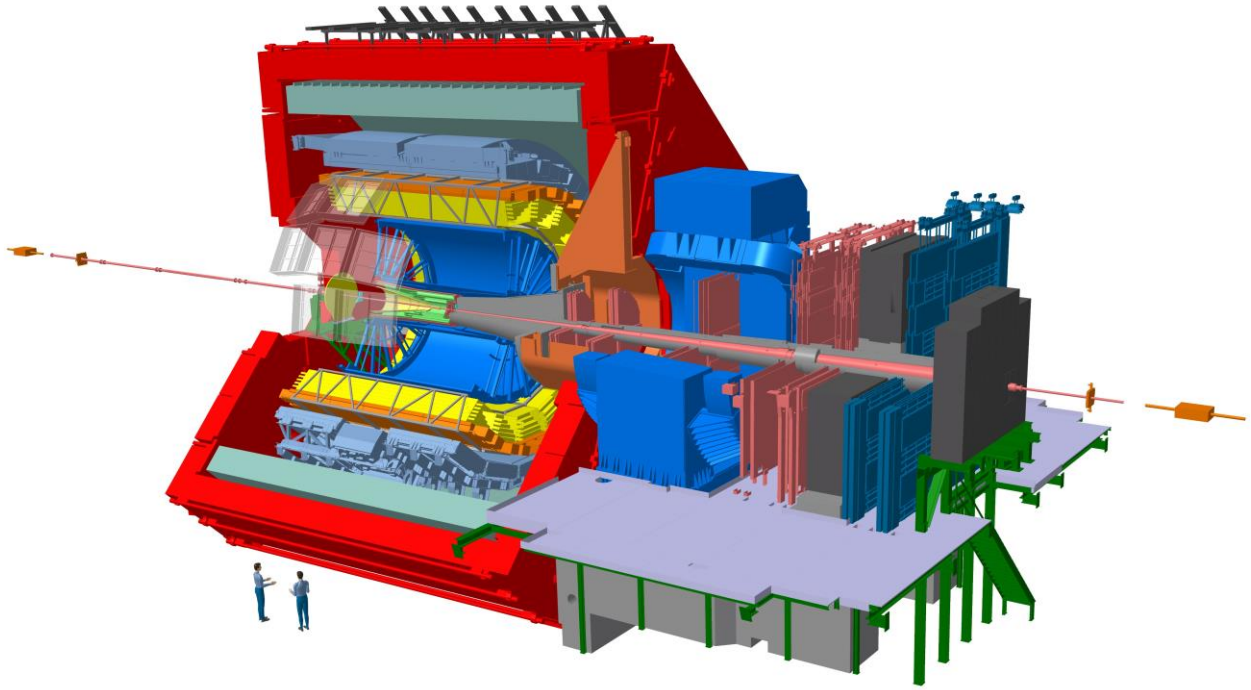
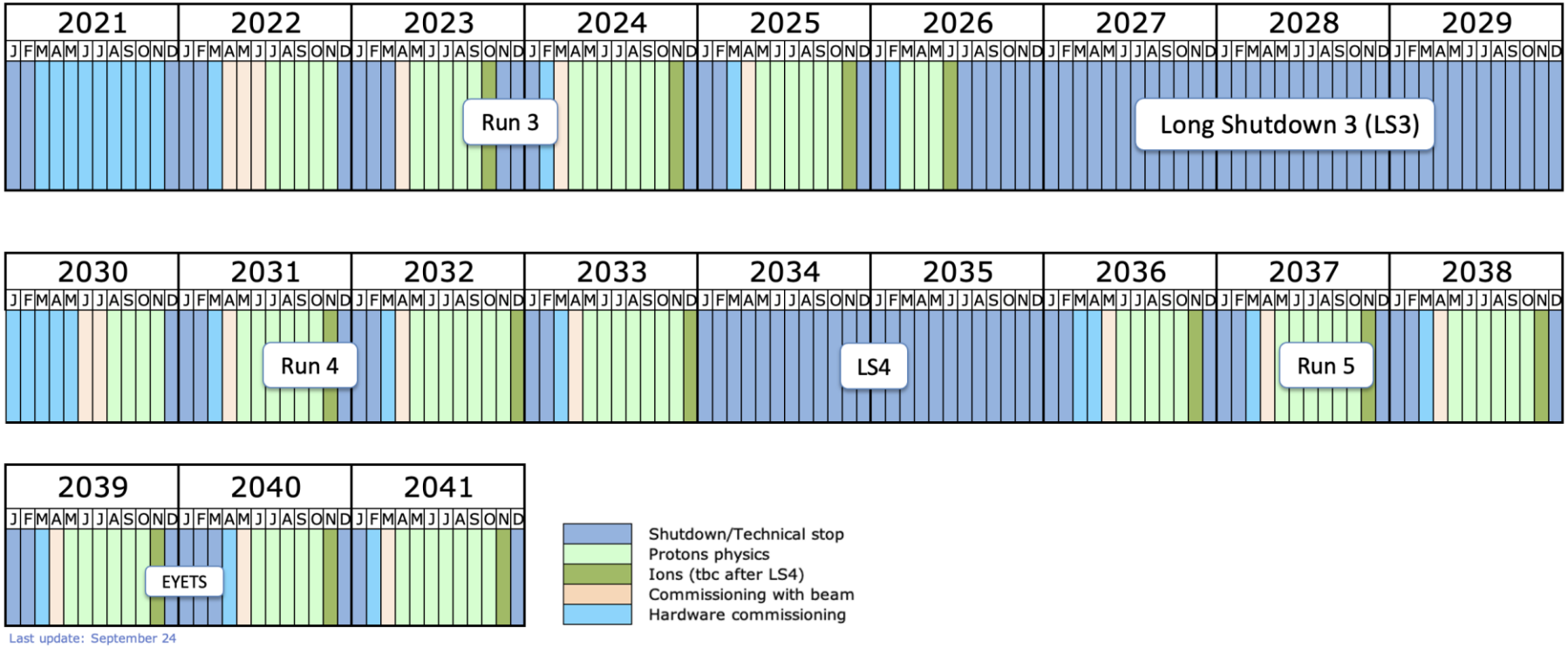
The ALICE group in Lund



