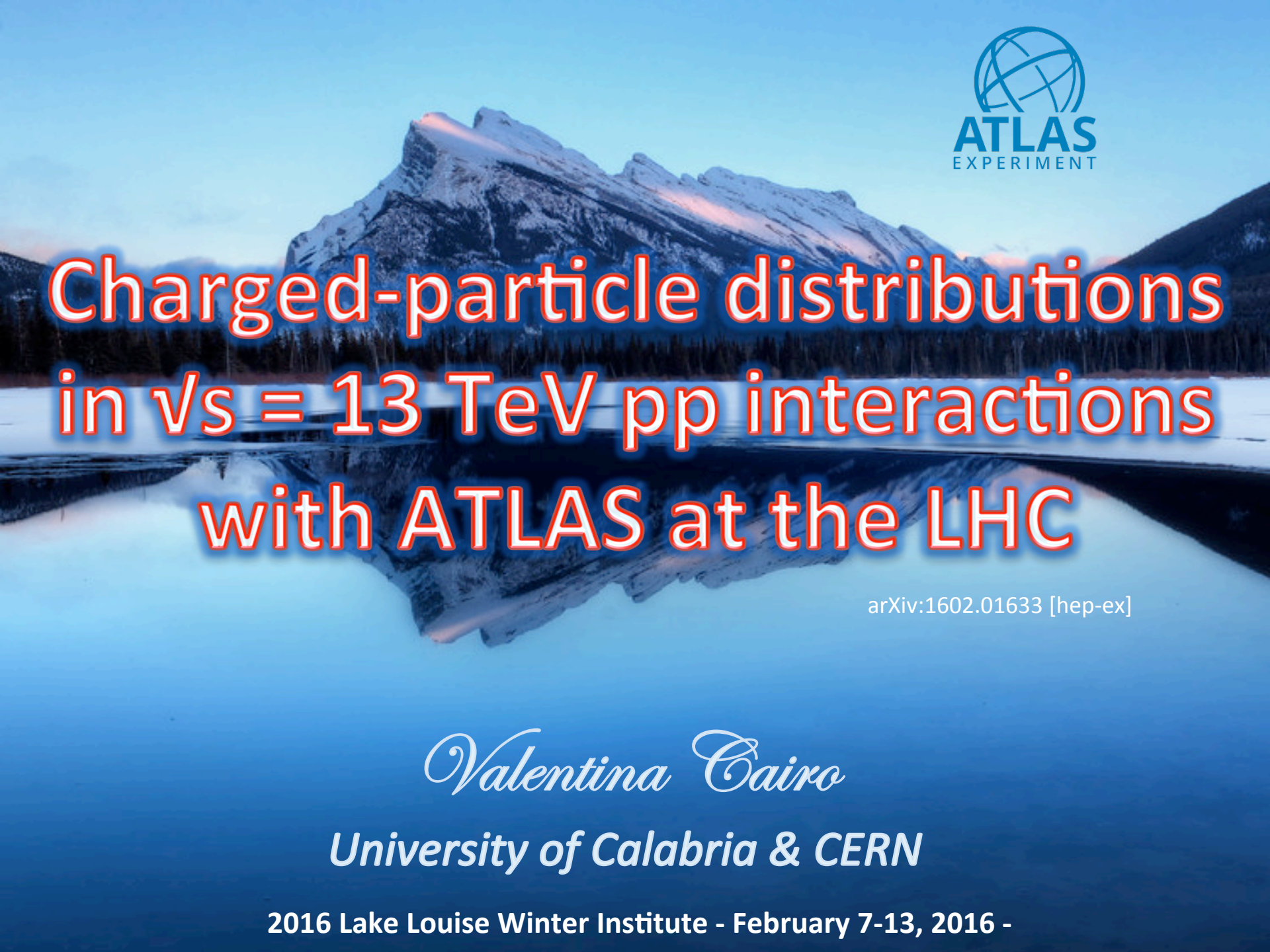

Charged-particle distributions in $\sqrt{s}$ = 13 TeV pp interactions with ATLAS at the LHC

arXiv:1602.01633 [hep-ex]

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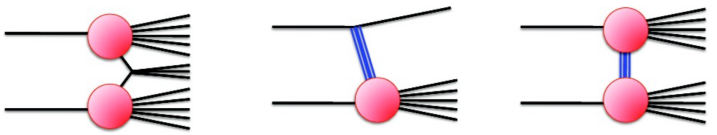
2016 Lake Louise Winter Institute - February 7-13, 2016 -

