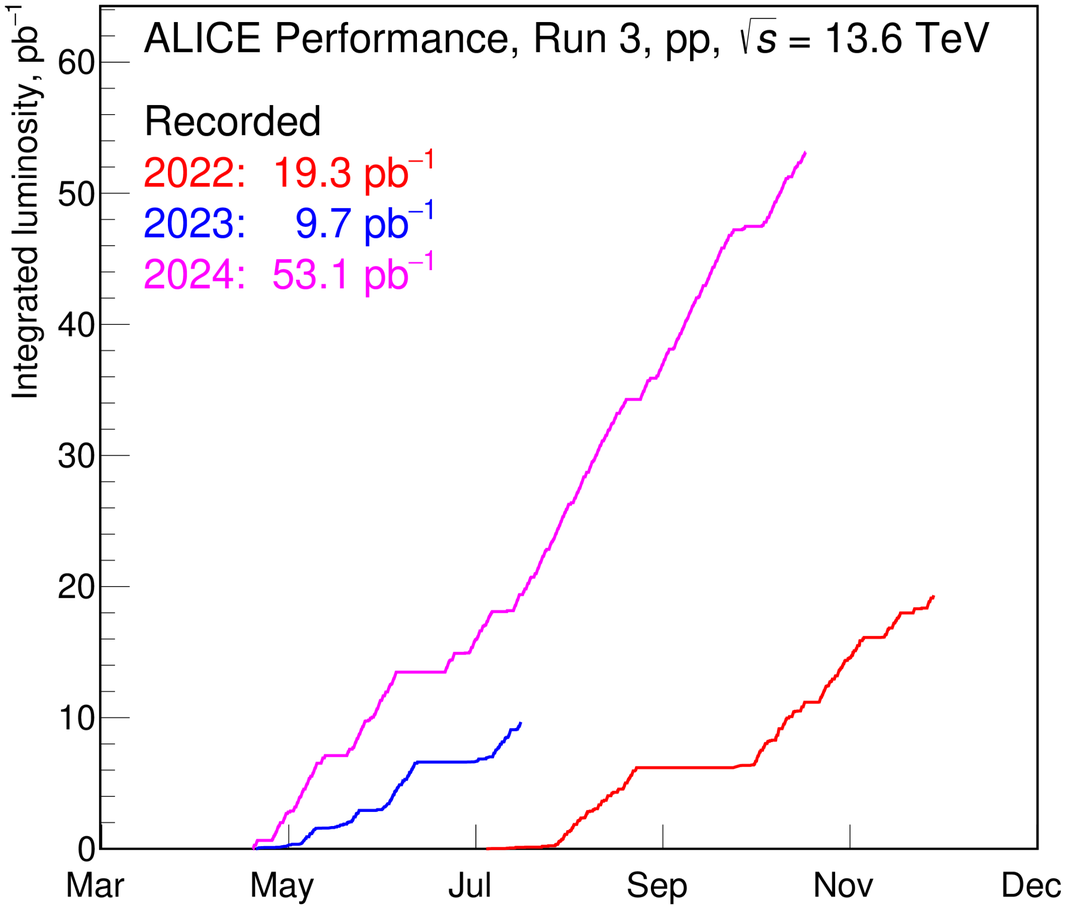
- IISER Berhampur, India
- Central University of Tamil Nadu, India
- Cooch Behar Pachanan Barma University West Bengal, India
- University of Kashmir, India

2024 run performance

Data taking efficiency



Collected pp luminosity by year

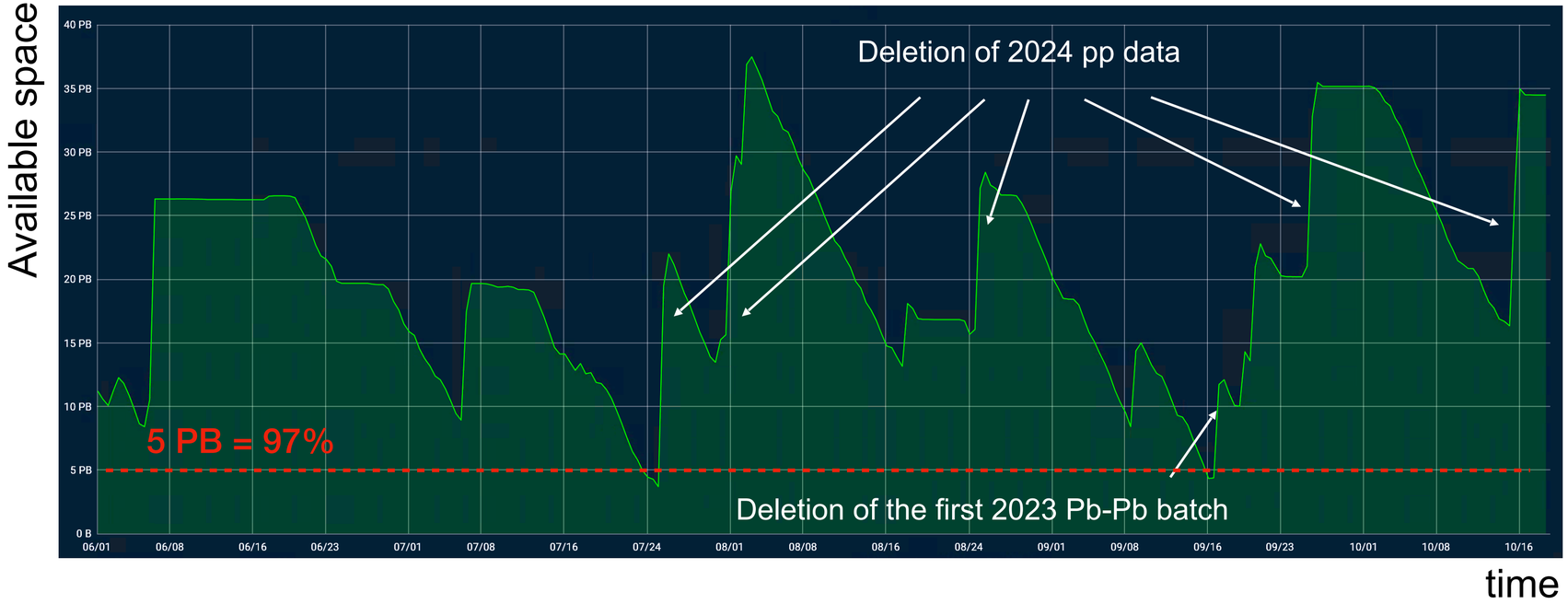


Excellent data taking year:

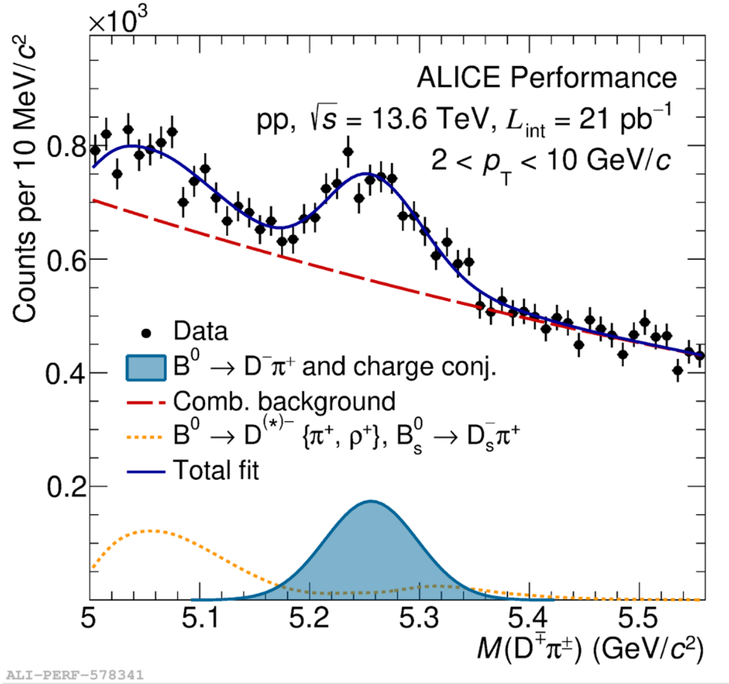
- High availability of LHC
- High ALICE efficiency typically 95%, overall > 90%
- Total sampled luminosity: 53.1 pb^{-1}

Raw data reconstruction: pp

Free space on EPN disk buffer vs time



$B^0 \rightarrow D^*\pi^\pm$ mass peak



Using 2023 pp skimmed data

- Large efficiency of LHC + ALICE: collect ~10 PB of raw data (CTF) per week
- Processing, QA, trigger selection, skimming handled in chunks of 1 week — total duration 8 weeks
- Need to keep pace to avoid filling up EPN disk buffer

New results: summer conferences

4 large conferences this summer:

- LHC Physics
- Strange Quark Matter
- ICHEP
- Hard Probes 2024

ALICE participants at Hard Probes, Nagasaki

LHCP Boston 2024

SQM2024
The 21st International Conference on Strangeness in Quark Matter
3-7 June 2024, Strasbourg, France

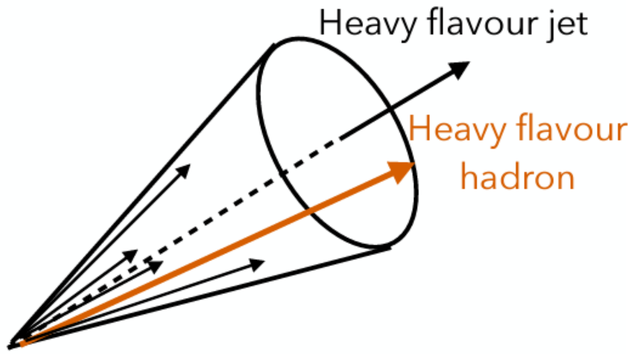
ICHEP 2024 PRAGUE
ichep2024.org
42nd International Conference on High Energy Physics
18-24 July · 2024 · Prague · Czech Republic

HP2024 NAGASAKI

Many new preliminary results from Run 3 pp and Pb-Pb

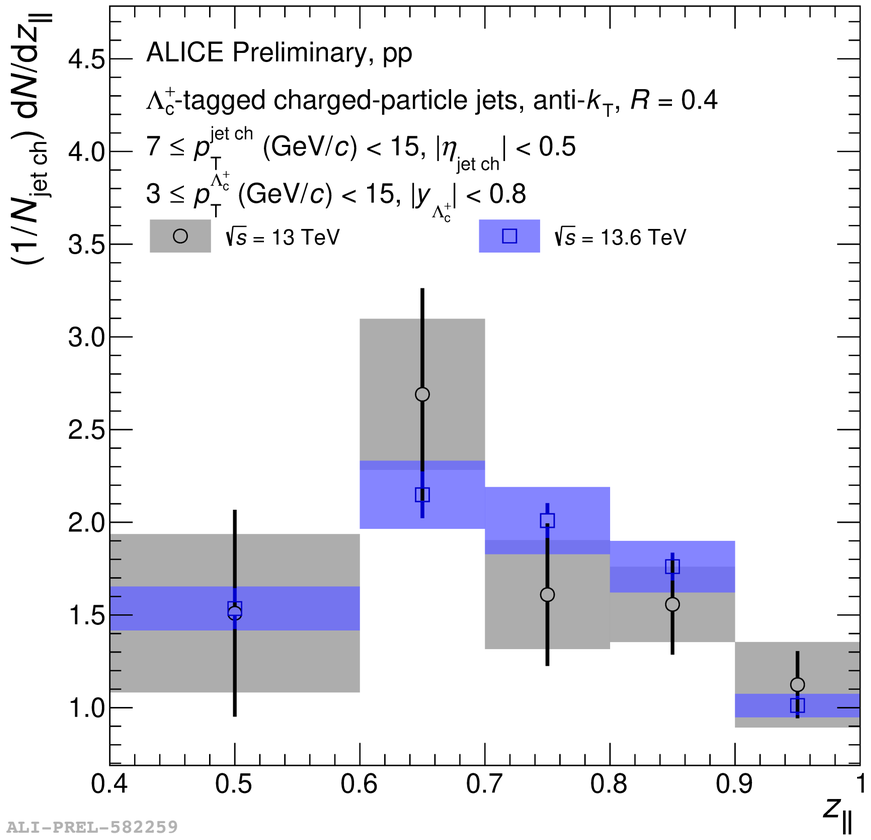
Example in the next slide

Run 3 pp result example



- Momentum distribution of Λ_c baryons in jets
  - investigate baryon production mechanism
  - clear increase of precision with Run 3 data
  - extend measurement to large p_T
  - shown at Hard Probes, Nagasaki

