Production of $\pi/K/p$ in pp and PbPb collisions measured with ALICE

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ALICE Detector

- Inner Tracking System (ITS)
- Time of Flight (TOF)
- Time Projection Chamber
- HMPID Cherenkov detector
PID Performance
Particle identification is made:
→ by selecting reconstructed tracks which have a PID signal close to expected value
→ fitting empirical functions to PID signal distributions

Final spectra are combinations of spectra measured using different particle identification (PID) methods and detectors.
Spectra are measured from 100 MeV/c to 20 GeV/c in $p_T$
Spectra are normalized to the number of inelastic events
pp results vs. theory

⇒ Ratios are similar at 7 TeV and 2.76 TeV and they are not reproduced by theory
⇒ Color reconnection improves a description of ratio by PYTHIA [arXiv:1303.6326]
⇒ More on color reconnection in pp=> Jonas Anielski “Identified spectra in p-Pb”
$p_T < 3 \text{ GeV/c}$ flow and bulk properties

$3 < p_T < 7 \text{ GeV/c}$ anomalous baryon enhancement and coalescence?

$p_T > 7 \text{ GeV/c}$ search for medium modification of fragmentation functions

M. Chojnacki (NBI)
Spectra in Blast-Wave Model

- Good description of the spectra in combined fit ranges especially for central events
- The individual fits can describe spectra over the full measured range
- Useful tool for comparison with previous results

arXiv:1303.0737
Results of the BW

- Centrality dependence of the $T_{\text{kin}}, \langle \beta_T \rangle$ similar to RHIC
- More rapid expansion with increasing centrality
Spectra in hydro models

Hydro models:

**VISH2+1**: viscous hydrodynamics without description of hadronic phase, using thermal yields at \( T_{ch} = 165 \) MeV

(Shen et al., PRC 84, 044903 (2011))

**HKM**: hydro+UrQMD, additional radial flow built by hadronic phase which also affects particle ratios as a result of inelastic interactions

(Karpenko et al., arXiv:1204.5351)

**Kraków**: introduces non equilibrium corrections due to the bulk viscosity at the transition from the hydrodynamic description to particles which changes the effective \( T_{ch} \)

(Bożek, PRC 85, 034901 (2012))

**EPOS**: uses breakup of the flux tubes created by initial hard scatterings to described the spectra shapes for all \( p_T \)


Hydro models provide a reasonable description of the measured spectra at \( p_T \) lower than 3 GeV/c.
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They fail in peripheral collisions.
Global particle production

- $T_{ch} = 164$ MeV from lower energies extrapolation: does not reproduce the data, overestimates proton yield
- Baryon annihilation (Becattini et al., arXiv:1212.2431)
- Non-equilibrium SHM (Petran, Rafelski et al., arXiv:1303.2098)
- Flavor hierarchy in QCD phase transition (Ratti et al., PRD 85, 014004 (2012))
- Higher mass resonance states
Intermediate $p_T$

$\pi$ → $p/\pi$ in the bulk and in the peak
$\pi$ → $p/\pi$ in the peak agrees with pp results
enhancement of the baryon-to-meson ratio driven by bulk properties
more on the baryon-to-meson ratio in talk by Luke Hanratty on Thursday
High $p_T$

> At $p_T > 10$ GeV/c all $R_{AA}$s converge
> No difference in energy loss for $\pi/K/p$?

Resonances $R_{AA}$ talk by Anders Garritt Knospe, multi-strange $R_{AA}$ talk by Domenico Colella, both on Thursday.
Conclusions

- Hydro pictures give good description of $\rho_T$ distributions at LHC energies
- Lower $p/\pi$ than equilibrium thermal model expectations
- At intermediate $p_T$ the bulk effects dominate
- $R_{AA}$ for $\pi/K/p$ are comparable at high $p_T$, suggests that medium does not significantly affect fragmentation
- What about p-Pb? ⇒ Talk by Jonas Anielski on Friday
Backup
The secondary particles are subtracted using a data driven method.