Introduction

- Inclusive charged-particle measurements in *pp* collisions provide insight into the strong interaction in the low energy, non-perturbative QCD region

- Inelastic pp collisions have different compositions



Non-diffractive | Single-diffractive | Double-diffractive

- Main source of background when more than one interaction per bunch crossing

- Perturbative QCD can not be used for peripheral interactions
  - ND described by QCD-inspired phenomenological models (tunable)
  - SD and DD hardly described and little data available

Goal:

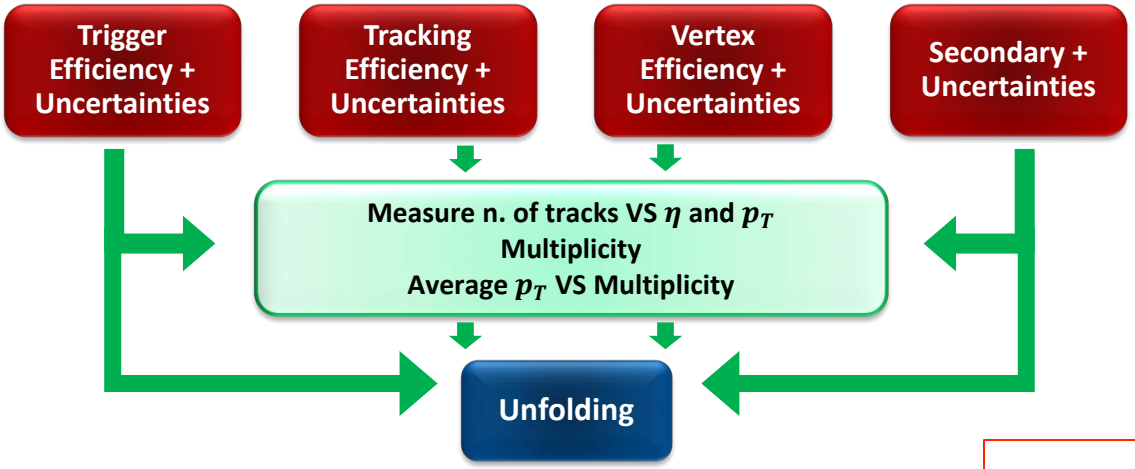
Measure spectra of unfolded primary charged particles

- Three different phase-spaces studied at 13 TeV:
  - Nominal: $p_T > 500$ MeV, $|\eta| < 2.5$ (Presented today)
  - Reduced: $p_T > 500$ MeV, $|\eta| < 0.8$ (For comparison to the various detectors)
  - Extended: $p_T > 100$ MeV, $|\eta| < 2.5$ (To investigate the low p_T region)

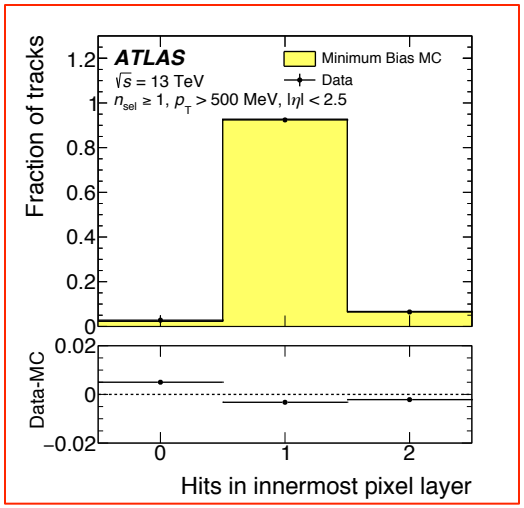
- Many different phase-spaces (included high multiplicity) studied at 8 TeV! (just published)