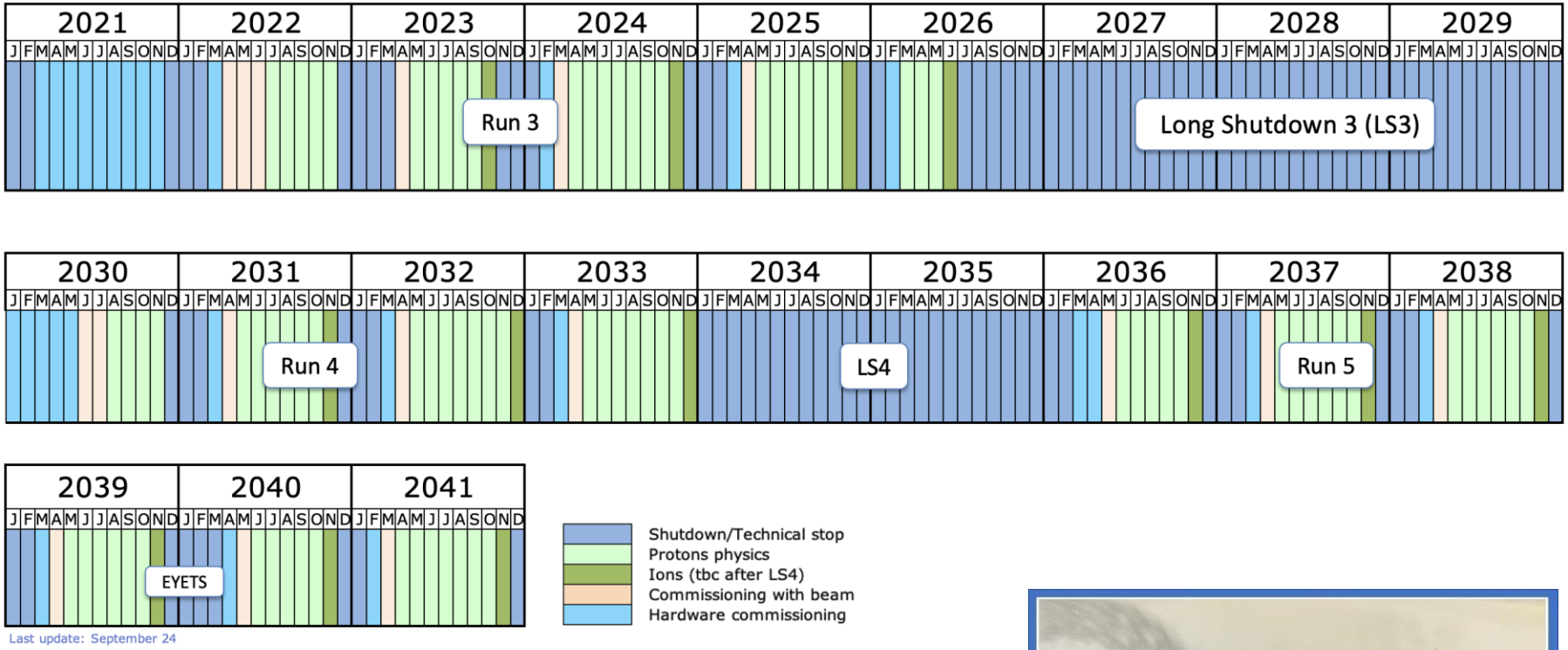
- 3 Seniors: Alice Ohlson, David Silvermyr, Peter Christiansen
- 1 Postdoc: Iaroslav Panasenko
- 4 Ph.D. Students: Joachim Hansen, Kaare Iversen, Roman Nepeivoda, Joey Staa

Activities: data analysis

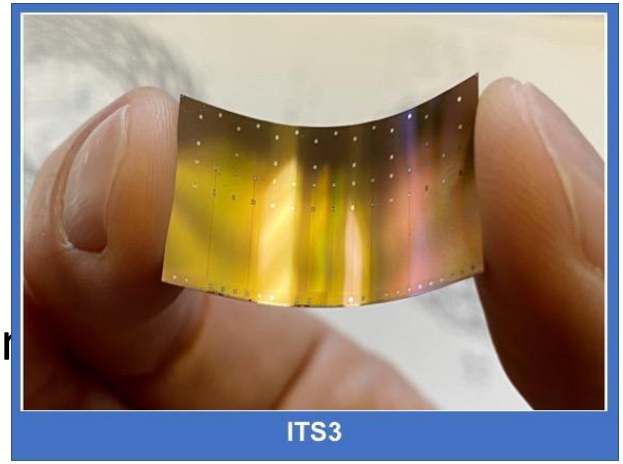


- ALICE has already had its main upgrade (in LS2)
- All 4 PhD students are involved in Run3 analyses covering both pp and Pb-Pb, see also talk of Joey Staa

