Pseudorapidity densities of charged particles with transverse momentum thresholds in pp collisions at $\sqrt{s}$ = 5.02 and 13 TeV with ALICE

30th CONFERENCE ON ULTRA-RELATIVISTIC NUCLEUS-NUCLEUS COLLISIONS: Quark Matter 2023
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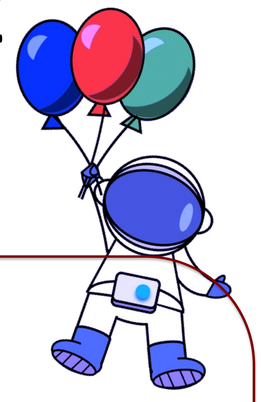
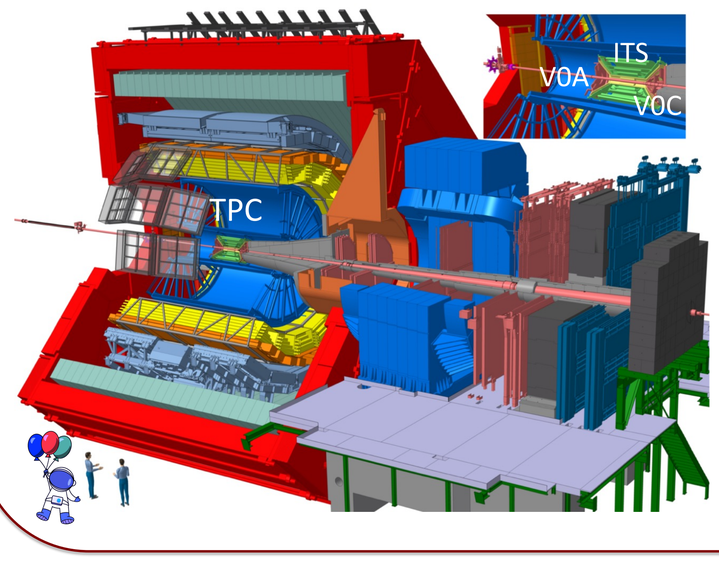


Motivation

Pseudorapidity density of charged particles $\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$

- $\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ is a key observable for understanding the general properties of particle production in high-energy hadronic collisions
- $\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$measurements provide constraints on particle production mechanisms and input for tuning of MC event generators
- $\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ serves as reference data to study nuclear effects in nucleus-nucleus and proton-nucleus collisions

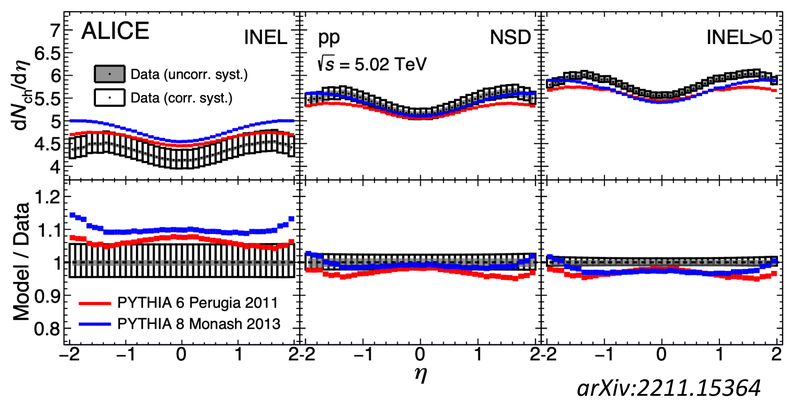
ALICE detector in Run 2



Detectors used in this analysis

- ITS Inner Tracking System
  tracking, event selection, vertex
- TPC Time Projection Chamber
  tracking $|\eta|<0.8$
- V0
  triggering, event selection

$\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ for event classes



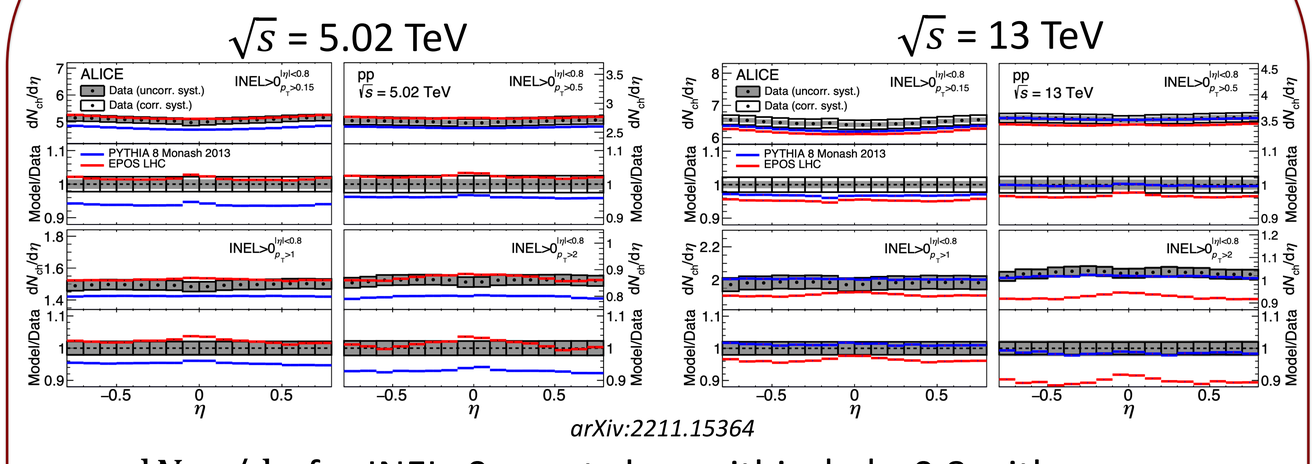
arXiv:2211.15364

$\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ for three event classes at $\sqrt{s}$ = 5.02 TeV

