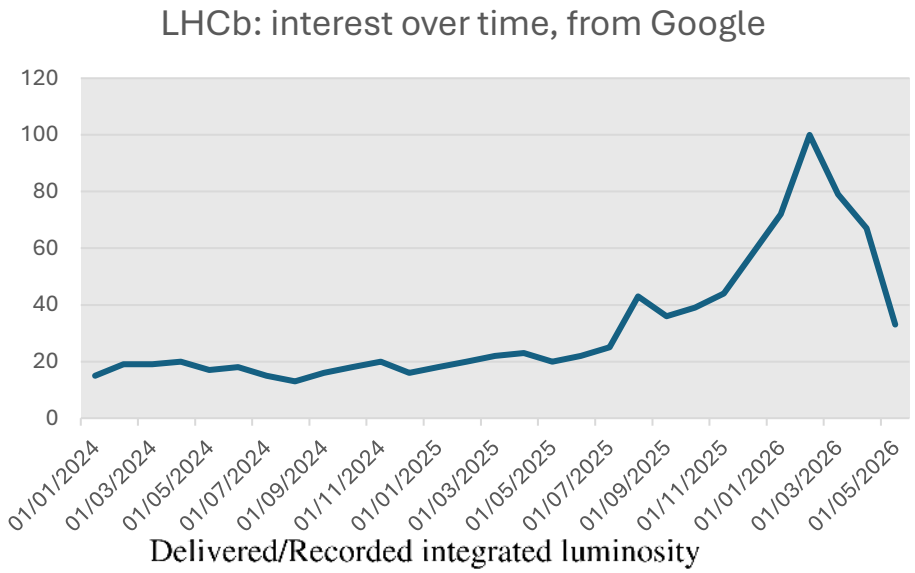
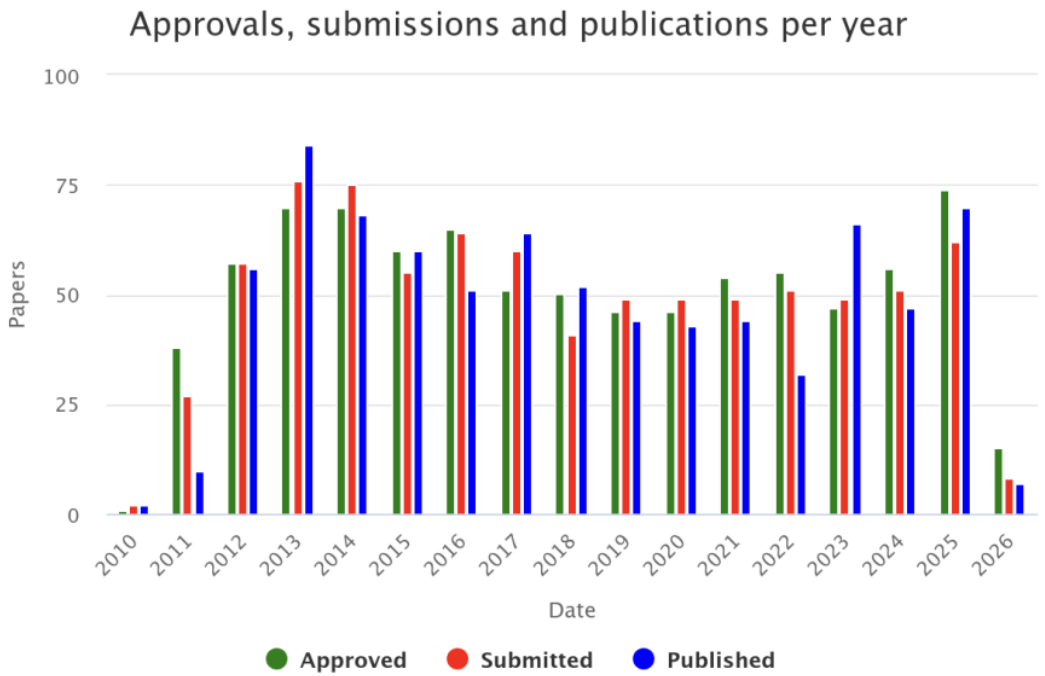
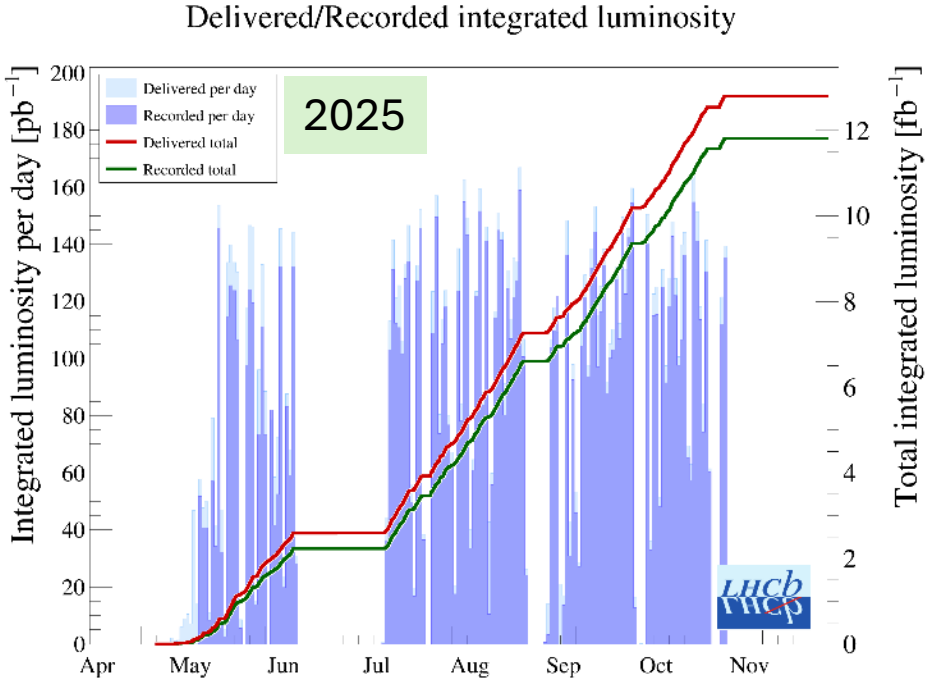
LHCb status, May 2026

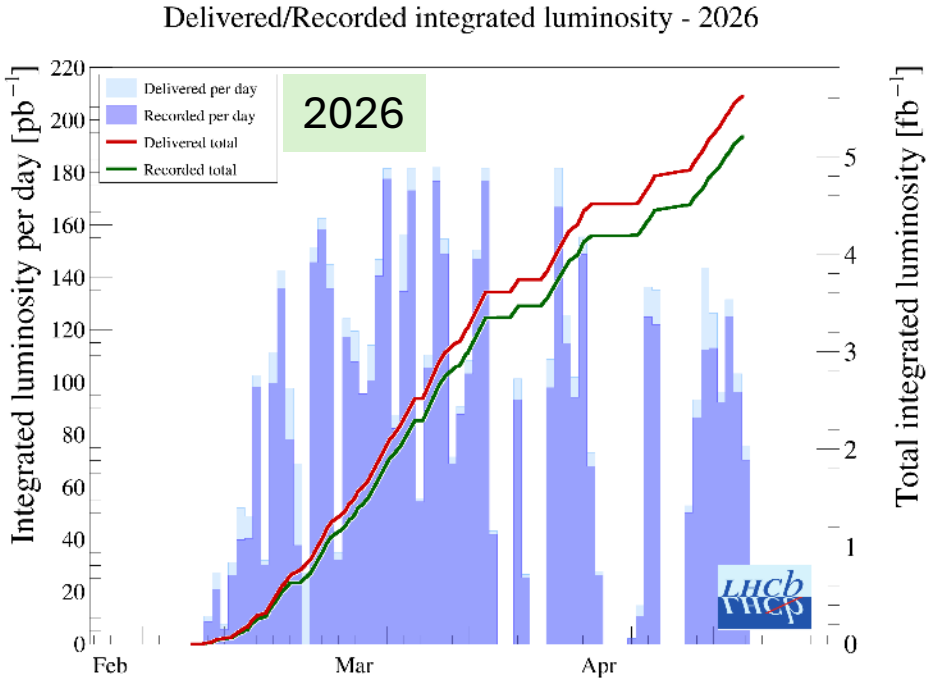
David Hutchcroft on behalf of the Liverpool LHCb group