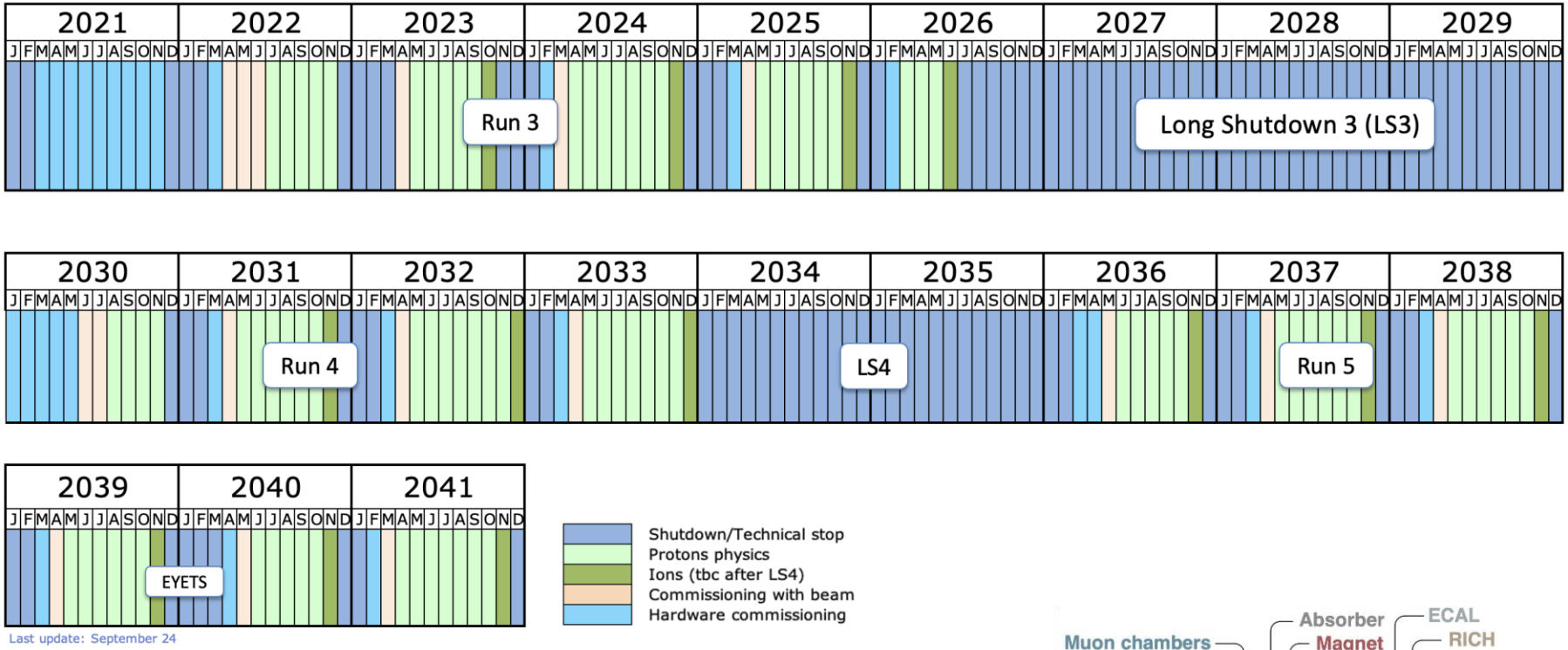
Activities: hardware



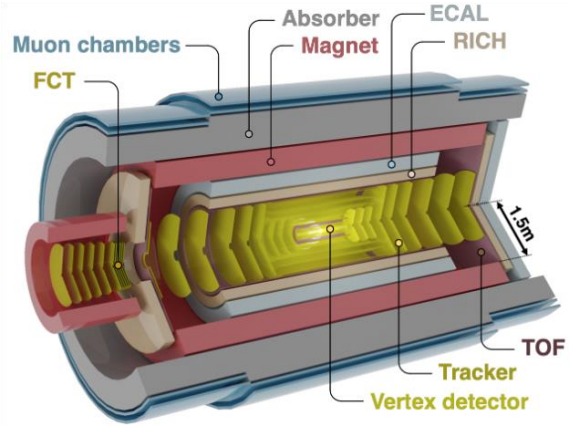
- We are involved in the development of the new ITS3 to be installed in LS3
  - Main activity of Iaroslav Panasenko
  - See David's slides from last Partikeldagarn for more details (link)



Activities: ALICE3



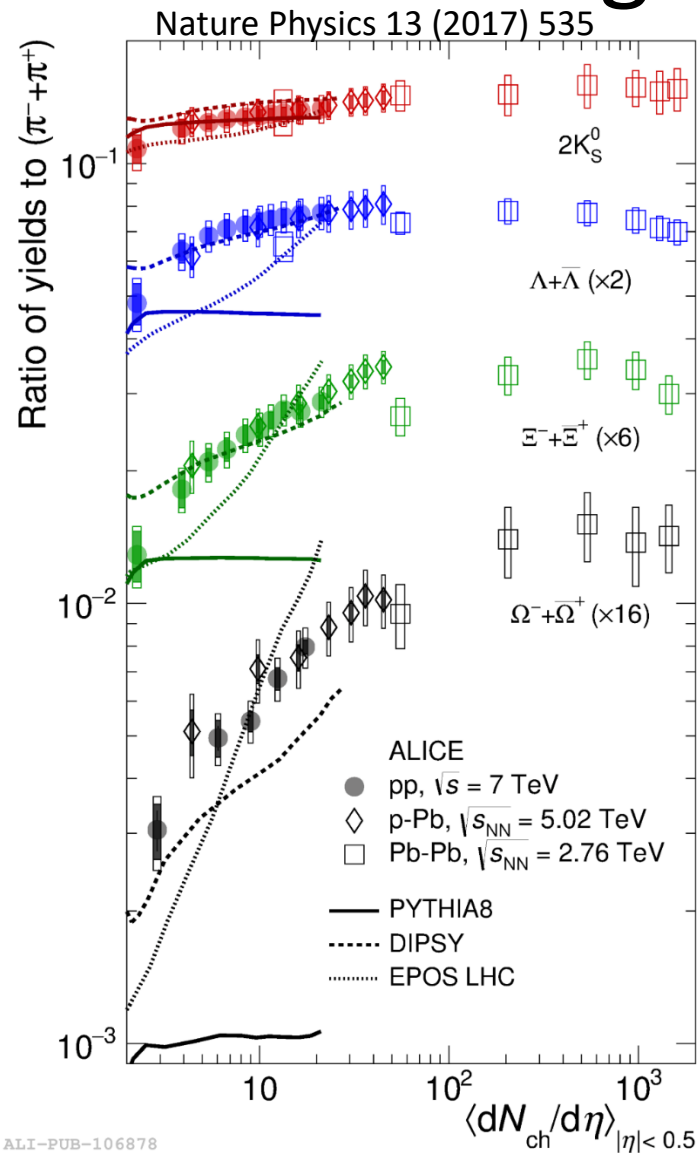
- New proposed experiment for Run5
  - Uses mainly ITS3 technology
  - Can it be a prototype for FCC-ee?



Recent physics results

- Focus on two recent ALICE-related results that indicates that we start to be able to devise tests that can falsify models
  - Going beyond just comparing to models and tuning

Why do we focus so much on the strangeness enhancement?



$(s\bar{d})$

(sud)

(ssd)