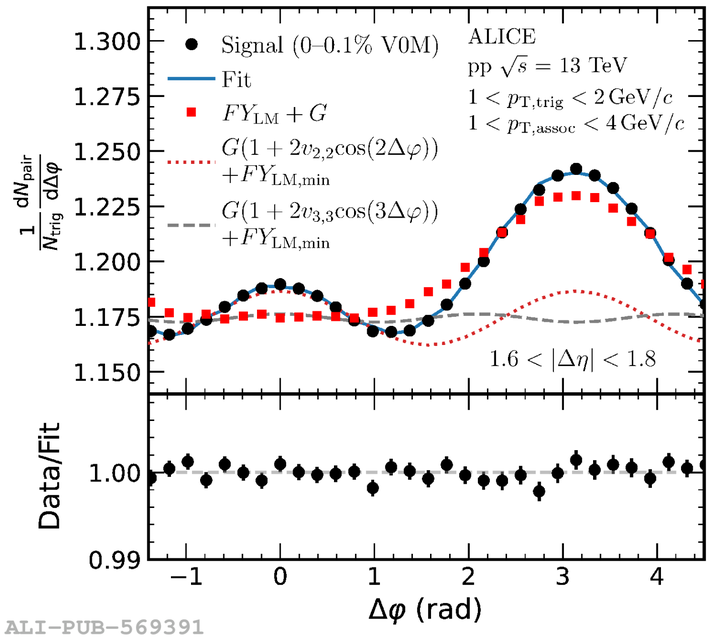
Λ_c baryons in jets



Analysis led by Vit Kucera, Inha University

Recent result: collectivity in small systems

Decomposition of azimuthal distributions



ALI-PUB-569391

Result highlighted in CERN Courier

ALICE

Collectivity in small systems produced at the LHC

High-energy heavy-ion collisions at the LHC exhibit strong collective flow effects in the azimuthal angle distribution of final-state particles. Since these effects are governed by the initial collision geometry of the two colliding nuclei and the hydrodynamic evolution of the collision, the study of anisotropic flow is a powerful way to characterise the production of the quark–gluon plasma (QGP) – an extreme state of matter expected to have existed in the early universe.

To their surprise, researchers on the ALICE experiment have now revealed similar flow signatures in small systems encompassing proton–proton (pp) and proton–lead (pPb) collisions, where QGP formation was previously assumed not to occur. The origin of the flow signals in small systems (and in particular whether the mechanisms behind these correlations in small systems share commonalities with heavy-ion collisions) are not yet fully understood. To better interpret these results, and thus to understand the limit of the system size that exhibits fluid-like behaviour, it is important to carefully single out possible scenarios that can mimic the effect of collective flow.

Anisotropic-flow measurements ▷

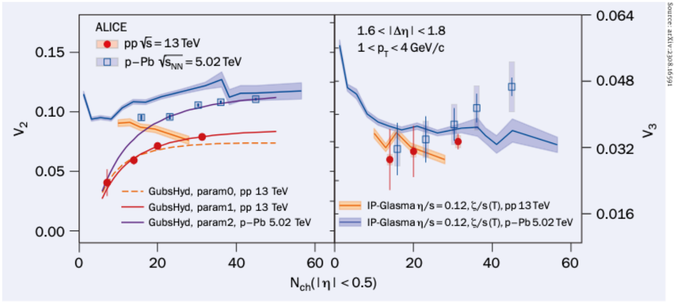


Fig. 1. *The measured and calculated evolution of elliptic (left) and triangular (right) flow in pp and pPb collisions as a function of charged-particle multiplicity at midrapidity. The measurements are compared to the state-of-the-art hydrodynamic calculations.*

- Investigation of long-range collective effects in pp and p-Pb collisions
- Multiplicity or density-driven azimuthal asymmetry: both v2 and v3 measured
- Effect visible down to low multiplicity