Current detector + M&O, for upgrade 2 see Karol's talk next



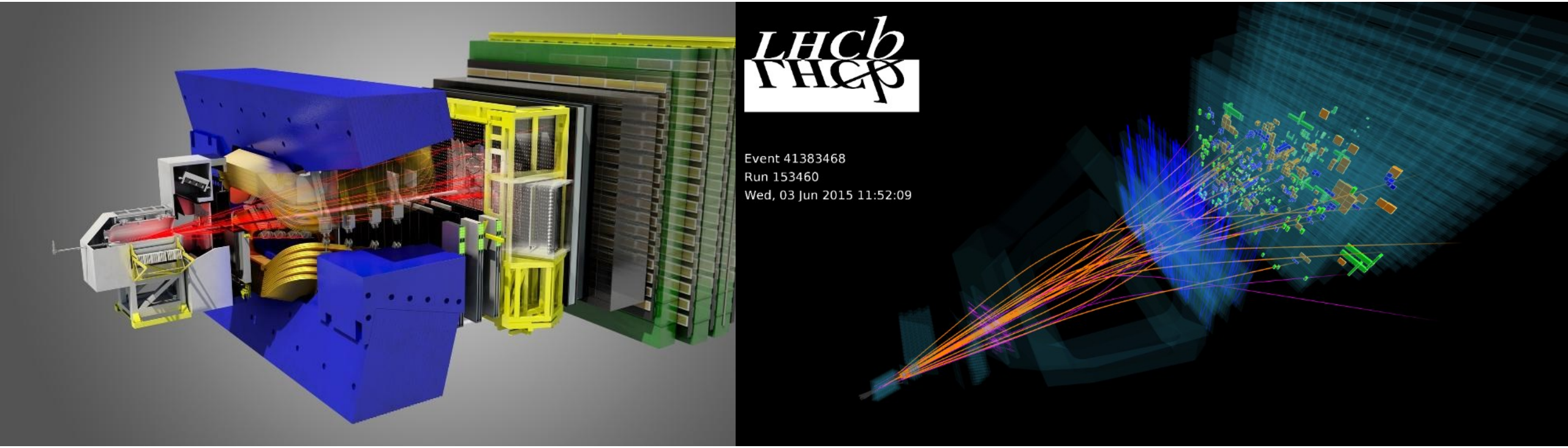






LHCb's year in plots

LHCb the forward spectrometer at the LHC



The 5600-tonne LHCb detector is made up of a forward spectrometer and planar detectors. It is 21 metres long, 10 metres high and 13 metres wide, and sits 100 metres below ground near the town of Ferney-Voltaire, France.
https://home.cern/science/experiments/lhcb/

Over 50 new baryons discovered, including pentaquarks and tetraquarks, CP violation, rare decays and more.
https://en.wikipedia.org/wiki/LHCb_experiment

LHCb Liverpool Group


Tara


David


Themis


Eva


Paras

Honorary


Eduardo


Karol

(at CERN)


Joined AMD

Ayushi


Ashley


Kieran

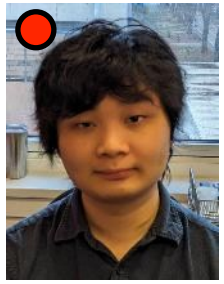

John


Afaf

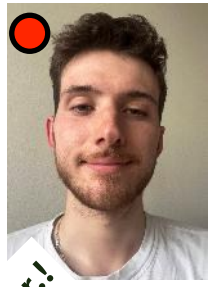
Visiting


Kurt


Giuseppe


Ho Sang


Abbie


Dr.!

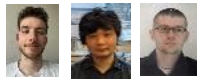
James


Ned

Anabelle

students!

Liverpool LHCb (& related) Service Work

- **LHCb-UK PI/Spokesperson** 
- **LHCb VELO Operations** 
- LHCb Mighty Tracker 
- LHCb VELO++ software 
- LHCb Quantum Computing Activities 
- LHCb VELO simulation lead 
- LHCb VELO DAQ 
- WLCG management board software liaison 
- **LHCb Shift Leader / Data Manager** 
- LHCb Data Processing & Analysis Project Leader 
- HFLAV Charm Decays convener 
- LHCb Speakers' Bureau 
- LHCb Quarkonia WG double charm trigger liaison 
- Outreach: LHCb featured in 2025 & 2026 Liverpool Masterclass 
- Outreach: British Science Festival Particle Detectors exhibit in Sept. 2025 

responsibility

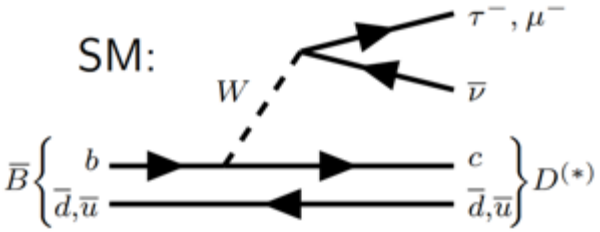
leadership

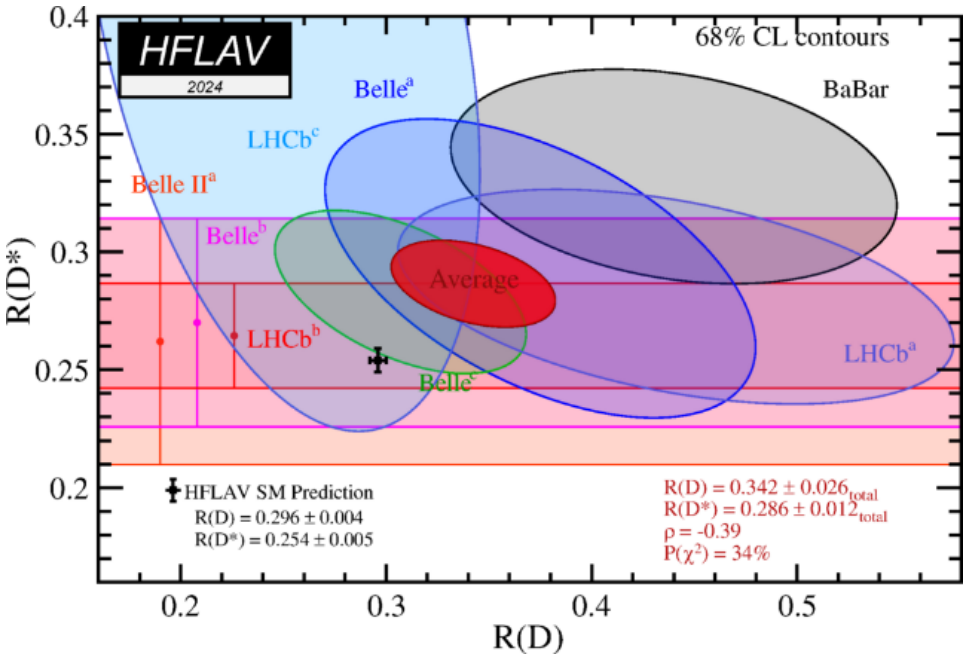
UNIVERSITY OF LIVERPOOL

And many former responsibilities / leadership roles!