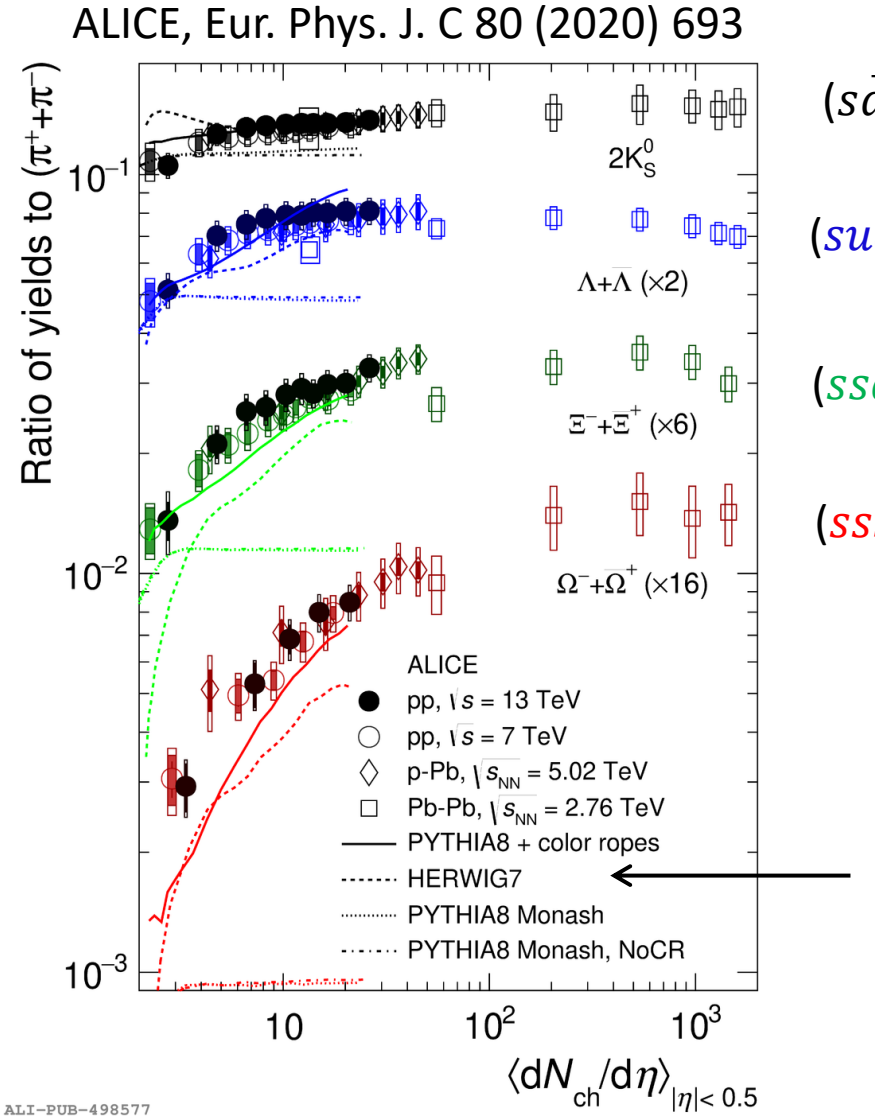
(sss)

PYTHIA:
pp
~ $\sum_{\mathrm{MPI}}$ parton−parton interactions

Predicts “more of the same” as one would expect from jet universality and lack of significant final state interactions.

<u>Irreversible</u> change in understanding of pp collisions!

Over time more models can describe the data



$(s\bar{d})$

(sud)

(ssd)

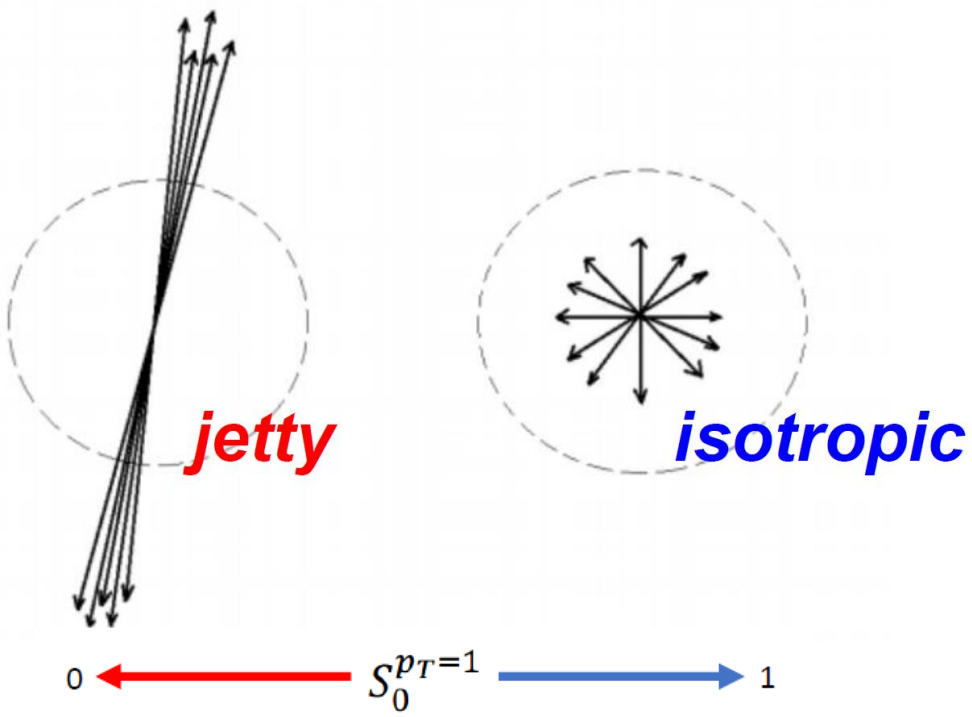
(sss)

- Many models – especially after some time – can describe the same data
- And it is not even clear if discrepancies are problematic or just due to “necessary” approximations
- Big question: how can we falsify some of the models?

Transverse Spherocity S_O

Define the unweighted transverse spherocity:

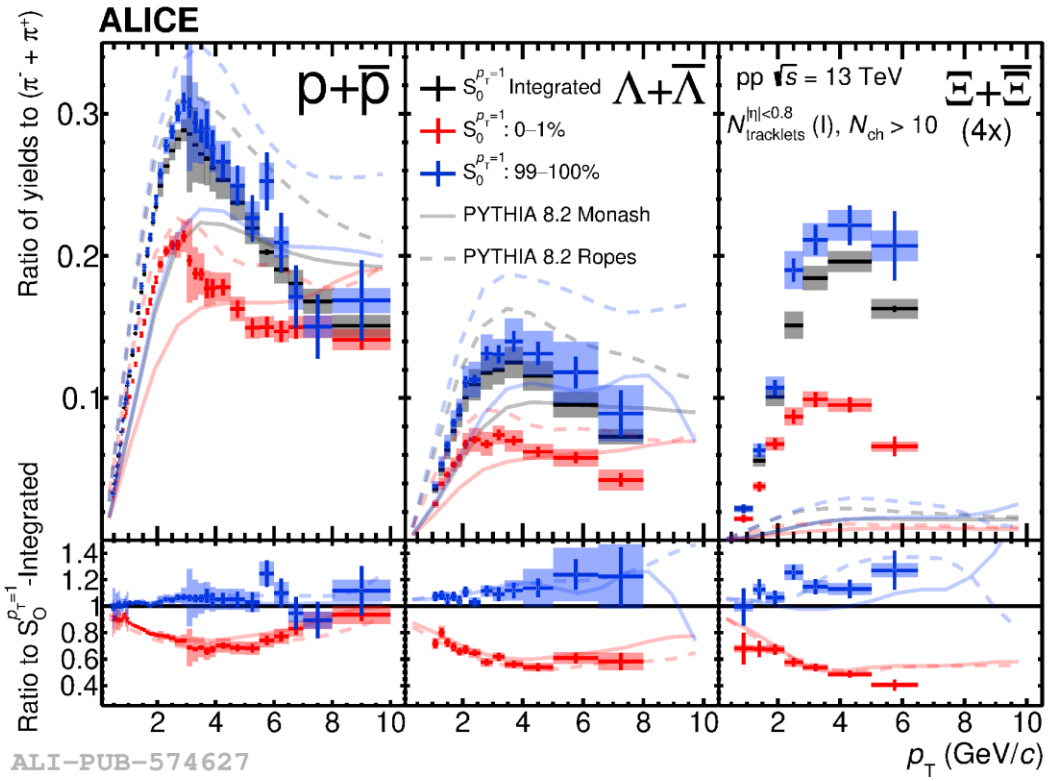
$$S_O^{p_T=1} = \frac{\pi^2}{4} \min_{\hat{n}} \left(\frac{\sum_{tracks} |\hat{p}_T \times \hat{n}|}{N_{tracks}} \right)^2$$