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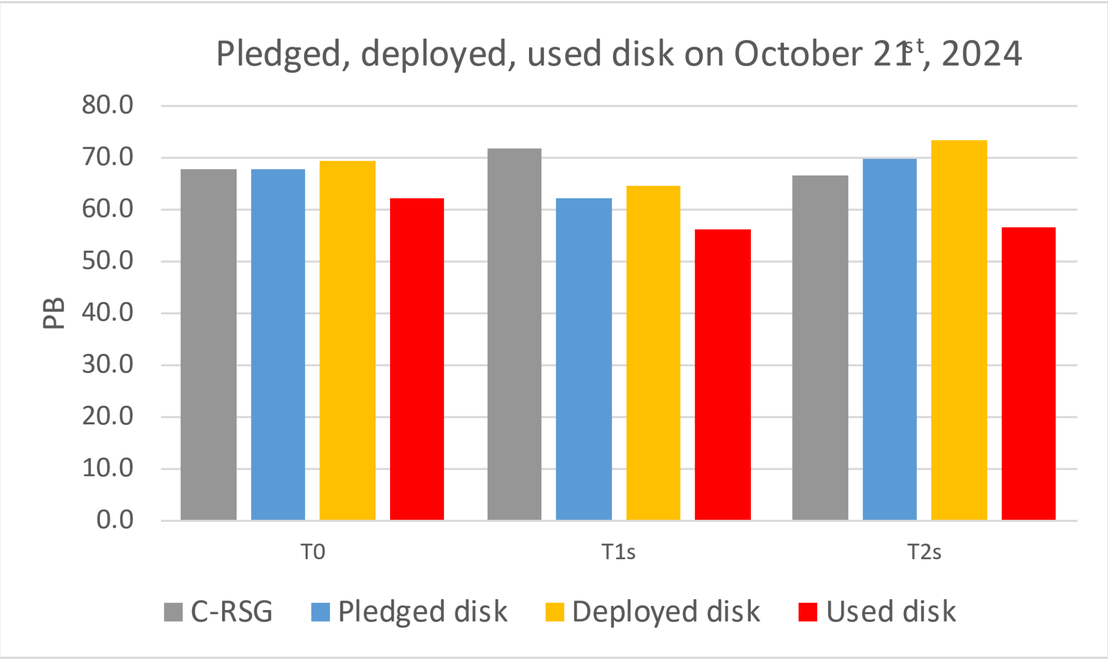
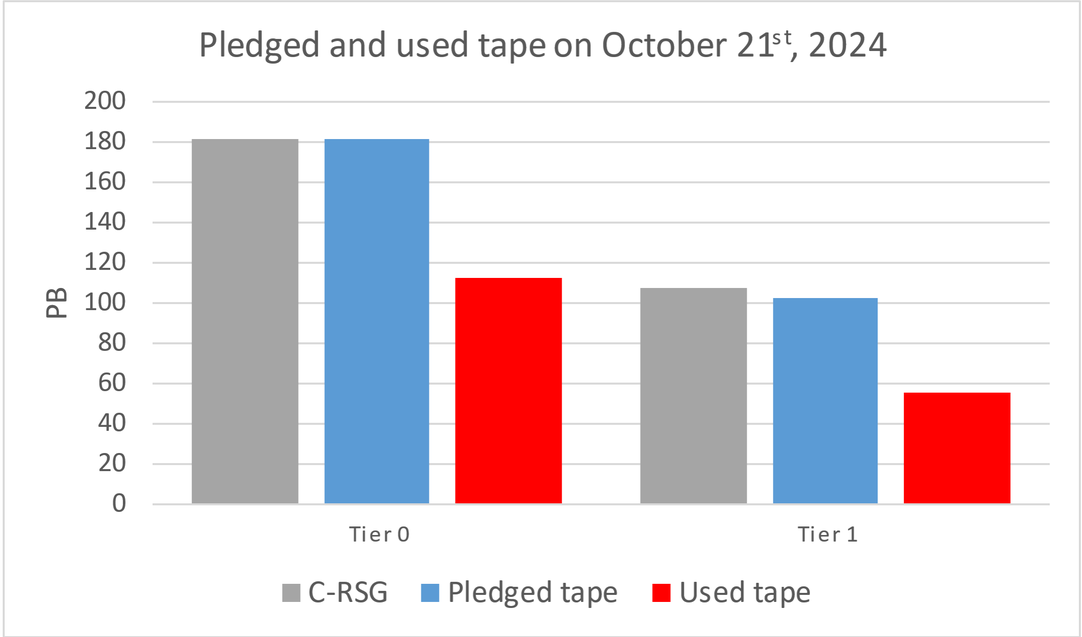
Paper Committee: Junlee Kim, Beomkyu Kim