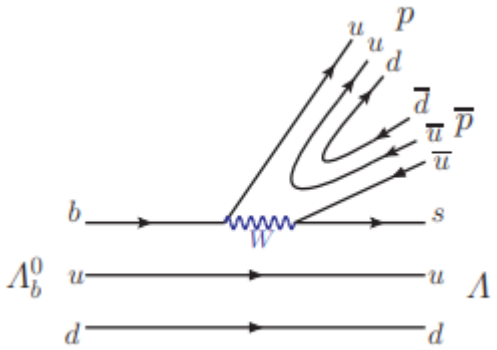
Papers (I)

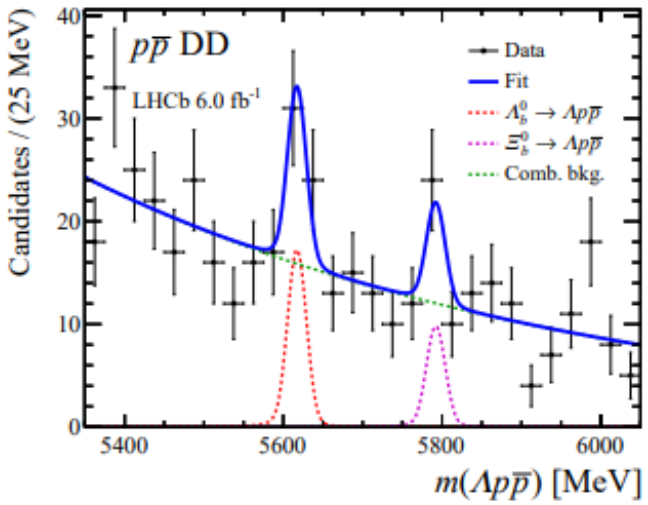
- **Averages of b-hadron, c-hadron, and τ-lepton properties as of 2023** Phys. Rev. D **113**, 012008 (Paras)

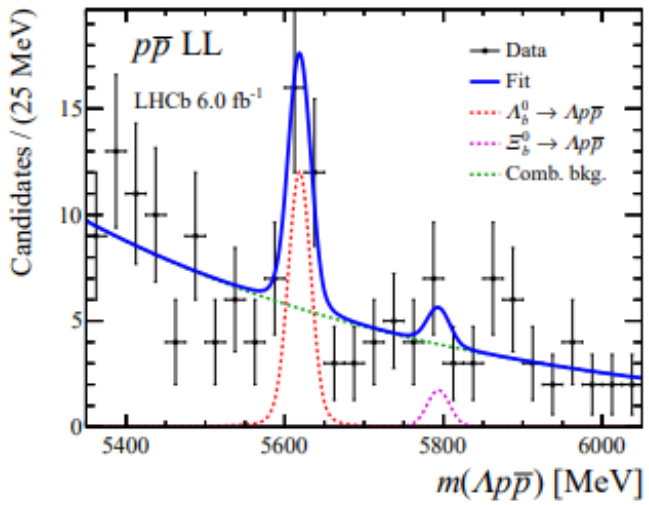




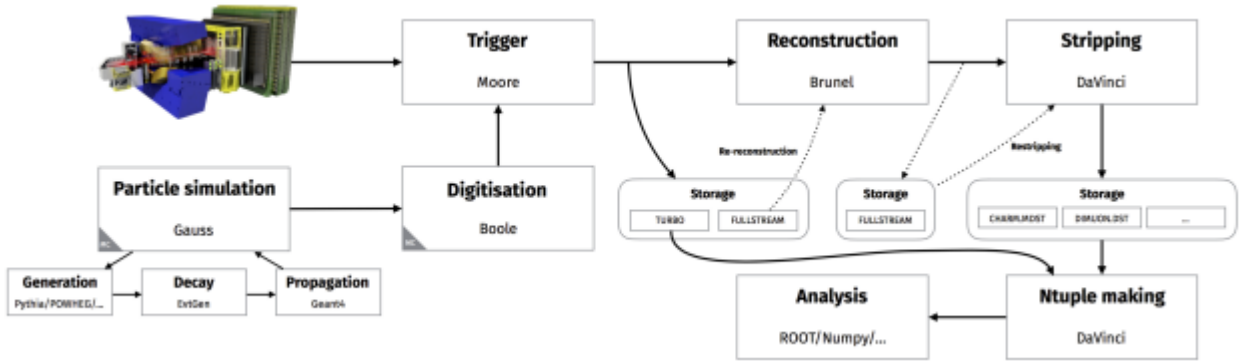
- **Observation of the charmless purely baryonic decay $\Lambda_b^0 \to \Lambda^0 p\bar{p}$** submitted to JHEP arxiv.org/abs/2605.04348 (Eduardo)







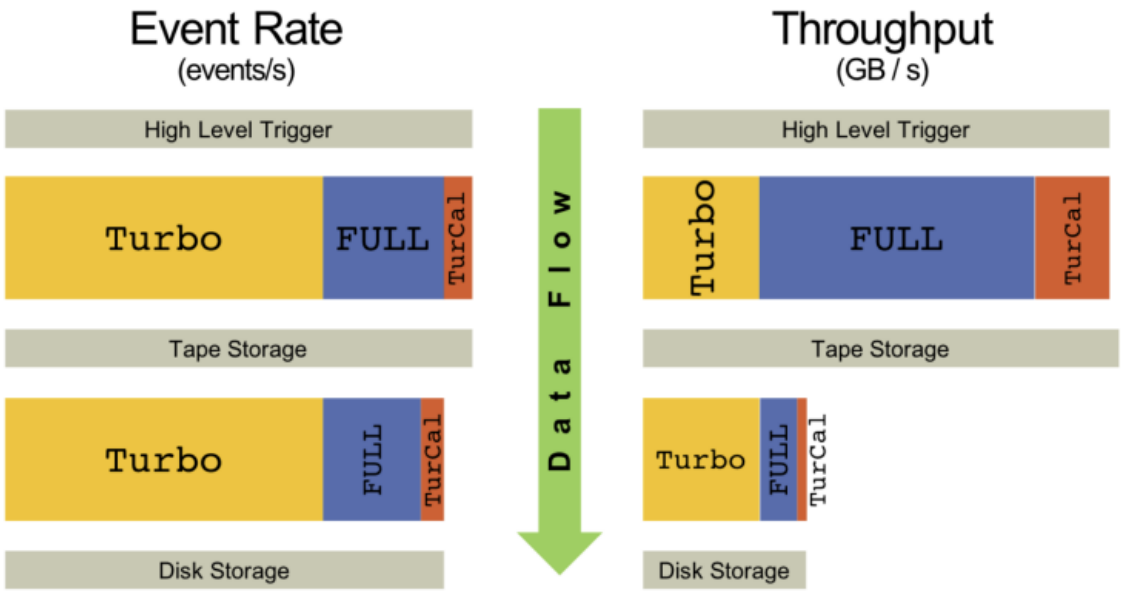
Papers (II)



- **The LHCb Stripping Project: Sustainable Legacy Data Processing for High-Energy Physics**, N. Grieser et al., Comput Softw Big Sci 9, 21 (2025) (Eduardo)