- Most other ALICE results were for the p_T-weighted S_O
  - We need this change because we study shortlived and neutral particles
  - Will call it S_O in the following

ALICE at Lund University (P. Christiansen, Lund)

Jetty vs Isotropic results

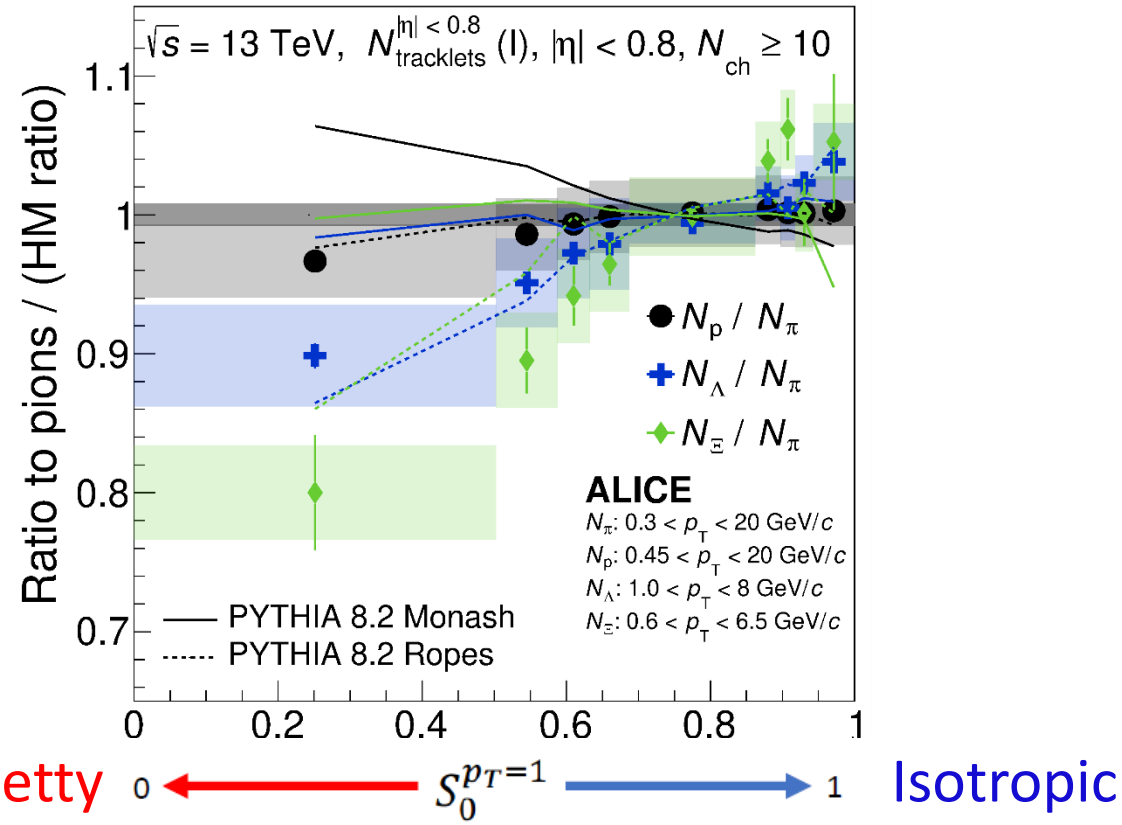


ALICE, JHEP 05 (2024) 184

- Results for top 1% multiplicity and top 1% S_O (0.01% of events)
- Large differences between Jetty and Isotropic particle ratios ✓
- Events without S_O selection are similar to Isotropic
  - Jetty events are the outliers
    - In jetty events, strangeness is significantly reduced at high p_T

ALICE at Lund University (P. Christiansen, Lund)

