

# HSF Event Generator Tuning Workshop

27<sup>th</sup> June 2023

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# ALICE overview and ideas for event generators tuning

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on behalf of ALICE

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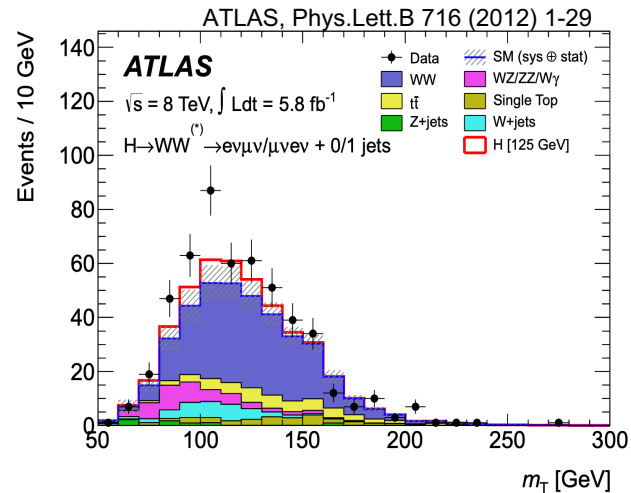
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# Why do Collaborations need tuning?



Monte Carlo event generators tuning is *usually* needed for accurate

- discoveries** – prediction-to-data differences bring to a discovery
- corrections** – precisely tuned simulations help in correcting for efficiency/acceptance/background effects in data





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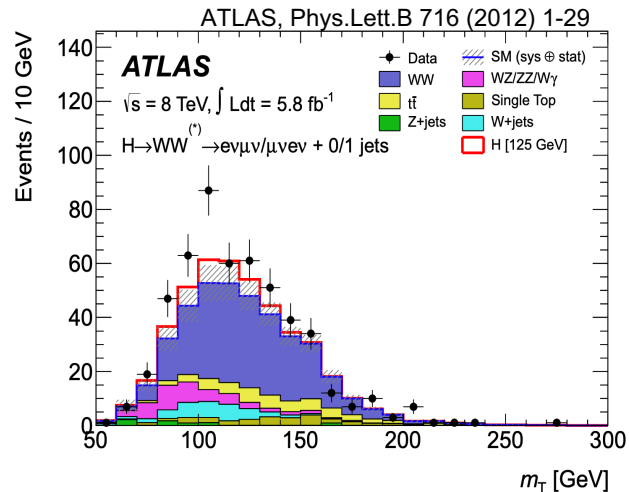
1. **discoveries** – prediction-to-data differences bring to a discovery

2. **corrections** – precisely tuned simulations help in correcting for efficiency/acceptance/background effects in data



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Almost exclusively for this purpose  
in ALICE





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# When *can* a simulation be precise?

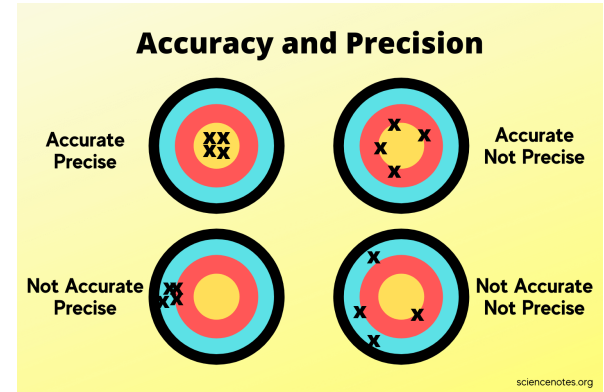


**Precision:** “the quality of being exact, accurate and careful” – Oxford dictionary

Perturbative QCD processes are the only ones that are calculable exactly and accurately.