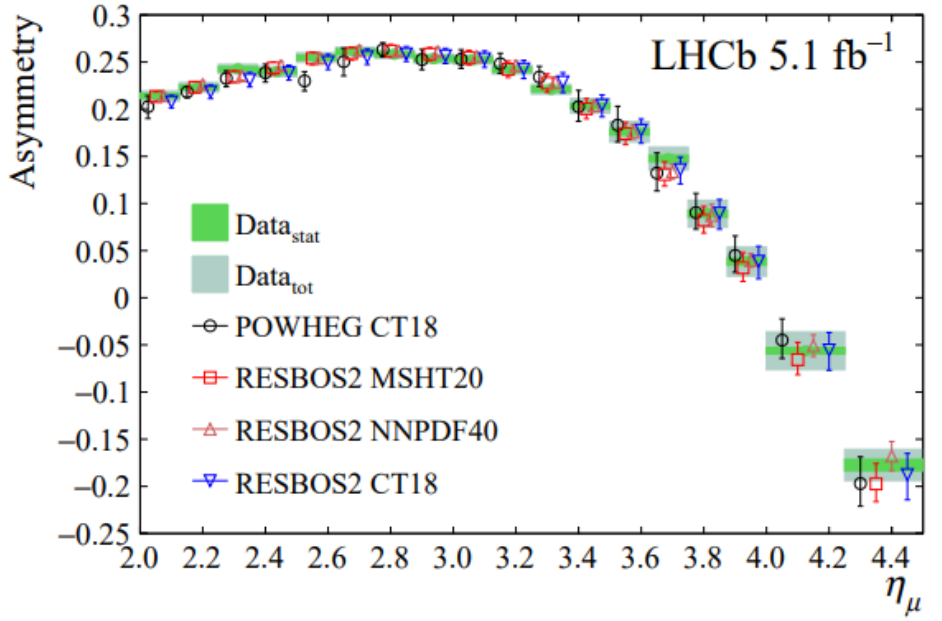
- **The LHCb Sprucing and Analysis Productions, A. Abdelmotteleb et al.,** Comput Softw Big Sci 9, 15 (2025) (Eduardo)

DPA: Data processing and analysis project at LHCb

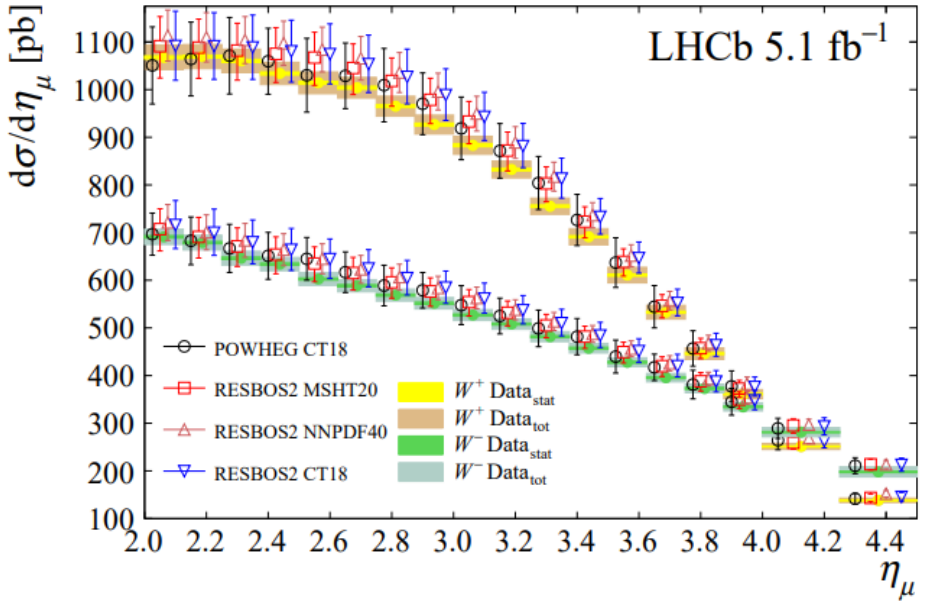


Papers (III)

- **Precision measurement of the muon charge asymmetry from W-boson decays in pp collisions at $\sqrt{s}$ = 13 TeV in the forward region** Submitted to Phys Rev Lett (Tara, David) arxiv.org/abs/2604.12593



- **Measurement of the W production cross-sections in collisions at $\sqrt{s} = 13$ TeV** submitted to PRD (Tara, David) arxiv.org/pdf/2604.12706

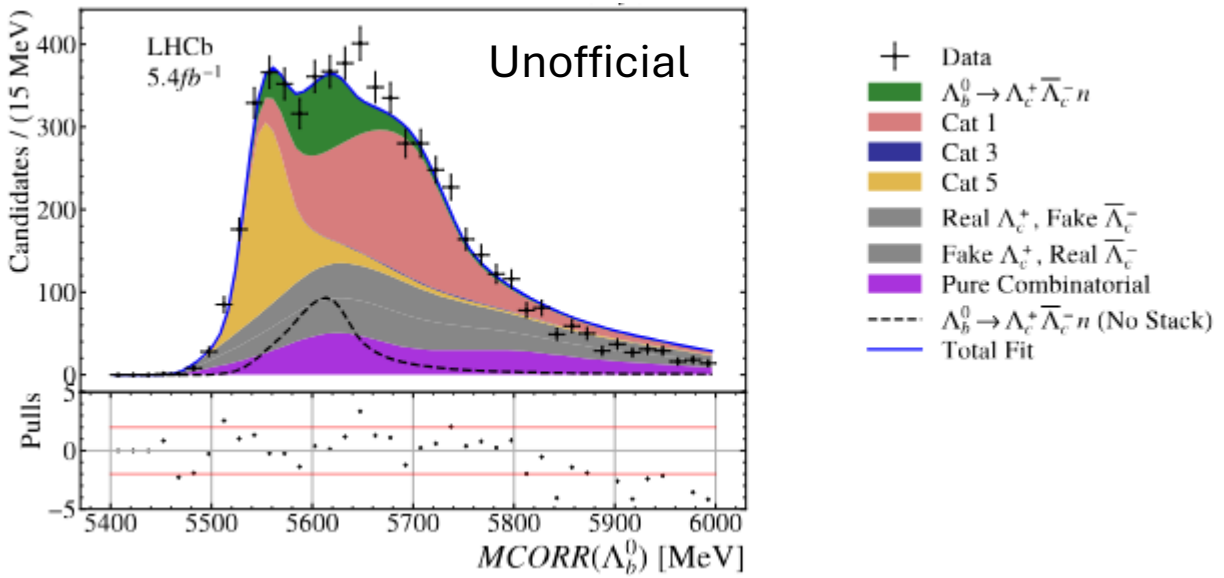


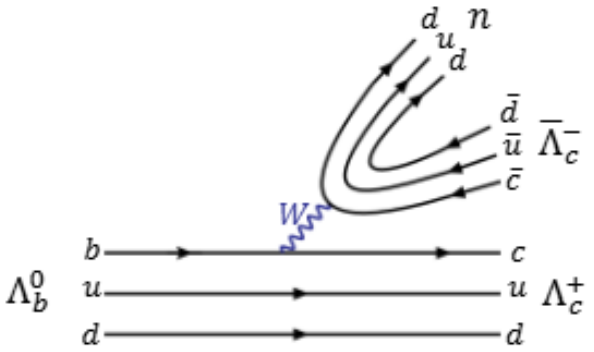
Plus: many internal results review committees and final paper draft reviews

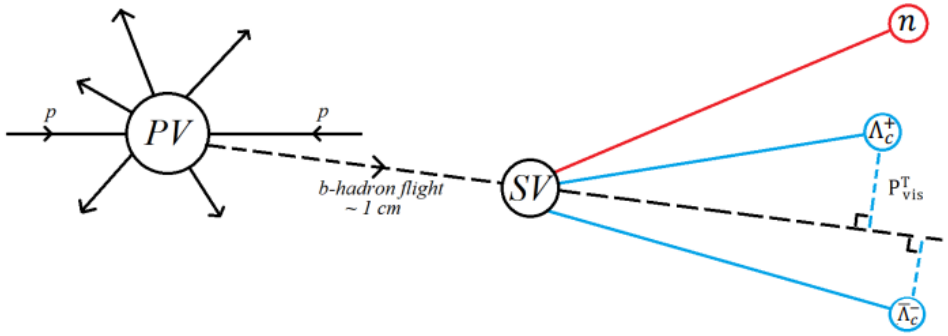
Student lead work in progress

Ho Sang, Guiseppe and Annabelle have already presented the work they are doing

Ned is evaluating final systematics for the $\Lambda_b^0 \to \Lambda_c^+ \Lambda_c^- n$ baryonic decay search



