Predictions for Transverse momentum spectra and Elliptic flow of identified particles in Xe-Xe collisions at $\sqrt{s_{NN}}$ = 5.44 TeV using AMPT

S. Tripathy*, R. Rath, S. De, M. Younus and R. Sahoo

Indian Institute of Technology Indore, Simrol, India

*email: Sushanta.Tripathy@cern.ch

References

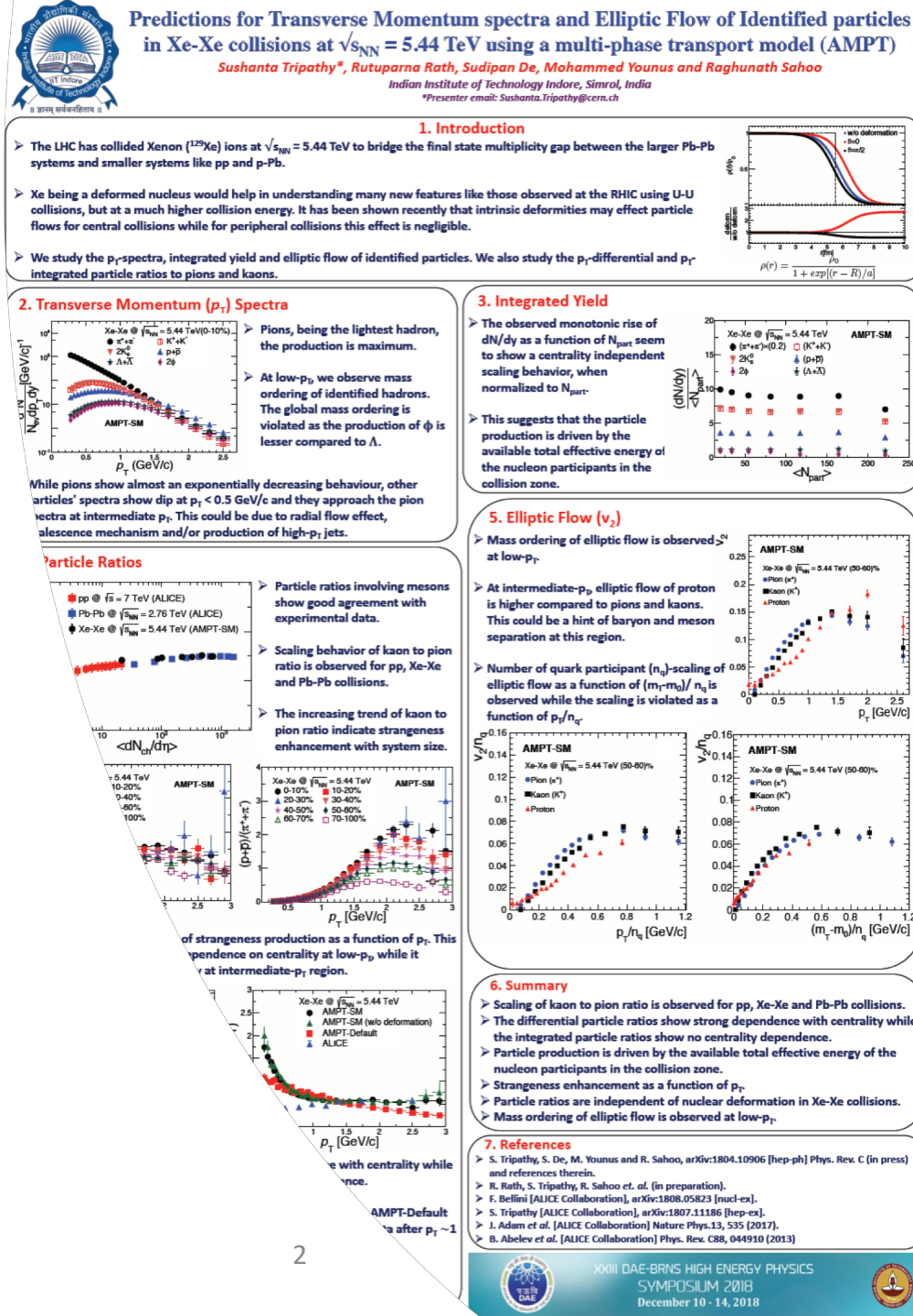
1. S. Tripathy *et. al.*, Phys. Rev. C 98, 064904 (2018)
2. R. Rath, S. Tripathy *et. al.*, arXiv:1812.05041 [hep-ph]