In ALICE this means

1. jets
2. heavy-flavour processes





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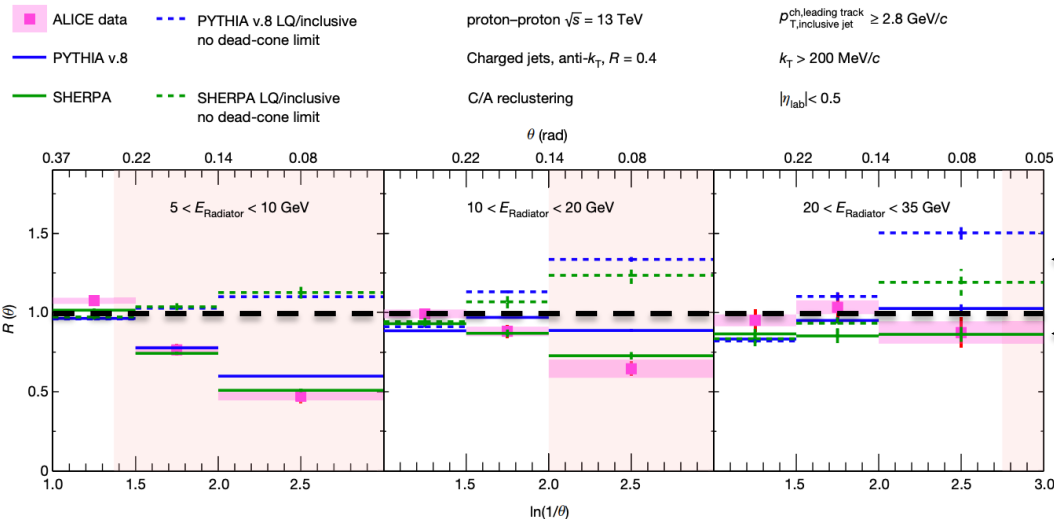
# Predictions bring to discoveries



## QCD dead-cone effect (\*):

- not a strict example of tuning, but an example of when **precise predictions** – with specific settings – drive to discovery

ALICE, Nature 605 (2022) 7910, 440-446



← not suppressed

← suppressed

(\*) gluon emissions suppressed in a dead cone with angular scale  $< m_q / E_{Radiator}$



# Core of ALICE physics programme



The ALICE Collaboration has built a detector optimised to study the **collisions of nuclei** at the ultra-relativistic energies provided by the LHC.

Nuclei simulations are implemented in some Monte Carlo generators – non exhaustive list:

Model	Implementation in AA	Available tunes
DPMJet	QGP	x
EPOS	QGP at high density	general tune of EPOS1.99 to LHC data
HIJING	QGP	x
JETSCAPE	QGP in AA	pp tune
Pythia/Angantyr	No QGP	several pp tunes



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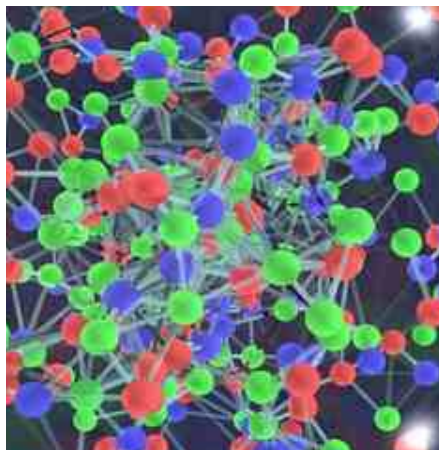


# Why tuning is *almost* absent in AA?



The reason lies on the fact that precise calculation are not possible:

1. **excess of degrees of freedom**



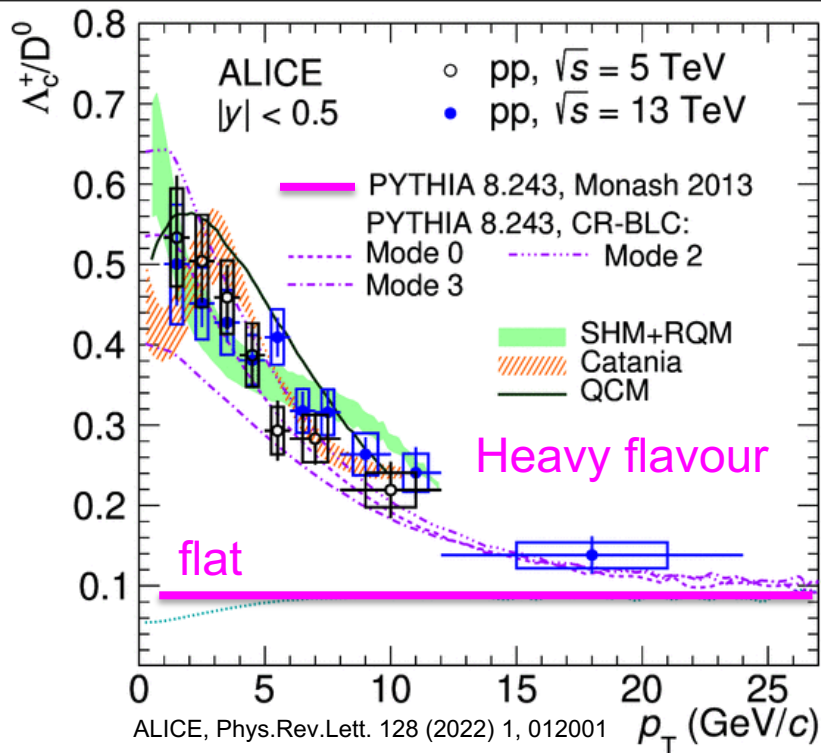
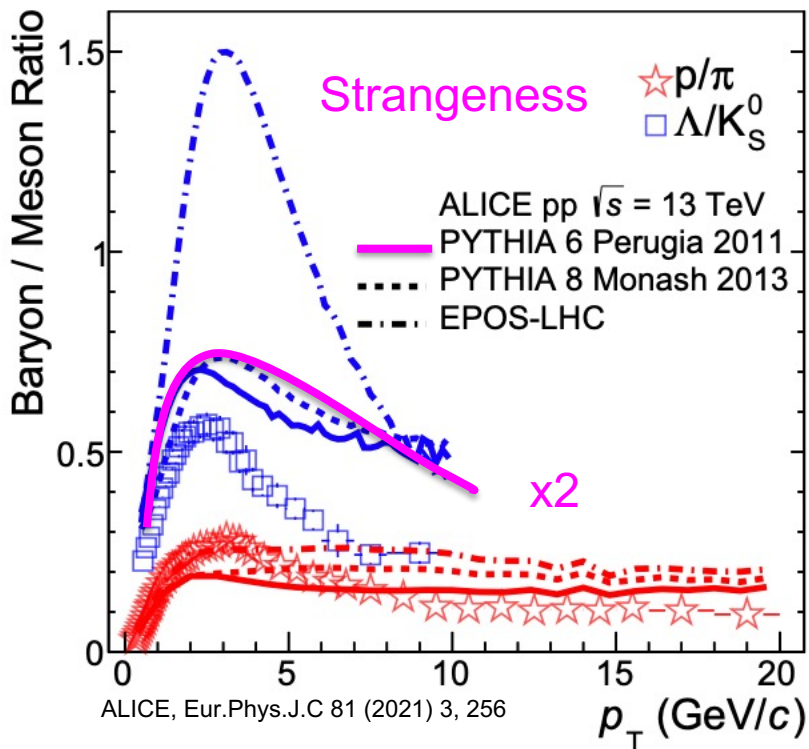
2. **soft QCD processes** rely on phenomenology, such as, e.g.:
  - soft diffraction
  - beam remnants
  - hadronisation





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# pp: focus on hadronisation



Pythia example: there is no tuning that can help!