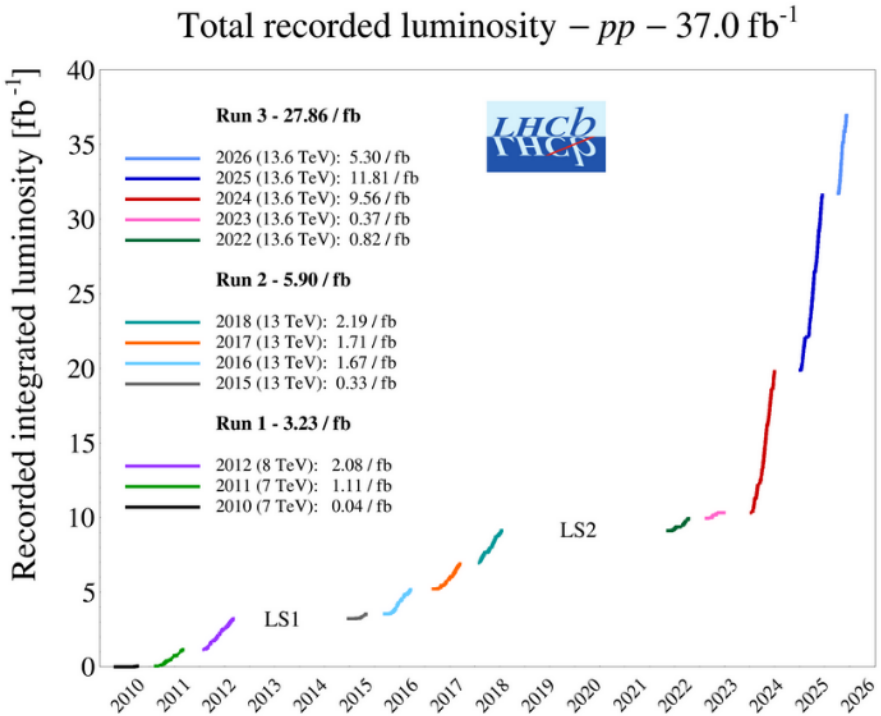


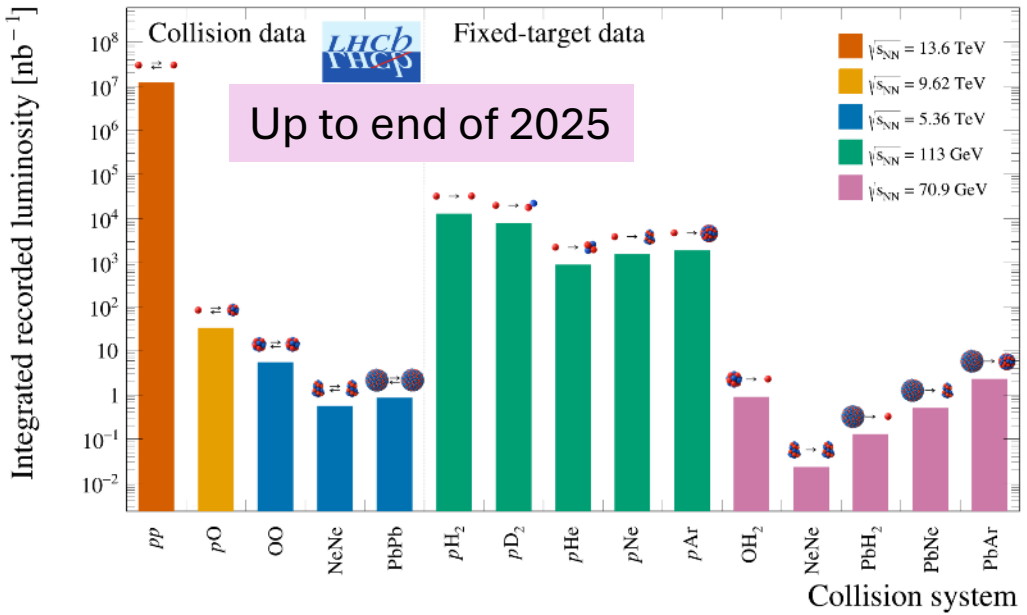


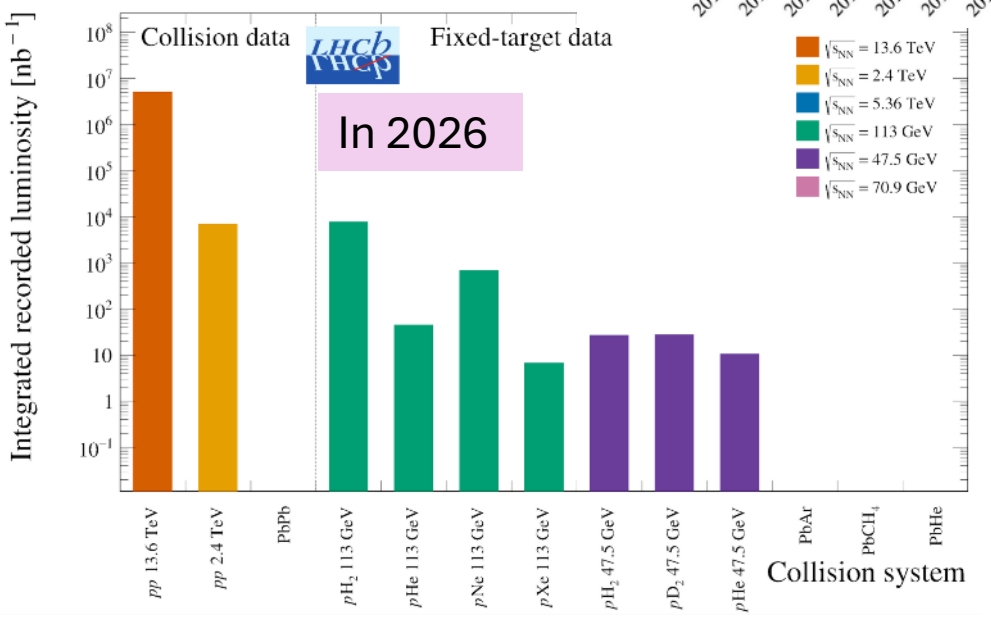
$$\mathrm{MCORR} = \sqrt{m_{\mathrm{vis}}^2 + p_{T,\mathrm{vis}}^2} + \sqrt{m_{\mathrm{inv}}^2 + p_{T,\mathrm{vis}}^2}$$

LHCb Operations 2026

- Good year of data taking
- High data taking efficiency for the detector
  - about 95% with VELO closed
- Unique set of fixed target data using SMOG (gas injection)
- So far collected about 28 fb^{-1} for Run3
- Our TDR said 50 fb^{-1} for Run3+Run4, we're on track despite many issues