CERN-EP-2016-020

Analysis overview and Data Selection



- **Accepted on single-arm** Minimum Bias Trigger Scintillator (**MBTS**)
- **Primary vertex** (2 tracks with p_T >100 MeV)
- **Reject pile up** with veto on any additional vertices with ≥ 4 tracks
- **At least one selected track**:
  - **p_T > 500 MeV** and **|η| < 2.5**
    (note track reconstruction runs with 100 MeV)
  - **At least 1 Pixel hit**
  - **At least 6 SCT hits**
  - **IBL or BL hit required** (if expected)
  - **$|d_0^{BL}|$ < 1.5 mm** (transverse impact parameter w.r.t beam line)
  - **$|\Delta z_0 \sin\vartheta|$ < 1.5 mm** (Δz_0 is the difference between track z_0 and vertex z position)
  - **Reject fakes** with track fit χ^2 probability > 0.01 for tracks with p_T > 10 GeV



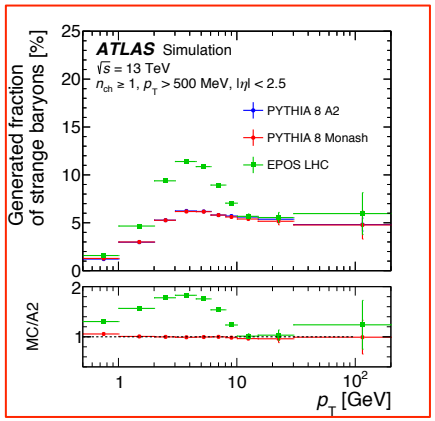
Using the two 13 TeV low mu (<μ> ~ 0.005) runs:

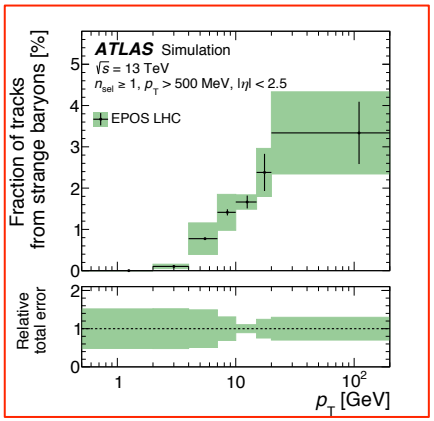
168 μb^{-1}
8,870,790 events selected, with
106,353,390 selected **tracks**!

New Aspects

Strange Baryons

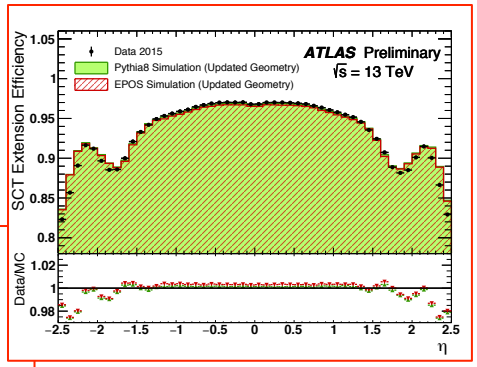
- Particles with lifetime 30 ps < τ < 300 ps (**strange baryons**) are **no longer considered primary particles** in the analysis, decay products are treated like secondary particles
- Low reconstruction efficiency (<0.1%) and large variations in predicted rates lead to a model dependence
- **Final results produced with and without the strange baryons** to allow comparison with previous measurements

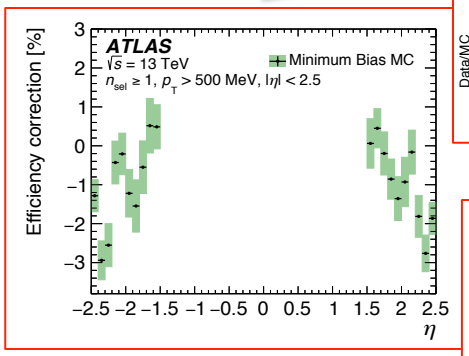


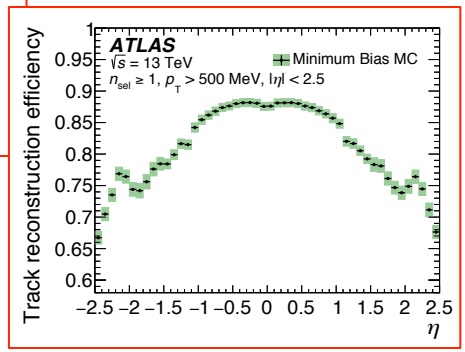


Data-Driven correction to tracking efficiency

- The track reconstruction efficiency in is corrected by using a method that compares the efficiency to extend a track reconstructed in the pixel detector into the SCT (**SCT Extension Efficiency Method**) in data and simulation

