Insight into Multiplicity Dependence of Strangeness and Resonance Production from Small to Large System with ALICE at the LHC **Arvind Khuntia on behalf of the ALICE collaboration IFJ PAN, Cracow**

I. Motivation:

ALICE

- Comparable to the lifetime (~10 fm/c) of the hadronic phase produced in high energy Nucleus-Nucleus collisions
- \clubsuit Resonances with different lifetimes [1.3–46.5 fm/c] help to probe the collision at various timescales
- * Regeneration and rescattering are possible processes in the hadronic phase that affect resonance production

Regeneration:

seudo-elastic scattering through

resonance state \rightarrow enhanced yield

Rescattering:

- Daughter particles undergo elastic scattering
- \therefore Smears out / destroys mass peak \rightarrow reduced yield
- Hadronic resonances can also be used to study strangeness production
 - \rightarrow strangeness enhancement, canonical suppression
- Nuclear modification factors of the resonances help to understand the in-medium parton energy loss

ALICE Preliminary

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0.03

0.01

-0.014

0.006

0.004

0.002

V0 Multiplicity Event Classes

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30 40 50 60

 $\langle d\tilde{N}_{ch}/d\eta \rangle_{|\eta_{lab}| < 0.5}$

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2. A Large Ion Collider Experiment (ALICE)

- At the LHC, ALICE has collected data in pp(0.9, 2.76, 5.02, 7, 8 and 13 TeV), p-Pb(5.02 and 8.16 TeV), Xe-Xe(5.44 TeV) and Pb-Pb(2.76 and 5.02 TeV) collisions
- Global tracking is performed using ITS and TPC
- The kinematic cuts for track acceptance are $|\eta| < 0.8$ with $p_T > 0.15$ GeV/c

Detectors used:

- Inner Tracking System (ITS) Tracking and Vertexing
- Time Projection Chamber (TPC) Particle Tracking Particle Identification (PID)
- Time of Flight (TOF) PID via time of flight measurement
- $\mathbf{V0}$
- Trigger and multiplicity estimator

4. Integrated Yield and $< p_T >$

Yields of K^{*0} and ϕ normalized to $\langle dN_{ch}/d\eta \rangle$ are independent of collision system and energy \rightarrow event multiplicity drives particle production, ≥ 2 2 2 0.02 -' irrespective of collision system and energy

3. Transverse momentum (p_T) spectra

- Evolution of the spectral shape with increasing multiplicity for $p_T < 5$ GeV/c in pp, p–Pb and Pb–Pb collisions
 - \rightarrow effect of radial flow (holds also for small systems?)
- The spectral shape is similar across multiplicity for $p_T > 5 \text{ GeV}/c$





- Mass ordering of $\langle p_T \rangle$ in central Pb–Pb →hydrodynamic behaviour
- Mass ordering breaks down for peripheral Pb–Pb, p–Pb and pp
- Steeper increase of $\langle p_T \rangle$ with multiplicity in small systems

6. Summary

Extensive results of resonance production across different collision systems and energies in ALICE Hardening of $p_{\rm T}$ spectra is observed with charged particle multiplicity from large to small collision system The K^{*0} yield normalized to the mean charged particle multiplicity is independent of collision energy and collision system \rightarrow event multiplicity drives particle production, irrespective of collision energy and system • Mass ordering of $\langle p_T \rangle$ holds for central Pb–Pb collisions, whereas it breaks down for peripheral Pb–Pb, p–Pb and pp Smooth evolution of strangeness production in small to large collision systems

- \rightarrow Does ϕ behave as hidden-strange or double-strange particle? **Effective strangeness of** ϕ **in small systems**
 - $\phi /\pi: (|S|=0)/(|S|=0)$
 - Saturates in Pb–Pb and is consistent with thermal model predictions
- Increases with multiplicity in pp/p–Pb, which is not expected for canonical suppression

 $\Xi / \phi : (|S|=2)/(|S|=0)$

- Flat for wide range of multiplicities $\rightarrow S \sim 2$
- Slightly increasing in pp and p–Pb vs multiplicity $\rightarrow S < 2$



 ϕ /K: (|S|=0)/(|S|=1)

in pp $\rightarrow S > 1$

Flat or slightly increasing

 \rightarrow enhancement in small collision systems for ϕ [hidden strange] meson

The ϕ meson behaves as a particle with an effective strangeness of 1-2 units

The φ meson behaves like a particle with an effective strangeness of 1-2 units



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