XXIII DAE-BRNS HIGH ENERGY PHYSICS SYMPOSIUM 2018

December 10 - 14, 2018

Outline

- *Introduction*
- *Transverse momentum (p_T) Spectra*
- *p_T-differential particle ratios*
- *p_T-integrated particle ratios*
- *Elliptic flow*
- *Conclusion*



Introduction

- *On October 12th 2017, an 8 hour run of collisions between ^{129}Xe nuclei at $\sqrt{s_{NN}}$ = 5.44 TeV was carried out at the LHC.*
- *The mass number being halfway between that of a proton and that of a Pb nucleus, this will help in bridging the gap of final state multiplicity between Pb-ion systems and smaller systems like pp and p-Pb collisions.*
- *Xenon being deformed nucleus would uncover features seen in U-U collisions at RHIC in much higher energy.*
- *It has been shown recently that intrinsic deformities may affect particle flows for central collisions while for peripheral collisions this effect is negligible.*
- *We perform a comprehensive study of transverse momentum spectra, particle ratios and elliptic flow of identified particles using a multi-phase transport model (AMPT).*

ALICE, Phys.Lett. B784 82 (2018)
ALICE, Phys.Lett. B788 166 (2019)

A Multi-Phase Transport Model (AMPT)

- ***A hybrid transport model which contains four components.***

1. ***Initialization of collisions:*** ***HIJING model (The produced partons calculated in pp collisions are converted to p-A and A-A by incorporating parameterized shadowing function and nuclear overlap function using in-built Glauber model)***

2. ***Parton transport after initialization:*** ***Zhang's Parton Cascade (ZPC) model transports partons using Boltzmann transport equation***

3. ***Hadronization mechanism:*** ***AMPT String melting (AMPT-SM) version uses coalescence mechanism while the default version uses fragmentation mechanism via Lund fragmentation***

4. ***Hadron transport:*** ***A relativistic transport (ART) model via meson-meson, meson-baryon and baryon-baryon interactions***

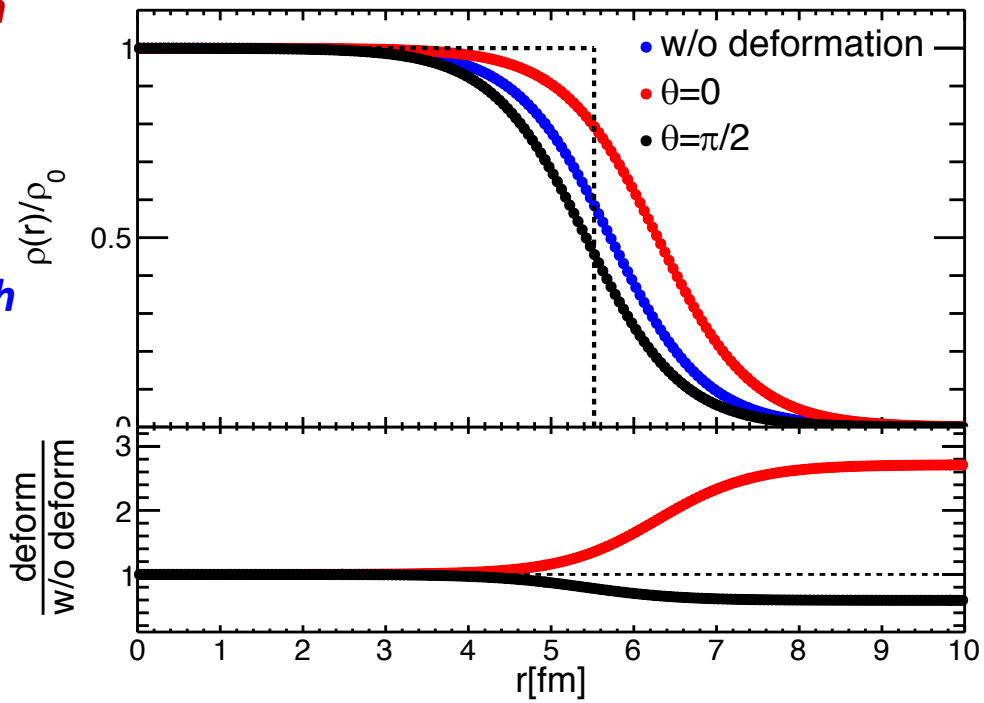
Z. W. Lin *et. al.* Phys. Rev. C 72, 064901 (2005).