Grid resources: disk and tape

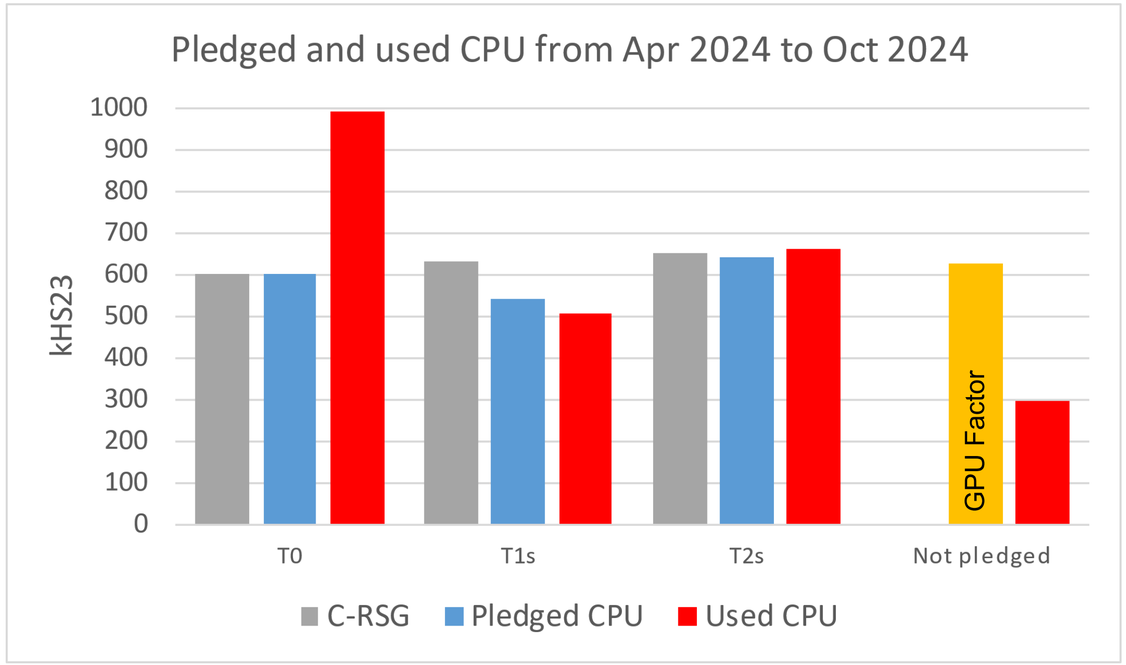


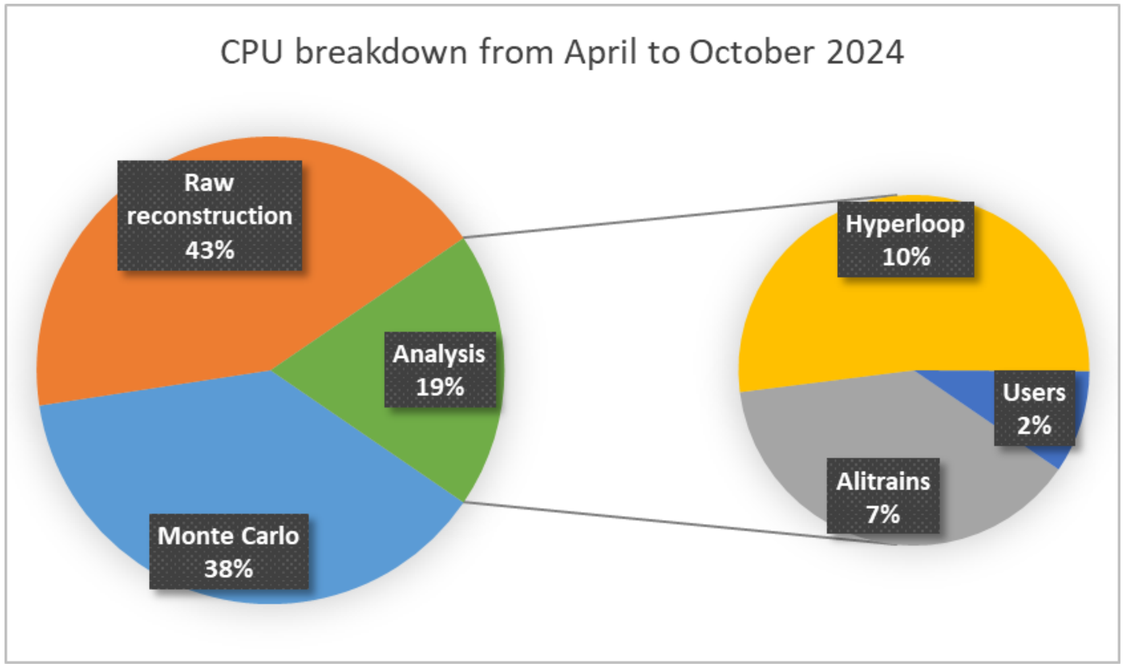


- Current disk use: 90% of deployed capacity at T0, 87% at T1s and 78% at T2s (32 PB free)
- Skimming of 2024 pp data exclusively at T0+EPN
- Continuous rebalancing and data removal

- Tape: 116 PB available for archival of 2024 Pb-Pb, skimmed pp, run 1+2 AODs
- 60 PB requested in 2025 for new data
- Depending on HI performance, may need some 2025 pledges for 2024 HI data
  - may request deployment early 2025

CPU utilization and breakdown by job types



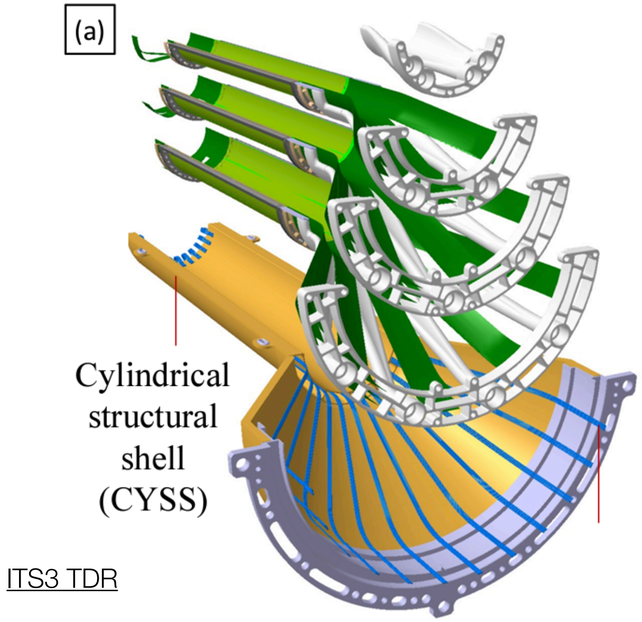


- Full utilization of the available resources at T2s
- Opportunistic CPU usage at the T0 and LBNL, Japan, Wigner and EPN
- At T1s: Used/Pledged 93% and Pledge / C-RSG 86% in 2024

- High activity in all areas: calibration, reconstruction, skimming, MC, and analysis
- Continuous shift of analysis to run 3 software
- MC is scaling up to full scale from June onwards (2023 Pb-Pb)

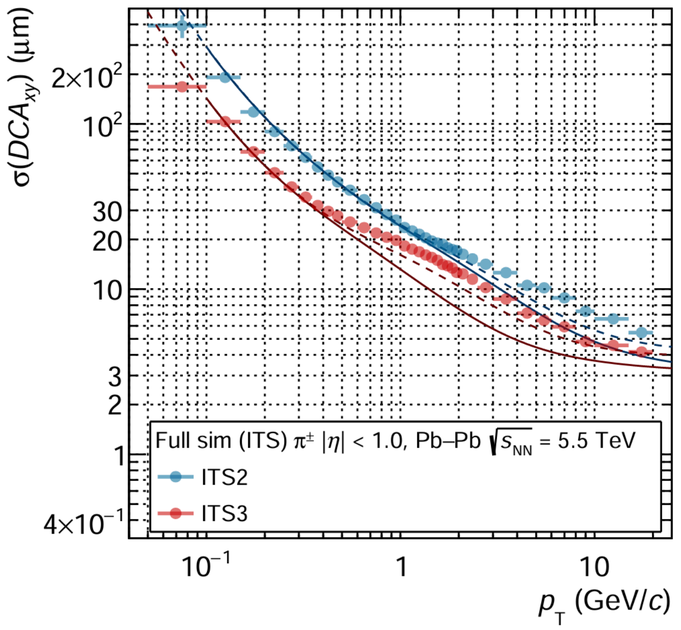
Thank you for the strong support at KISTI