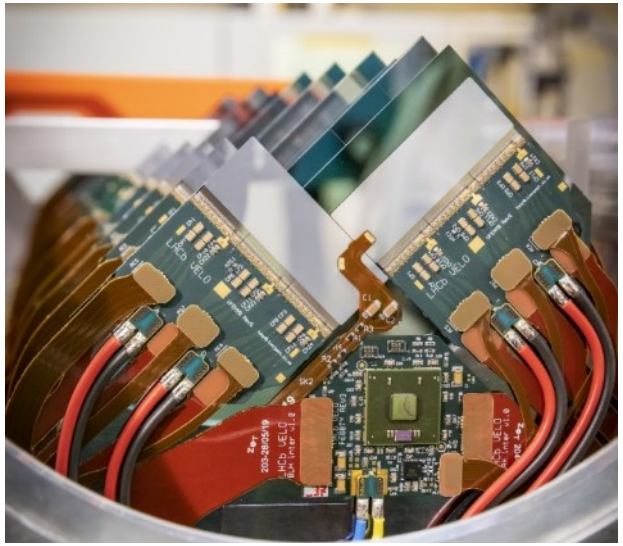


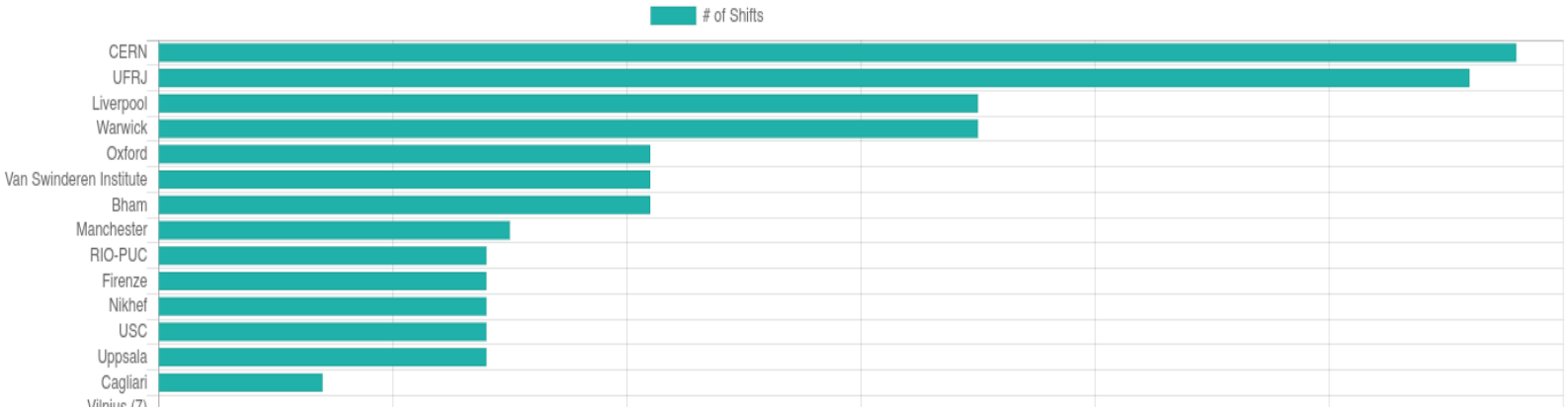


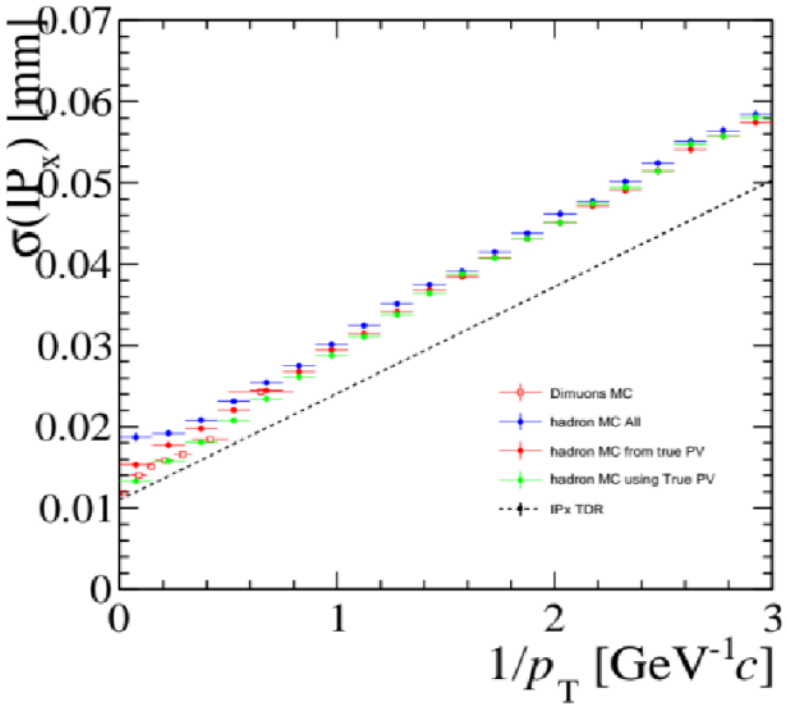


VELO

- On-site presence
  - Ho Sang (2025), Giuseppe (2026)
  - Kurt, Karol, Eduardo
- Liverpool in top 3 of piquet shifts for 2025/2026.
- Also doing Shift Leader and Expert on-call operations