Nuclear Deformation

- *In case of spherical nucleus, Woods-Saxon distribution is used to define the distribution of nucleons in HIJING.*

- *For the deformed nucleus like Xenon, deformation parameter is used along with spherical harmonics in Woods-Saxon density distribution.*

$$\rho(r) = \frac{\rho_0}{1 + exp[(r - R)/a]}$$

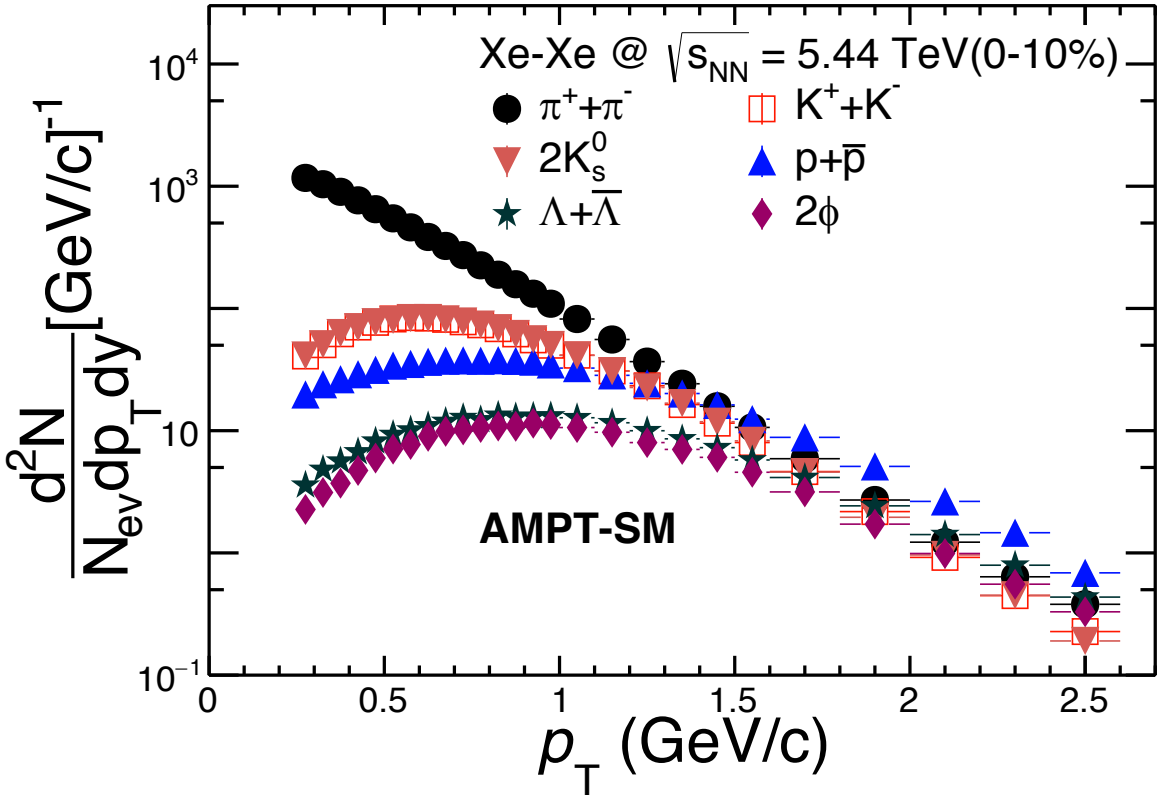


- *As Xenon has a prolate shape, the Woods-Saxon nuclear radius has been modified.*

- *We have done the calculations for random orientation of nuclei which means random values of polar and azimuthal angle.*