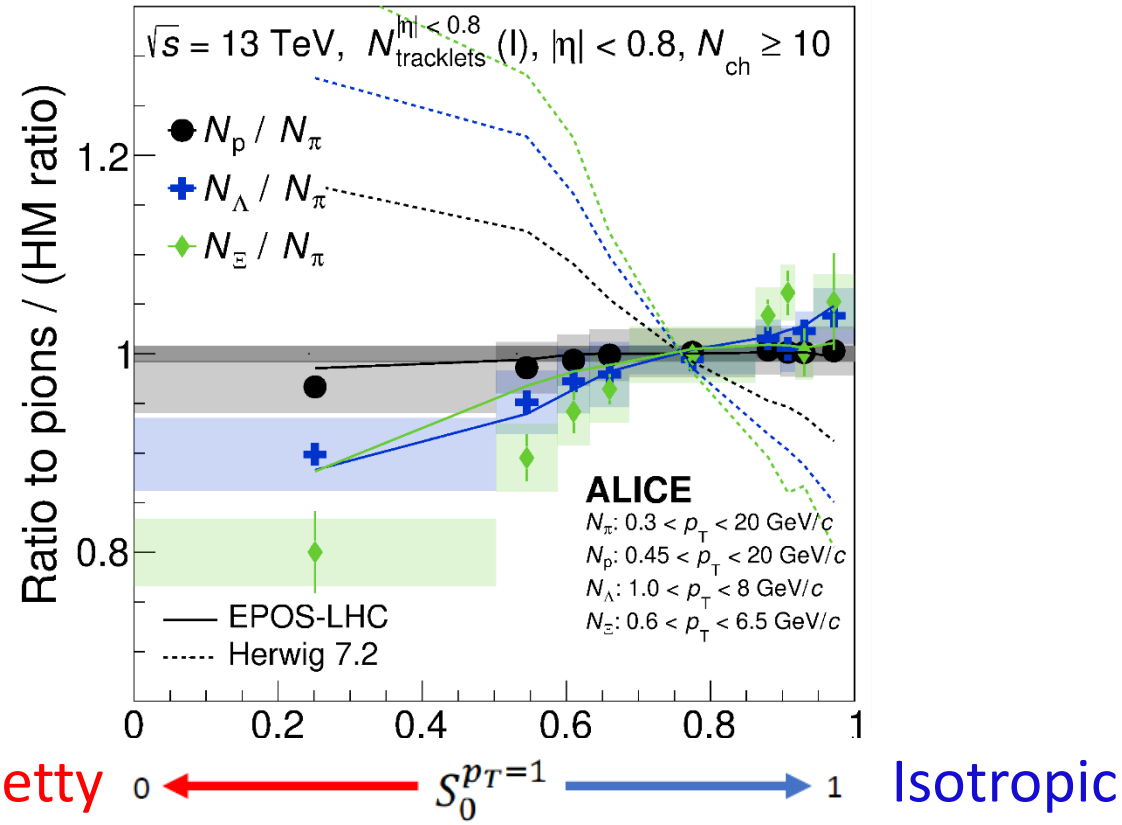
Strangeness modification vs S_0



- We can control the strangeness enhancement with S_0 ✓
  - The effect is bigger for Ξ (S=2) than for Λ (S=1)
- Pythia ropes can describe the enhancement qualitatively

ALICE at Lund University (P. Christiansen, Lund)

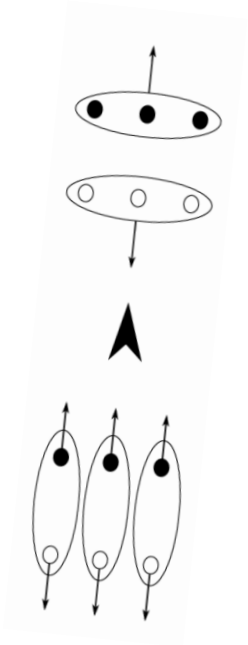
Strangeness modification vs S_0

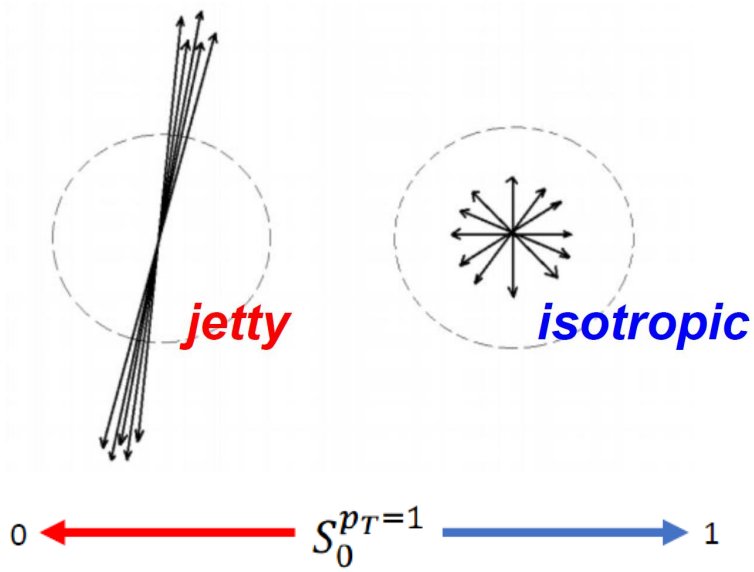


- EPOS LHC captures the trend
  - The QGP core is reduced in jetty events
- HERWIG has opposite trend?! (next slide)

Why Herwig is wrong

S. Gieseke,
P. Kirchgaeßer,
S. Plätzer
Eur.Phys.J.C 78 (2018) 2, 99



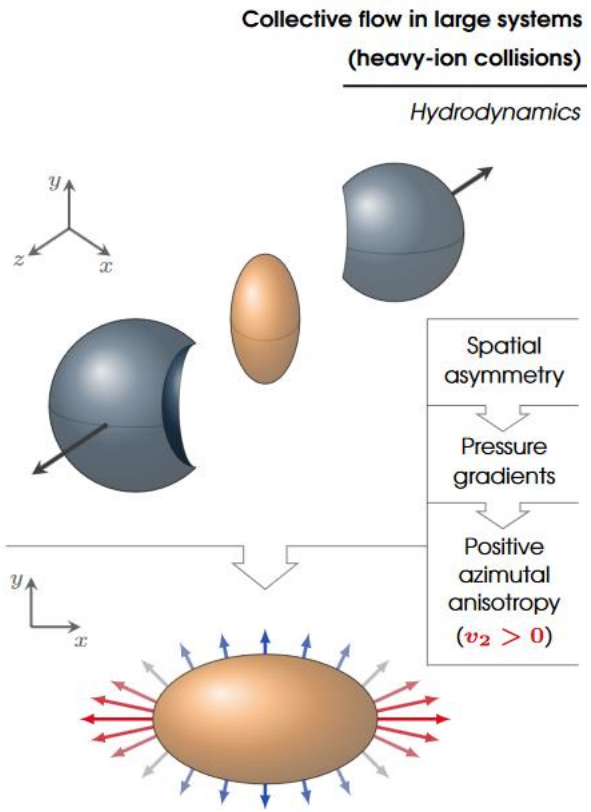


- Herwig produces a baryon enhancement by allowing 3 mesons close in phase space to form a baryon-antibaryon pair
  - But this will be more likely to happen in pencil-like events!
  - Can this challenge other models?
    - What about quark coalescence models?