LS3 upgrades: ITS 3 — ultra-light fully cylindrical tracking layers

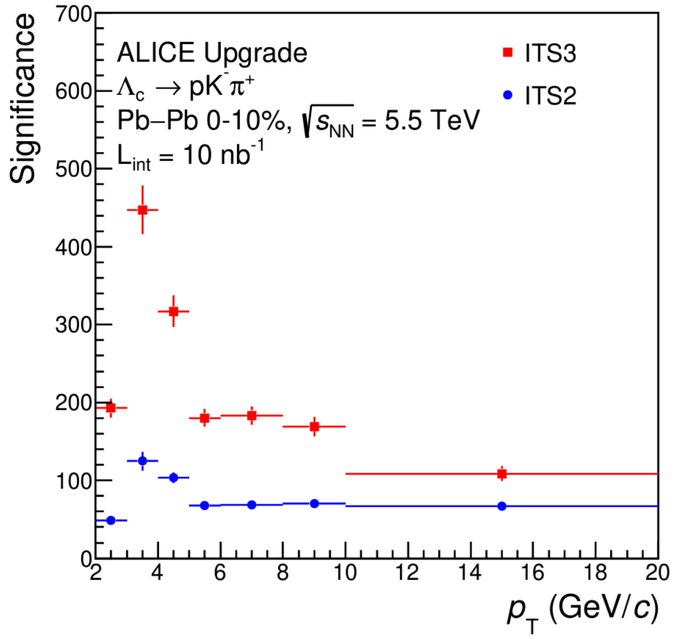


ITS3 TDR

Impact parameter resolution



Λ_c significance



Replace inner 3 tracking layers with ultra-light tracking layers

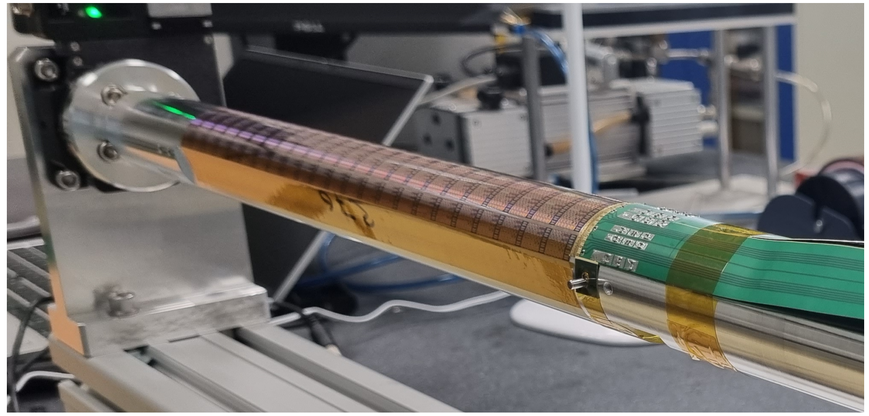
- Large area sensors, curved around beam pipe, carbon foam support

Improved pointing resolution for

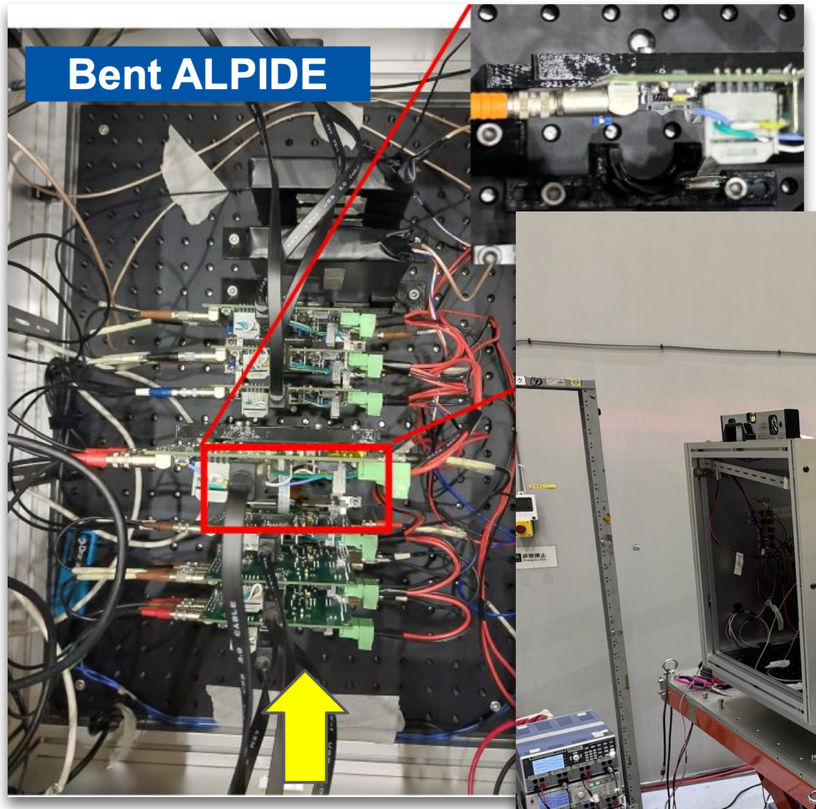
- Heavy flavour reconstruction
- Di-lepton measurements