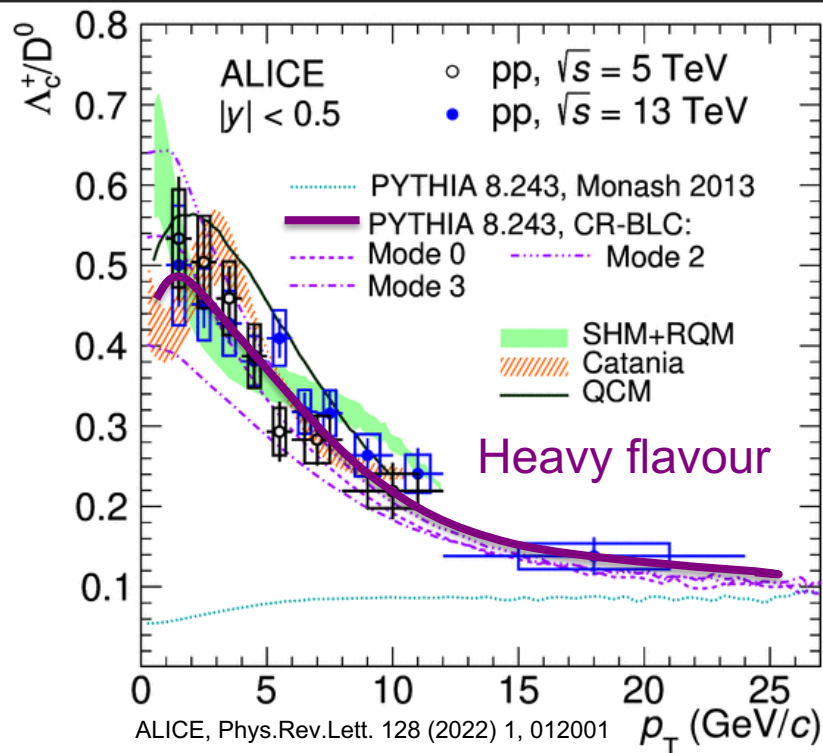
# pp: focus on hadronisation



New model for colour reconnections was needed

Tuning can be performed *if necessary* when a model can get basic features (\*)

(\*) e.g. see N. Fischer and T. Sjöstrand, JHEP 01 (2017) 140





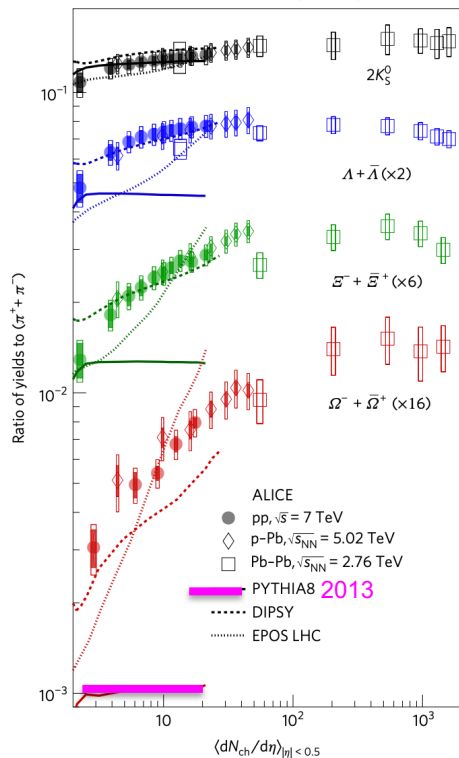
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# pp: focus on hadronisation

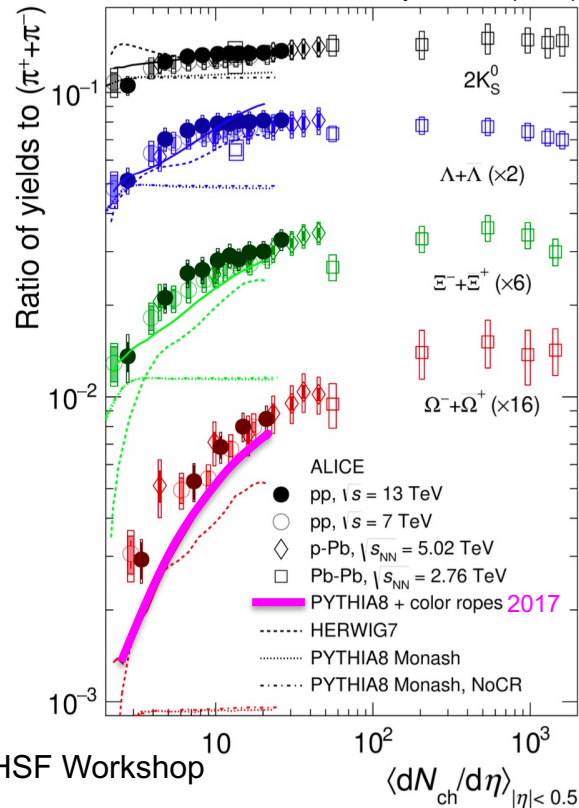


Same considerations apply to strangeness: new modelling to enhance string tension

ALICE, Nature Phys. 13 (2017) 535-539



ALICE, Eur.Phys.J.C 80 (2020)



No ALICE tune available for any of the generators presented, but...

The Future is  
Bright

Plans to work on a **strangeness tune of Pythia Ropes using ALICE data**

- will allow *primarily* to increase the precision and usability of MC simulations to correct for efficiency / acceptance / background effects with optimised computational resources
- will increase our understanding of the consequences of single parameter variations in phenomenological models