Another way to test models

- Going against the flow: Revealing the QCD degrees of freedom in hadronic collisions
  - Christian Bierlich, Peter Christiansen, Gösta Gustafson, Leif Lönnblad, Robin Törnkvist, Korinna Zapp
  - https://arxiv.org/abs/2409.16093

The sign of the elliptic flow (v_2)



- In Pb-Pb collisions it is positive ($v_2 > 0$)

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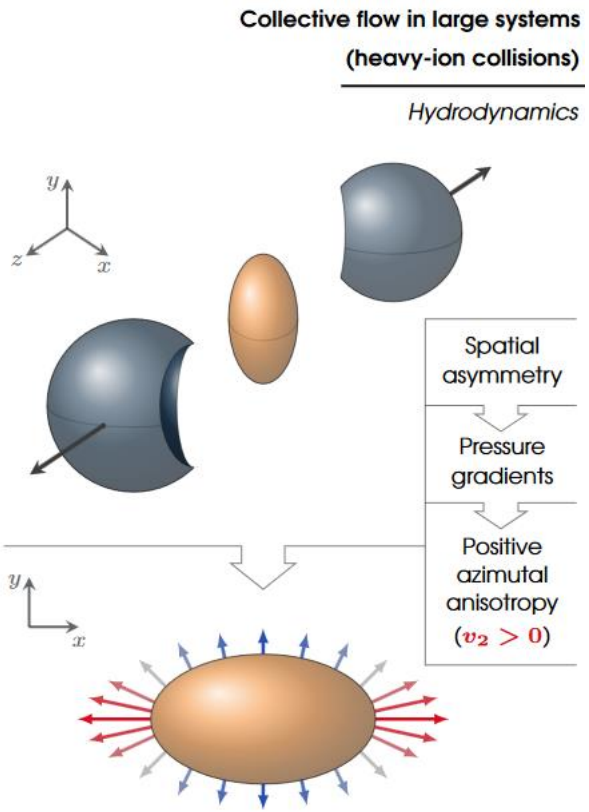

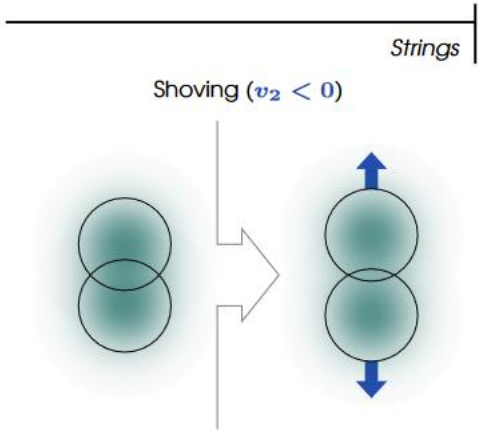

- In Pb-Pb collisions it is positive ($v_2 > 0$)
- But in some small system models it can be negative ($v_2 < 0$)

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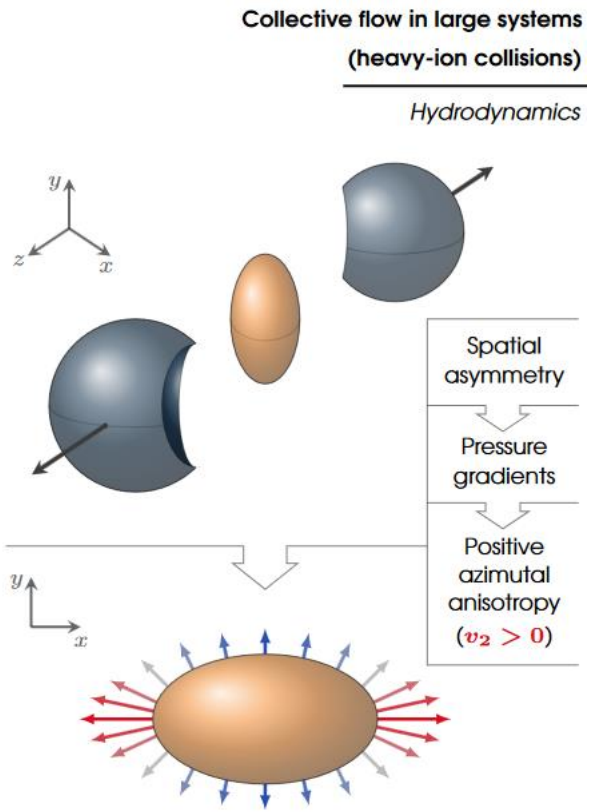

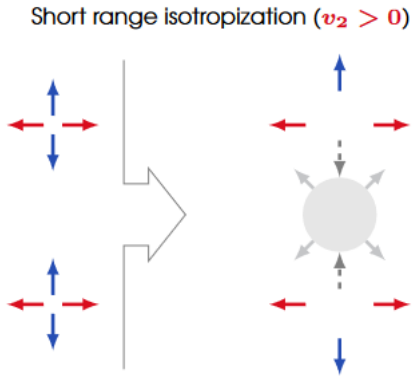

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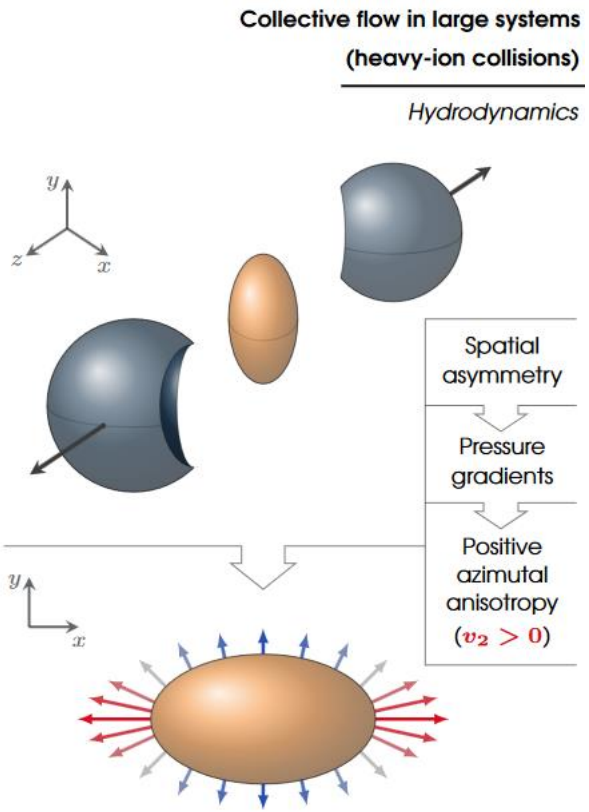