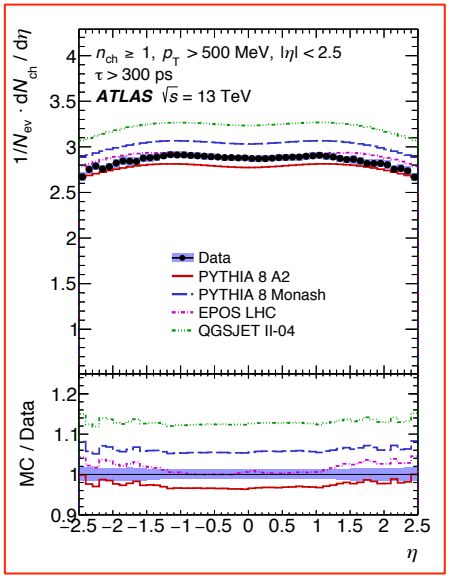




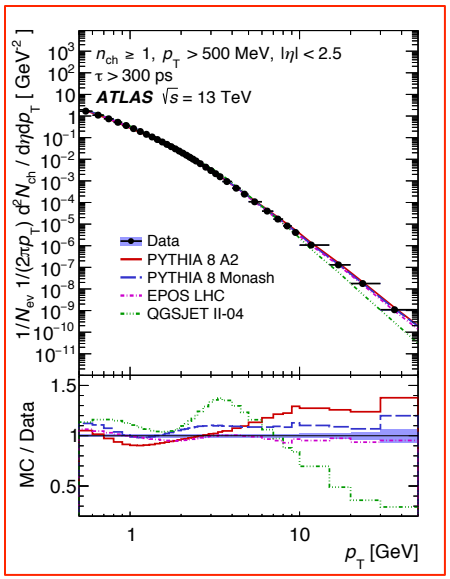


Final Results

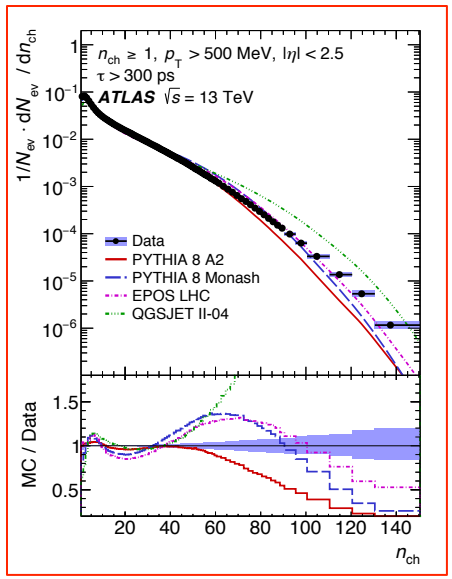
$dN_{ch}/d\eta$



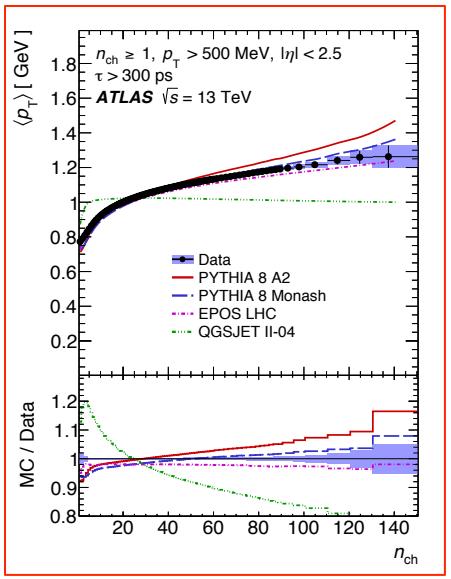
$d^2N_{ev}/d\eta dp_T$



dN_{ev}/dn_{ch}



$\langle p_T \rangle$ VS n_{ch}



Models differ mainly in normalisation, shape similar

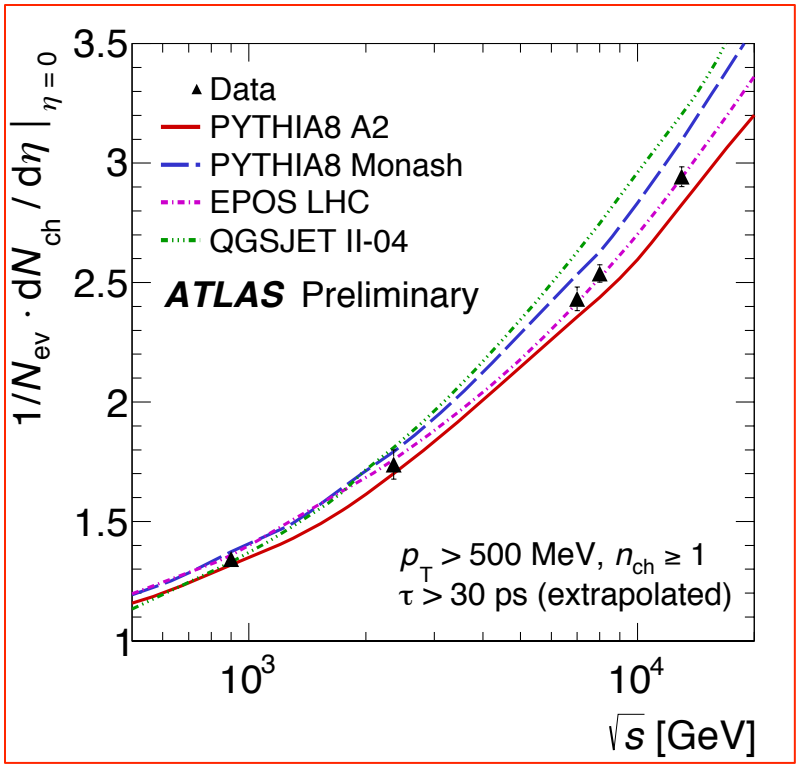
Measurement spans 10 orders of magnitude

Low n_{ch} not well modelled by any MC; large contribution from diffraction;
Models without colour reconnection (QGSJET) fail to model scaling with nch very well

Some Models/Tunes give remarkably good predictions:

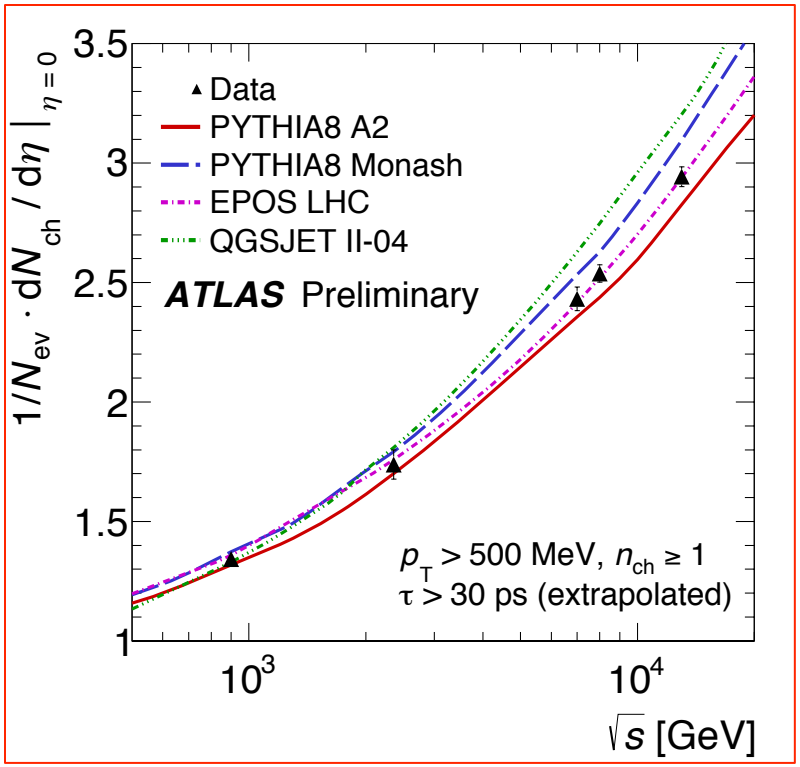
- **Pythia8-A2** (used as baseline) shows **nice agreement with data**
- **Epos-LHC** is performing **even better**!

Final Results



Mean number of **primary charged particles increases by a factor of 2.2** when √s increases by a factor of about 14 **from 0.9 TeV to 13 TeV**!

Final Results



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For further details… See the poster!

2016 Lake Louise Winter Institute - Poster Session
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ATLAS EXPERIMENT

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