R. Rath, S. Tripathy *et. al.*, arXiv:1812.05041 [hep-ph]

Transverse Momentum (p_T) Spectra



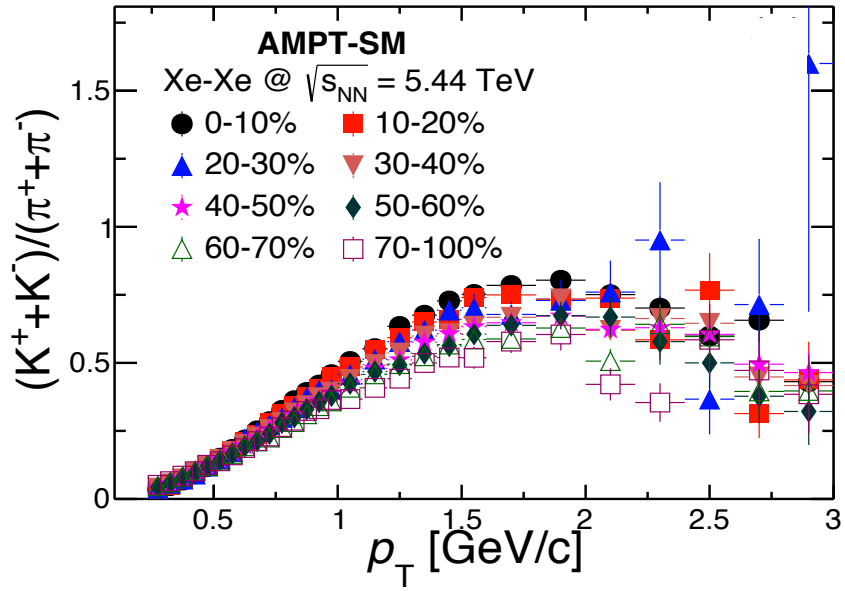
- ***p_T-spectra sheds light into the kinetic freeze-out of the medium and helps to obtain the temperature at the kinetic freeze-out and radial flow of the system.***

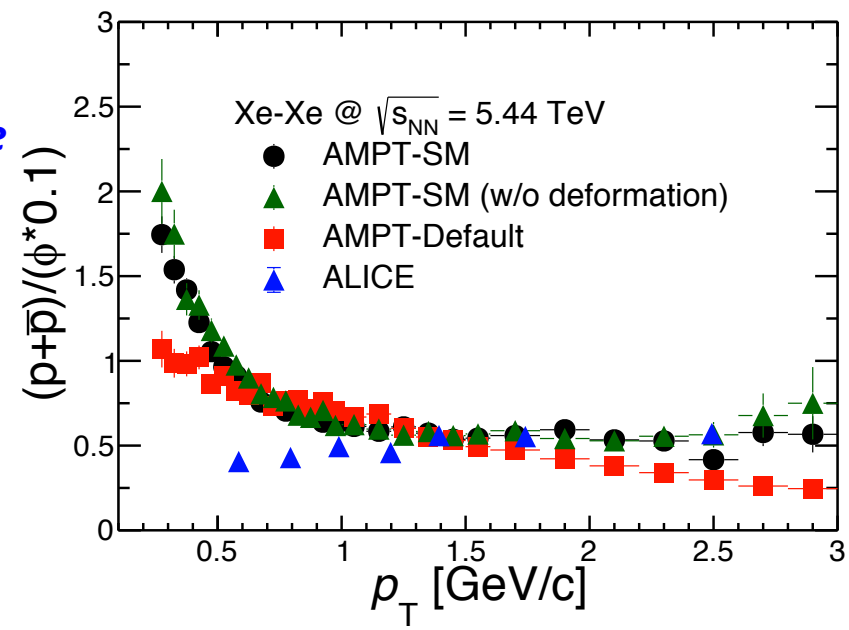
- ***Can be used to test the hydrodynamic models.***

R. Rath, S. Tripathy *et. al.*, arXiv:1812.05041 [hep-ph]

p_T-differential particle ratios

- *As the particle production mechanisms are highly dependent on p_T-range, p_T-differential particle ratios has major importance*
- *K/π ratio has enhancement with p_T suggesting enhanced strangeness production from low to intermediate-p_T*
- *Weak dependence on centrality at low-p_T while centrality dependence is observed at intermediate-p_T*
- *Nuclear deformation has no effect on particle ratios although particle yield in central collisions vary with deformation*
- *For p/ϕ ratio, AMPT-Default is closer to experimental data at low-p_T while AMPT-SM does a better job at intermediate-p_T*