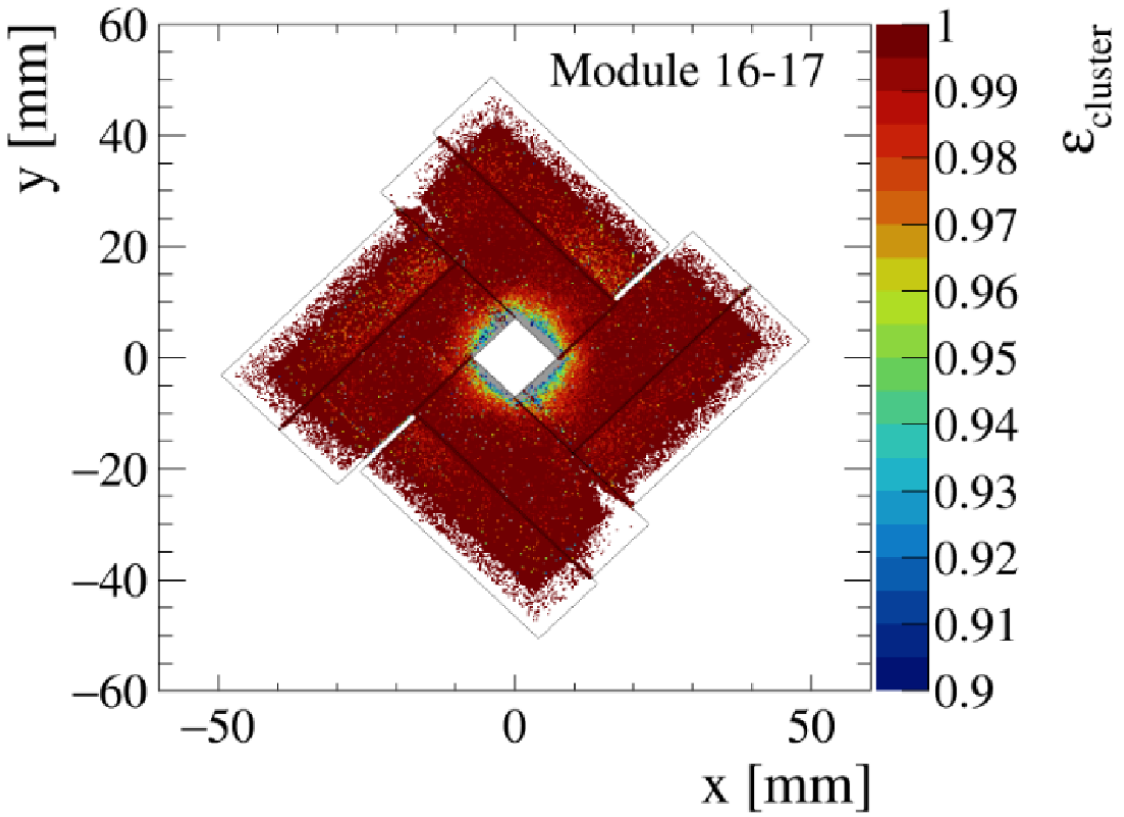




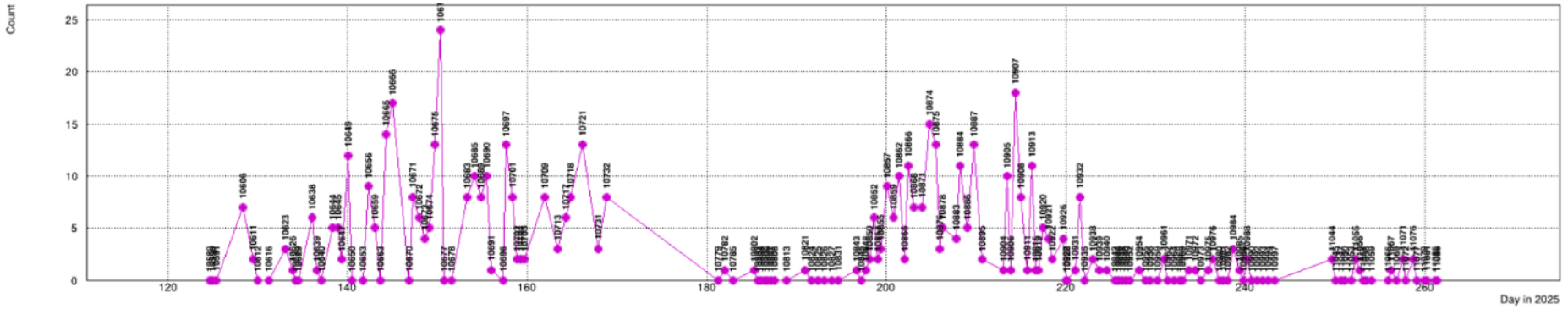


VELO Operations

- Mostly smooth until Nov. 2025
- Data from last week of pp run in 2025
- Drop in hit efficiency at the inner radius due to radiation damage
- Decision to increase HV from 400V to 600V in inner region to compensate

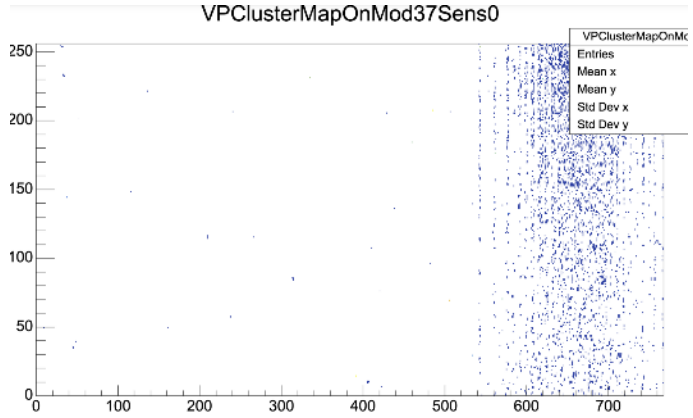


VELO DAQ Inefficiency over time

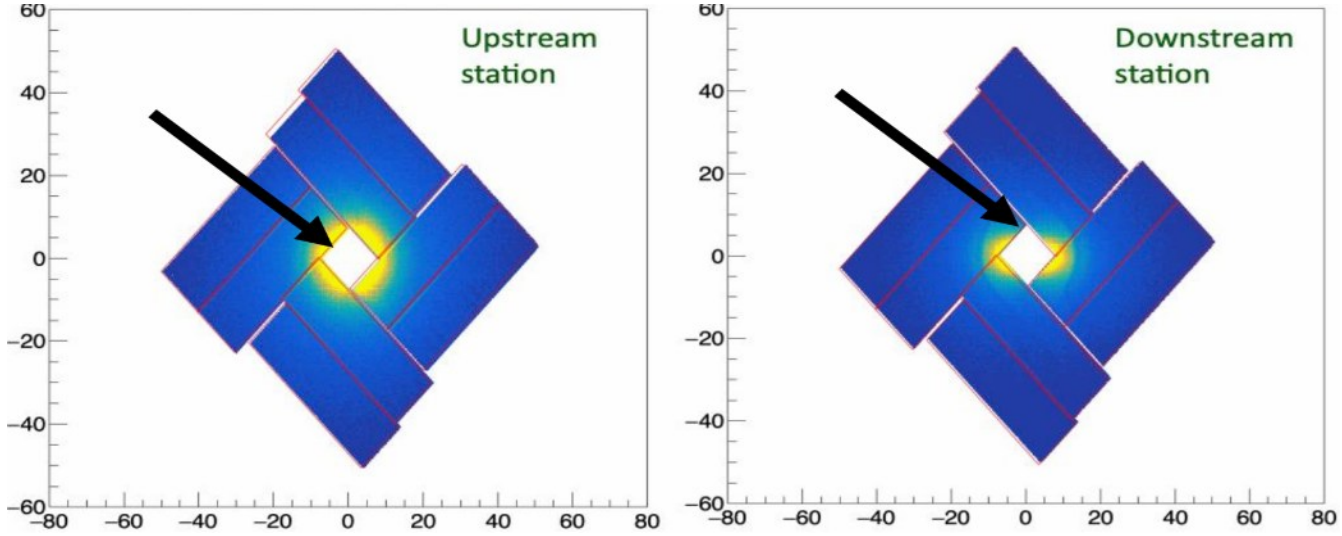


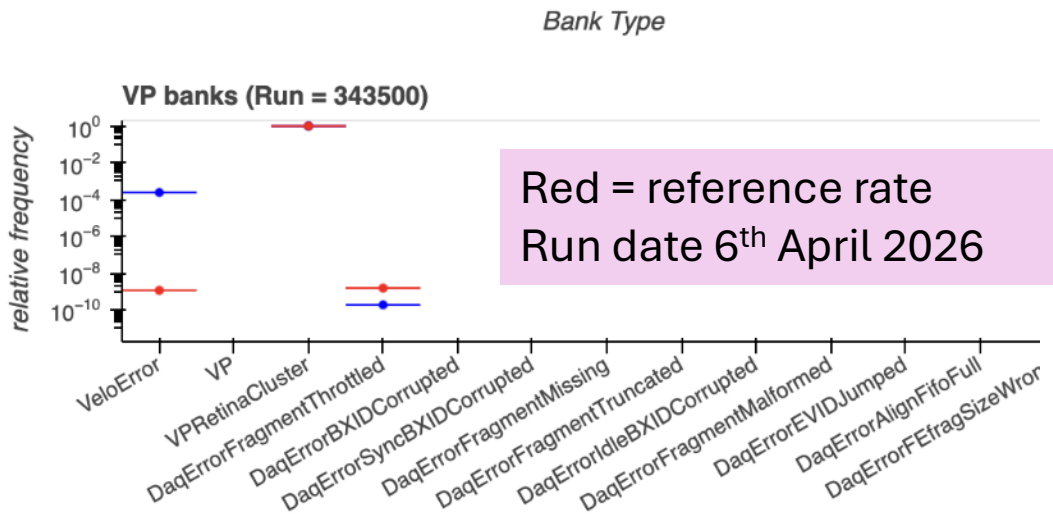
Highly Ionising Objects

- Start of 2025 Pb-Pb run
- Saw HV trips and damage to sensors/chips
- Some chips had massive increase in noise coupled with lots of error banks
- Also beam profile looked different