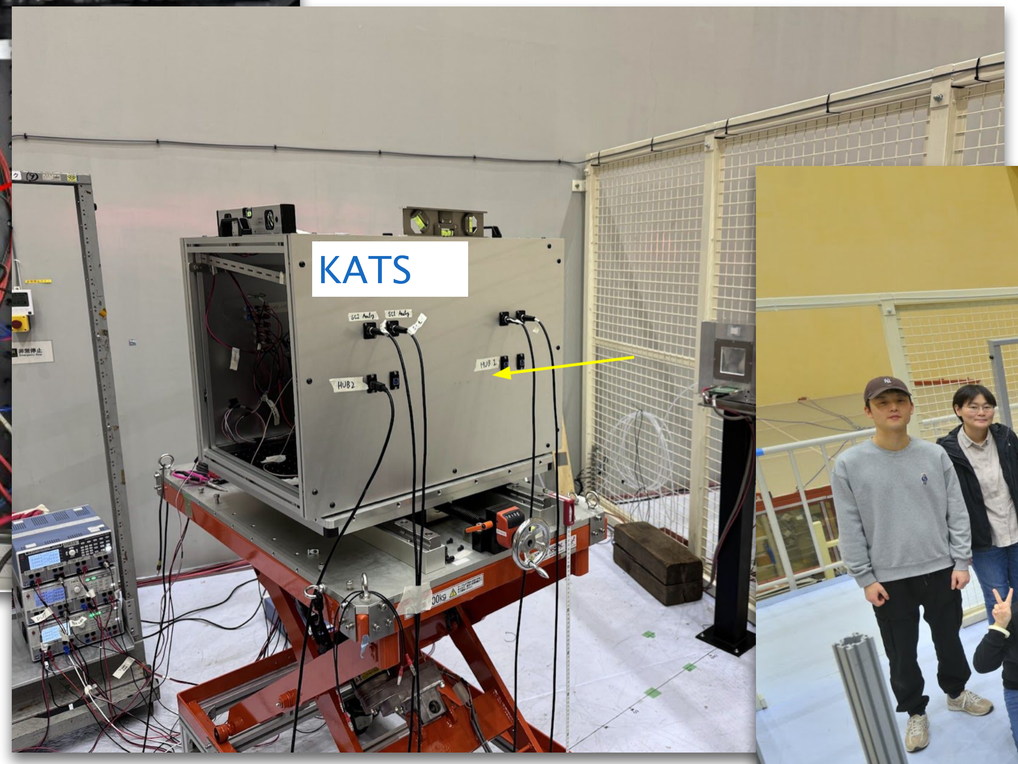
Construction MoU to be circulated for signatures