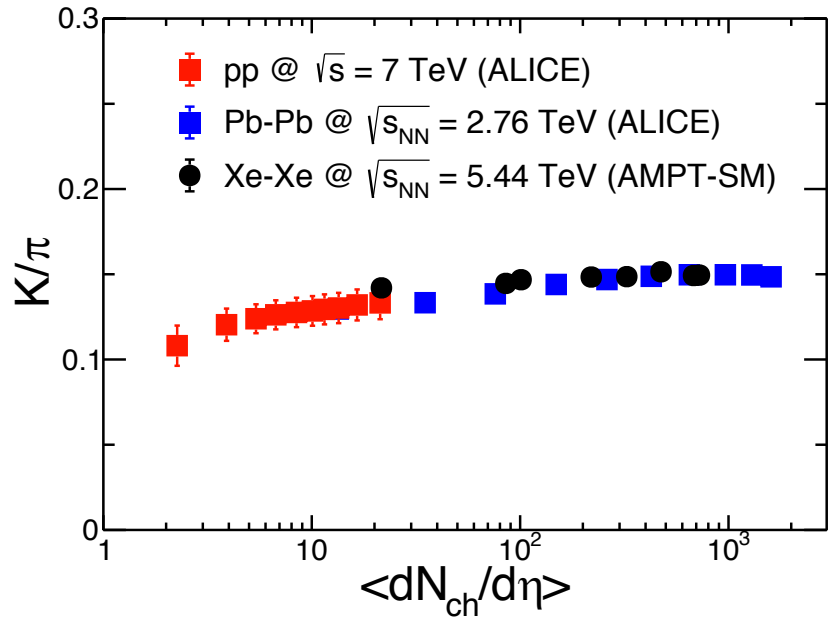


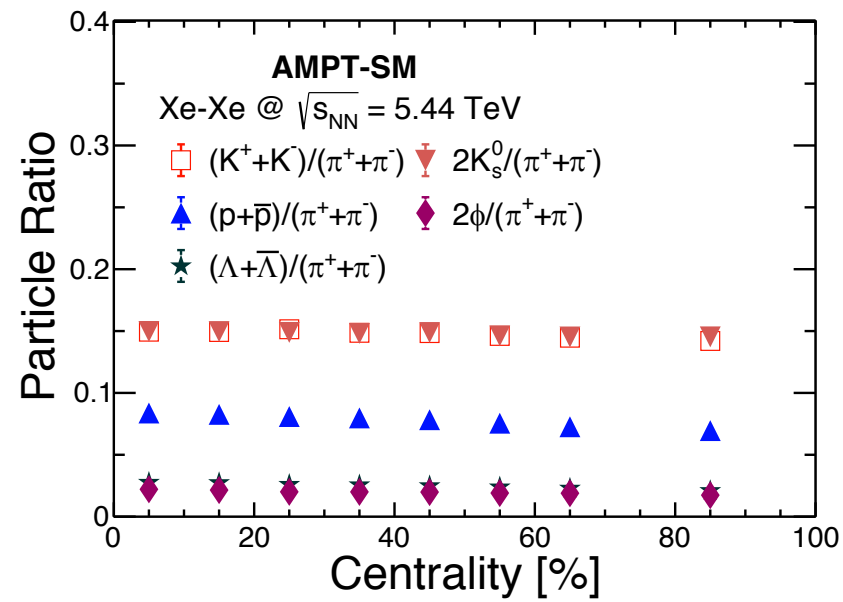


R. Rath, S. Tripathy *et. al.*, arXiv:1812.05041 [hep-ph]
F. Bellini [ALICE Collaboration], arXiv:1808.05823 [nucl-ex]

p_T-integrated particle ratios

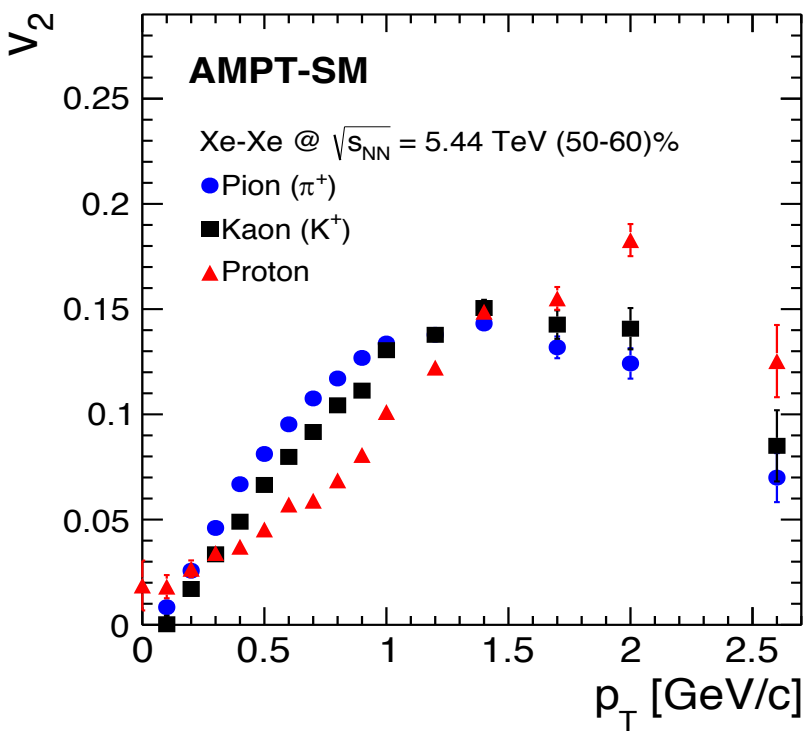
- *Measurements of the relative abundances of identified light-flavored hadrons can be used to infer of the system at the chemical freeze-out*
- *The p_T-integrated K/π ratio for Xe-Xe collisions is consistent with experimental data for pp@7 TeV and Pb-Pb@2.76 TeV suggesting the relative yield are driven by the charged-particle multiplicity regardless to collision energy and system type*
- *Although dependence of differential particle ratios on centrality is observed, we do not observe centrality dependence of integrated particle ratios.*

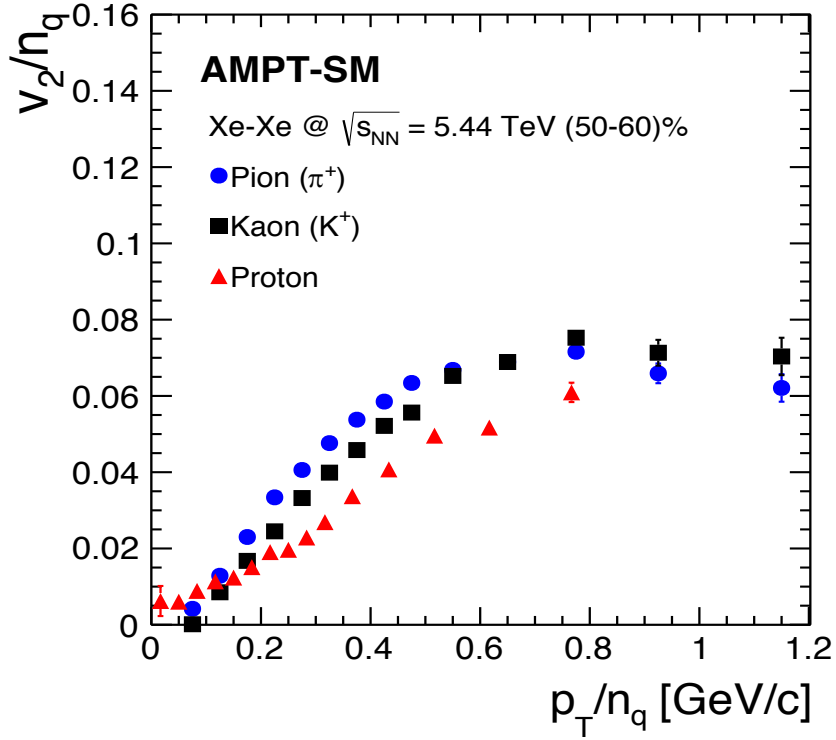




R. Rath, S. Tripathy *et. al.*, arXiv:1812.05041 [hep-ph]

Elliptic flow





- ***Mass ordering of elliptic flow at low-p_T is observed.***
- ***At intermediate-p_T, elliptic flow of proton is higher compared to pions and kaons. This could be a hint of baryon and meson separation at this region.***
- ***Number of quark participant (n_q)-scaling of elliptic flow is violated.***

S. Tripathy *et. al.*, Phys. Rev. C 98, 064904 (2018)

Conclusion

- ***p_T-differential ratios show weak dependence on centrality at low-p_T while centrality dependence is observed at intermediate-p_T***
- ***Nuclear deformation has no effect on particle ratios although particle yield in central collisions vary with deformation***
- ***The relative yield are driven by the charged-particle multiplicity regardless to collision energy and system type***
- ***Mass ordering of elliptic flow at low-p_T is observed***
- ***Number of quark participant (n_q)-scaling of elliptic flow is violated.***

Thank You