- INEL: inelastic events
- NSD: non-single-diffractive events
- INEL>0: inelastic events with at least one charged particle in $|\eta|<1.0$
- Data are compared to simulations obtained with PYTHIA 6 Perugia 2011 tune and PYTHIA 8 Monash 2013 tune
- Models better describe distributions with a smaller diffractive contribution: NSD, INEL>0

Event class	$\langle \mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta \rangle$ Data±syst.		PYTHIA 6 Perugia 2011		PYTHIA 8 Monash 2013	
	$\lvert\eta\rvert < 0.5$	$\lvert\eta\rvert < 1$	$\lvert\eta\rvert < 0.5$	$\lvert\eta\rvert < 1$	$\lvert\eta\rvert < 0.5$	$\lvert\eta\rvert < 1$
INEL	$4.17^{+0.23}_{-0.19}$	$4.25^{+0.23}_{-0.19}$	4.48	4.54	4.58	4.65
NSD	$5.18^{+0.14}_{-0.13}$	$5.28^{+0.13}_{-0.12}$	5.09	5.16	5.14	5.23
INEL>0	$5.60^{+0.08}_{-0.08}$	$5.70^{+0.08}_{-0.07}$	5.48	5.55	5.44	5.54

$\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ with p_{T} thresholds



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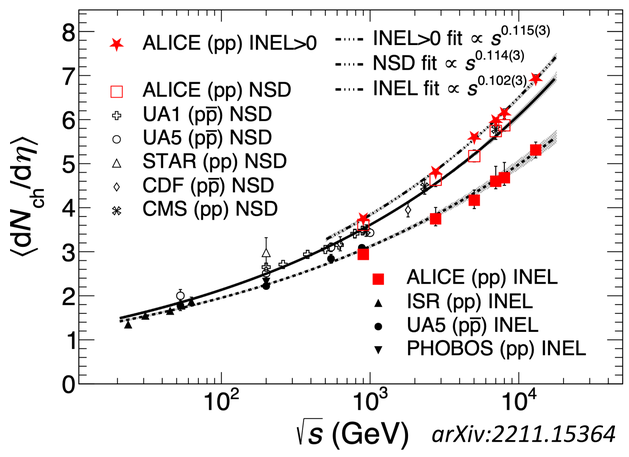
$\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ for INEL>0 event class within $|\eta|<0.8$ with p_{T} thresholds at $\sqrt{s}$ = 5.02 and 13 TeV

- p_{T} > 0.15, 0.5, 1.0, 2.0 GeV/c
- Compared to the distributions from models: PYTHIA 8 Monash 2013 and EPOS-LHC.
- Better description by EPOS-LHC at $\sqrt{s}$ = 5.02 TeV while PYTHIA8 is better at $\sqrt{s}$ = 13 TeV
- The result provide further constraints on charged particle production mechanisms implemented in models affecting both soft and hard QCD and their energy dependence

Energy dependence of $\langle \mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta \rangle$



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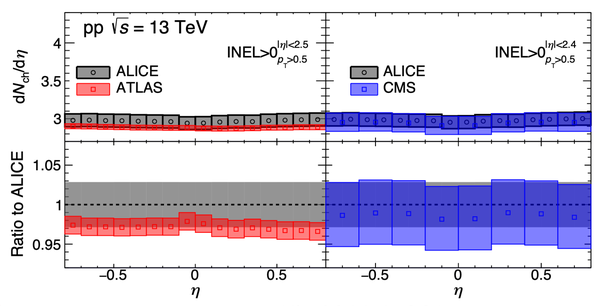
$\langle \mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta \rangle$ averaged over $|\eta|<0.5$ as a function of centre-of-mass energy

- The lines indicate a power-law fit for each event class The grey bands show one standard deviation
- $\langle \mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta \rangle$ at 5.02 TeV is in good agreement with the power law fit ($\langle dN_{\mathrm{ch}}/\mathrm{d}\eta \rangle \propto \mathrm{s}^{\delta}$)
- δ = 0.102(INEL), 0.114(NSD), 0.115(INEL>0)
- δ = 0.153(INEL) in AA collisions
  →$\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ increases faster with energy in AA collisions
  →Initial longitudinal energy is more efficiently converted into particles in AA collisions

Comparison with ATLAS, CMS



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$\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ for INEL>0 with p_{T} > 0.5 GeV/c at $\sqrt{s}$ = 13 TeV is compared with ATLAS, CMS results

- $|\eta|<0.8$ is normalized using PYTHIA8
- ALICE result is 3%(2%) larger than ATLAS(CMS), still compatible within systematic uncertainty

Summary and Outlook

- ALICE has measured $\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ for INEL, NSD, INEL>0 event classes at $\sqrt{s}$ = 5.02 TeV. The predictions of PYTHIA 6 Perugia 2011 and PYTHIA 8 Monash 2013 tunes agree with NSD and INEL>0 results
- $\mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta$ with different p_{T} thresholds at $\sqrt{s}$ = 5.02 and 13 TeV are measured
- ALICE 13 TeV result with p_{T} > 0.5 GeV/c is compared with ATLAS and CMS result Result provide important constraint for the tuning of MC event generators
- Run3 analysis ongoing for Pb–Pb 5.36 TeV and pp 0.9, 13.6 TeV