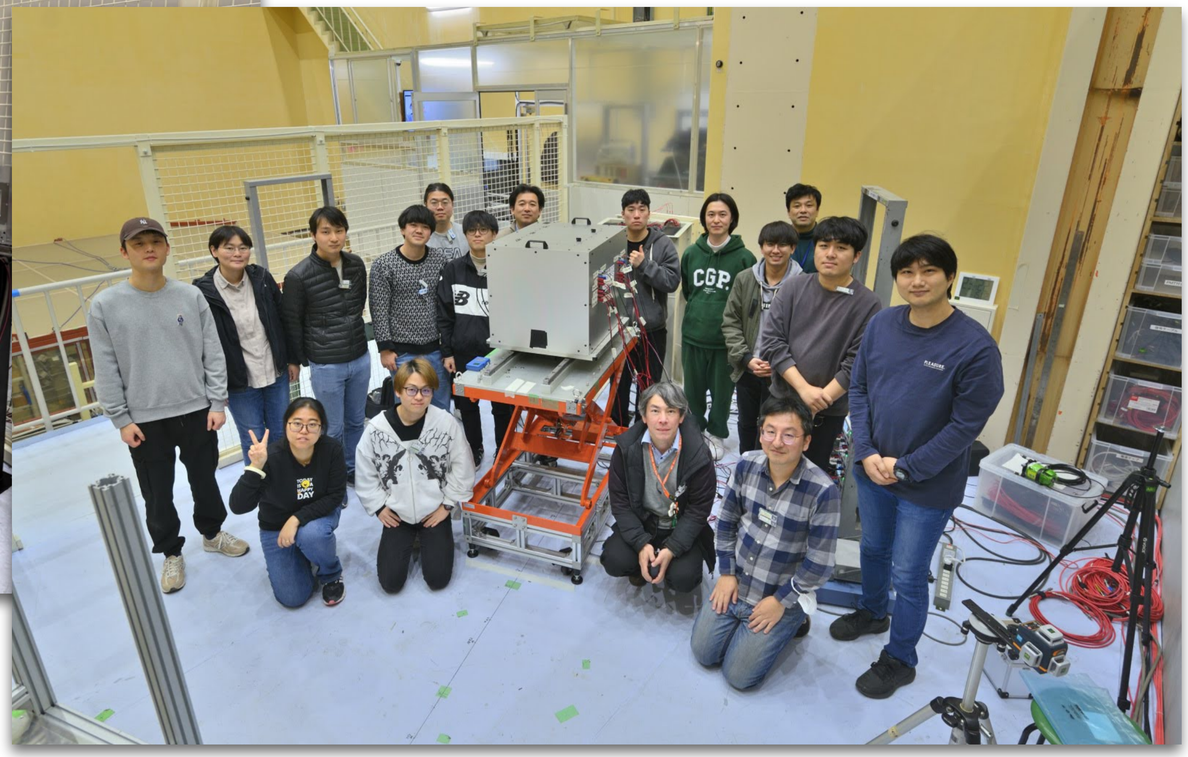
Curved sensor bonding test



ITS3 R&D actitivity in Korea





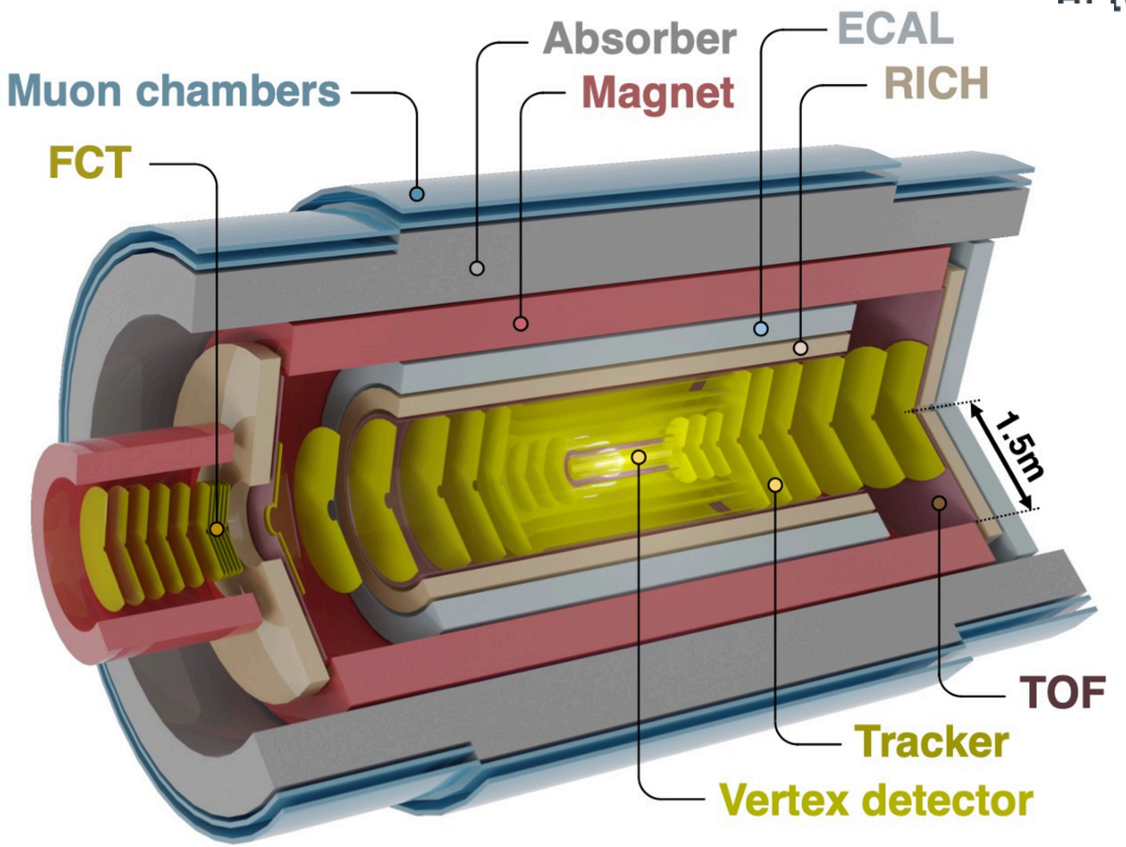


- New telescope with ALPIDE monolithic pixel sensors: KATS
- Beam test at KEK

LHC Run 5 and 6: ALICE 3

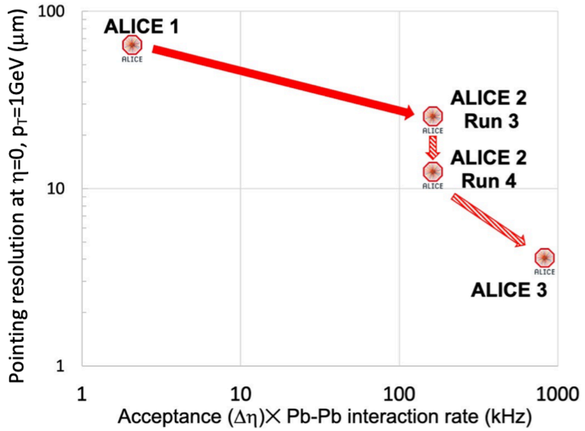
ALICE 3 scoping document submitted to LHCC

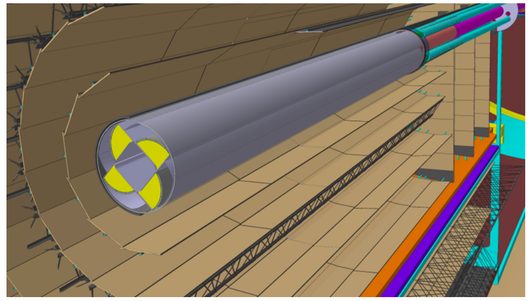
- Scoping options:
  - Setup without ECal
  - Reduced magnetic field: ~ 1 T
  - Reduced acceptance (rapidity coverage)
- Test beams for 2024: MID, ECal, RICH, TOF in progress

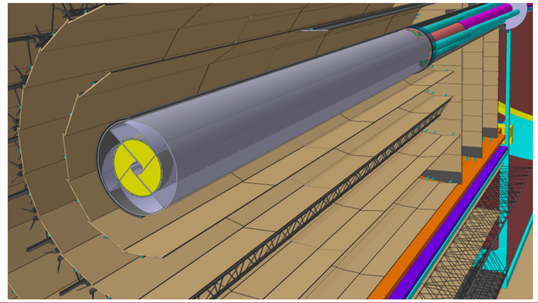


Letter of Intent: LHCC-2022-009

Upgrades: improvements in precision, rate, acceptance







ALICE 3 R&D in Korea

KoALICE R&D update at Upgrade week:
automatisation and industrialisation
of module assembly

OT module design and assembly

ALICE 2024 UPGRADE WEEK

Sanghoon Lim
Pusan National University
Korean ALICE team

5th ALICE Upgrade Week in Krakow

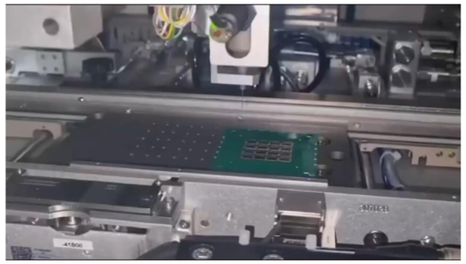
Module assembly for ALICE 3 OT

- **Automatization and industrialization of module assembly**
  - Collaboration with MEMSPACK
    using a multi-purpose machine die bonder

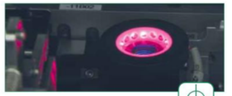
Datacon 2200 evo+

MRSI 705

Henner and Ralf's visit (May)



Integrated Dispenser
- Pressure/time (Musashi®), Auger, Jetter types available
- Epoxy stamping option
- Filled and unfilled epoxy, wide viscosity range
- Small footprint, low cost-of-ownership



Vision Alignment
- New high-speed image processing unit
- Full alignment & Bad mark search
- Pre-defined fiducial geometry & customized teaching

Automatic Wafer and Tool Changer
- Fully Automatic cycle for Multi-Chip production
- Up to 7 Pick & Place tools (optionally 14), 5 eject tools
- Stamping tools and calibration tools possible

Pick & Place Head
- Die Attach, Flip Chip and Multi-Chip in one machine
- Die pick from: wafer, waffle pack, Gel-Pak®, feeder
- Die place to: substrate, boat, carrier, PCB, leadframe, wafer
- Hot and cold processes supported: epoxy, soldering, thermo-compression, eutectic

7

ALICE 3 R&D MoU ready for signature at this meeting

Thank you for your support