Damaged chip with extra noise

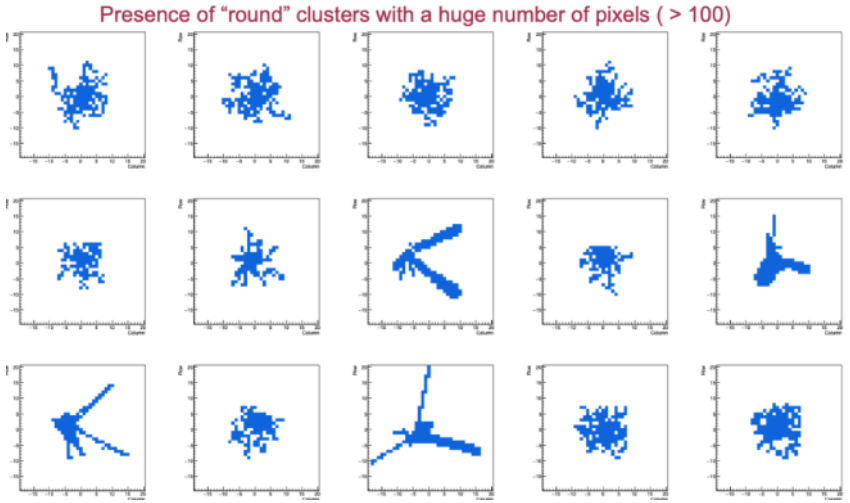


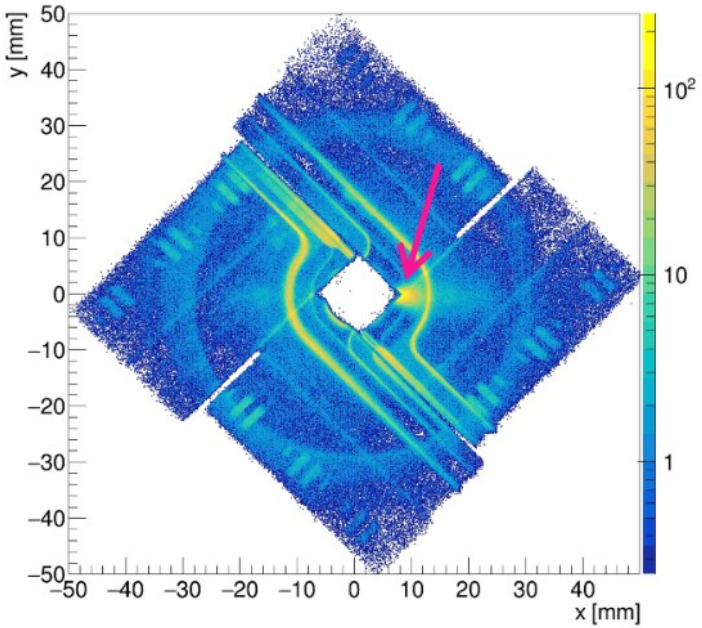


Red = reference rate
Run date 6th April 2026

Remora beam

- But was it the PbPb events causing damage or the increase in HV?
- Looked for large deposits in the VELO and found many
- Looks like there's an offshoot of the beam travelling ~10mm parallel (probably from a collimator upstream)

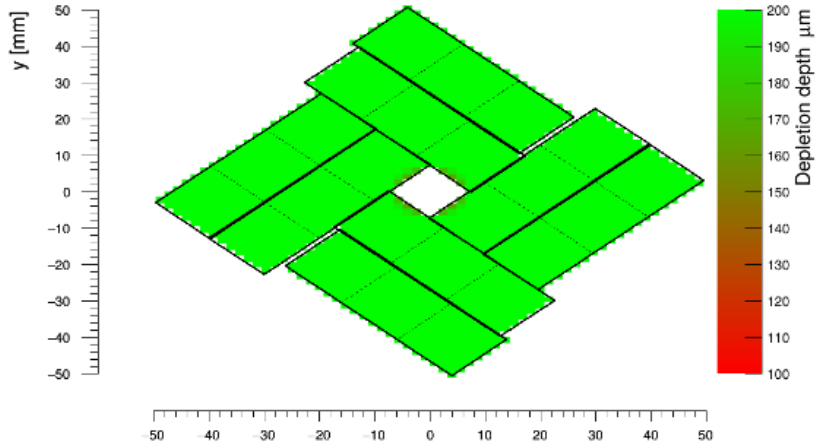




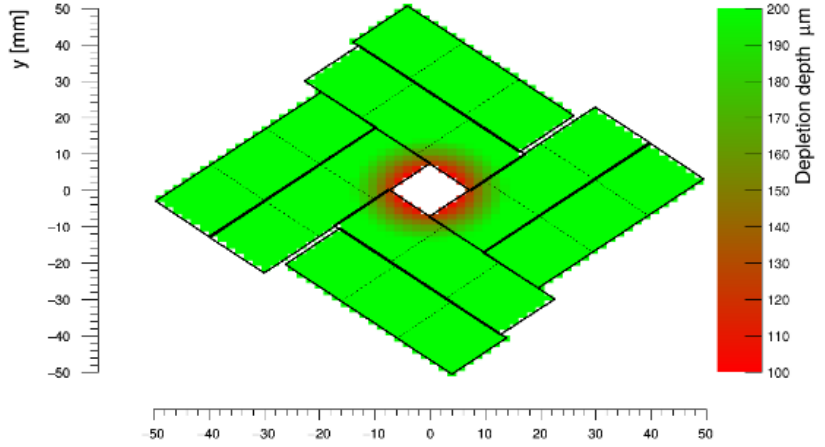
Secondary vertices

Current understanding

- Opened the VELO partially for rest of the PbPb run
- Effect also seen in pp but at a lower rate
- Not clear if the higher voltage exacerbates the issue
- The chips are damaged, not the sensors
- Recalibration has helped recover some damaged chips
- If we can't raise the HV, we have a problem for Run 4!



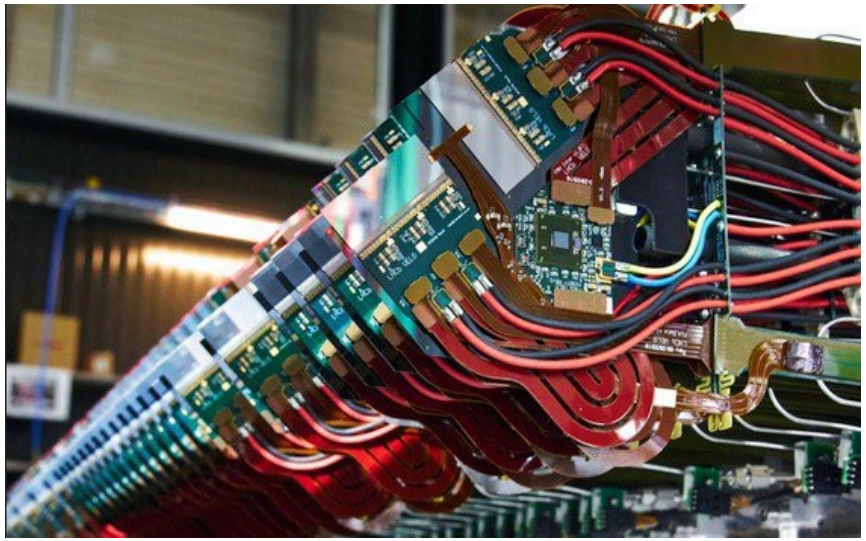
Depletion depth for station 14 at 75 fb^{-1} and 1000V



Depletion depth for station 14 at 75 fb^{-1} and 400V

Replacement

- Current plan is to take out VELO at the end of Run 3 and replace the worst modules.
- Replacing the whole detector does not seem feasible
- Currently at least 10 spare modules available
- Need testing!
- Karol, Kurt, Giuseppe part of the testing team, Kieran will be part of the dismount/reinstall operations



Any questions?

My thanks to everyone in LHCb for both all their work in the last year and providing their input to this presentation.

Backup

Current VELO status

- Significant deterioration compared to this time last year
- Despite (many) mitigations and recoveries, 2 extra half modules dead + damage to interior chips on 2 downstream modules.
- Studies planned at CERN and Heavy Ion facilities to try understand the problems
- Simulations and weekly meetings to try understand the issues