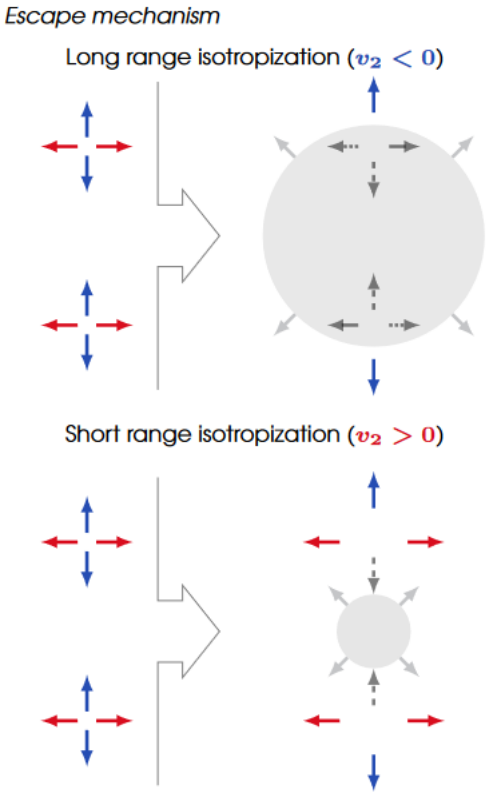

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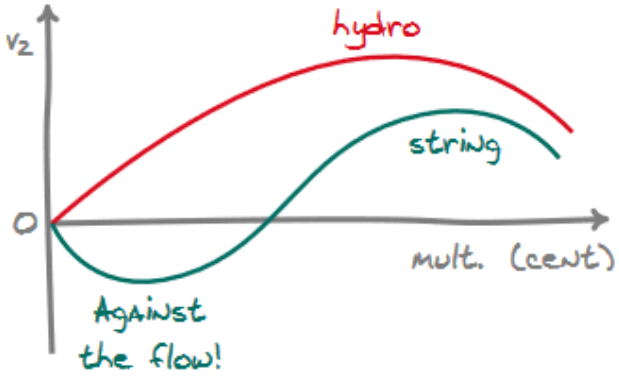
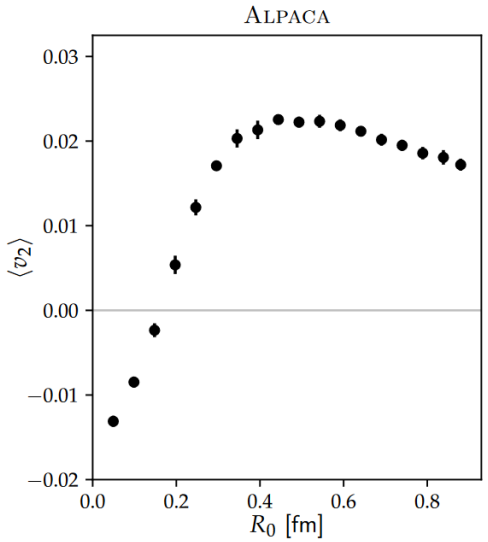
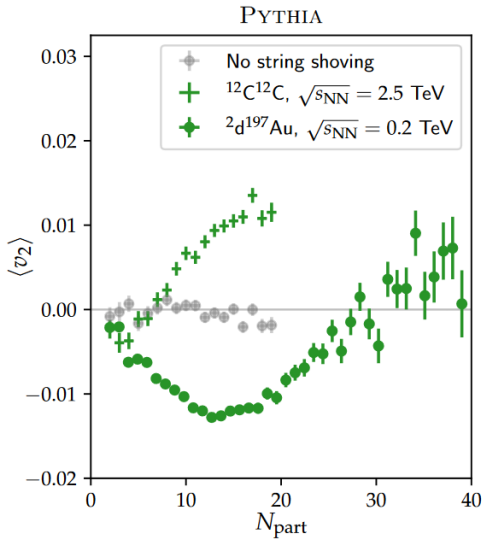
Proposed test







- We want to observe a change of the sign of v_2 with multiplicity
- Challenge: you need a way to determine the reaction plane like directed flow (v_1) in large systems
  - Can one maybe find another way?

Conclusions and outlook

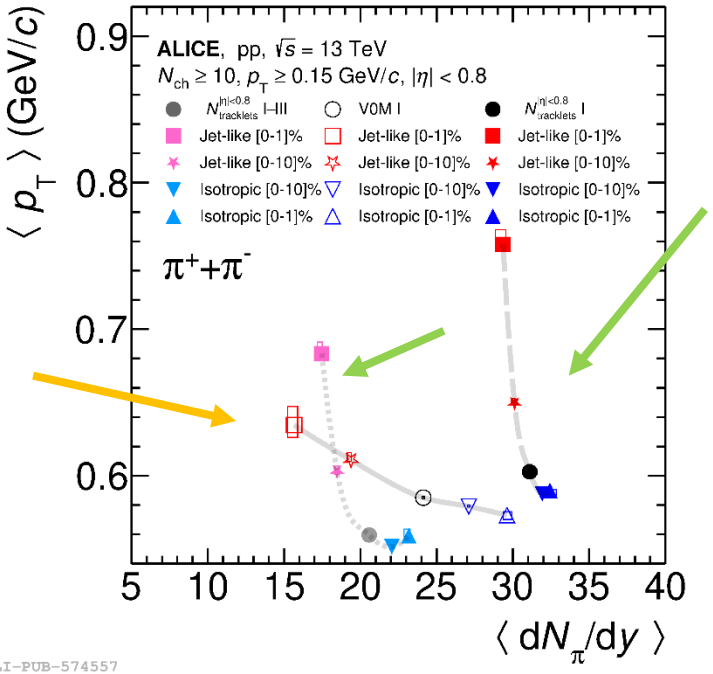
- A lot of analysis activities taking advantage of the upgraded ALICE detector
- Development of ITS3 for Run 3
  - New ALICE 3 experiment?
- Overlapping activities with theorists in Lund that can hopefully lead to many new ideas and tests

Thank You!

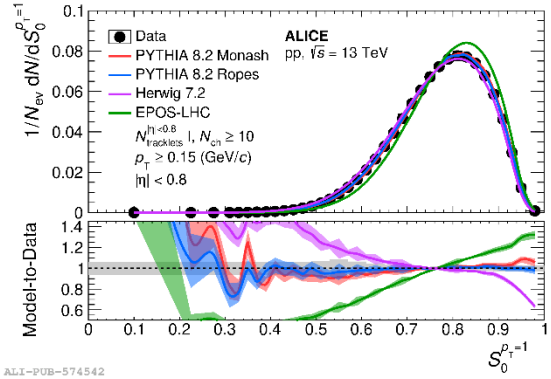
Backup

The effect of S_O selection for different multiplicity estimators

Forward estimator
Different region than where we measure S_O
Shown for top 10%.
(typically used in ALICE to avoid autocorrelations)



Mid-rapidity estimator
Same region where we measure S_O



- Physics we can address with S_O depends on where we select the multiplicity
- The following results are all done with the mid-rapidity estimator
  - This ensures that multiplicity is almost constant so that we mainly select harder or softer events