Neutral pion and η meson production at midrapidity in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV with PHENIX

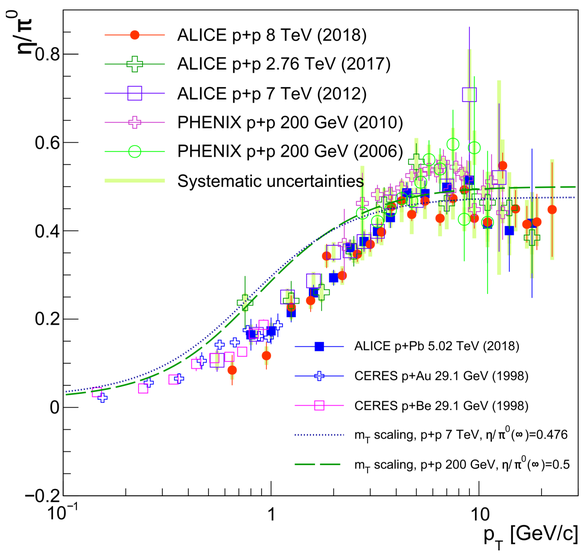
Dading Chen, for the PHENIX collaboration

Stony Brook University

Direct photons are useful probes to study the properties of QGP and the dynamic evolution of the collision systems. Estimating and subtracting direct photons from hadron decays that contribute to the bulk of the measured photons is crucial and challenging. Although the most abundant source, $\pi^o \rightarrow \gamma\gamma$ is well studied and constrained. $\eta \rightarrow \gamma\gamma$ is less constrained and the related study is scarce below p_T < 2 GeV /c. The ratio, η/π^o exhibits universal behavior regardless of collision system, energy, and centrality in high p_T from the analysis of world data. However, associated measurements have been inconclusive in low p_T. Possible deviations from the universal behavior could be owing to the rapid radial hydrodynamic expansion of the A+A collision system. PHENIX presents measurements of the centrality dependence of p_T spectra of π^o and η and their ratio in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV with large statistics data taken in the year 2014. Thanks to the large Au+Au data sample taken at $\sqrt{s_{NN}}$ = 200 GeV in the year 2014 and improved analysis methods, PHENIX is capable of studying the p_T spectra of π^o and η down to 1 GeV/c and exploring the effect of radial flow on η/π^o as a function of centrality.

Universal behavior of η/π^o in *p+p*

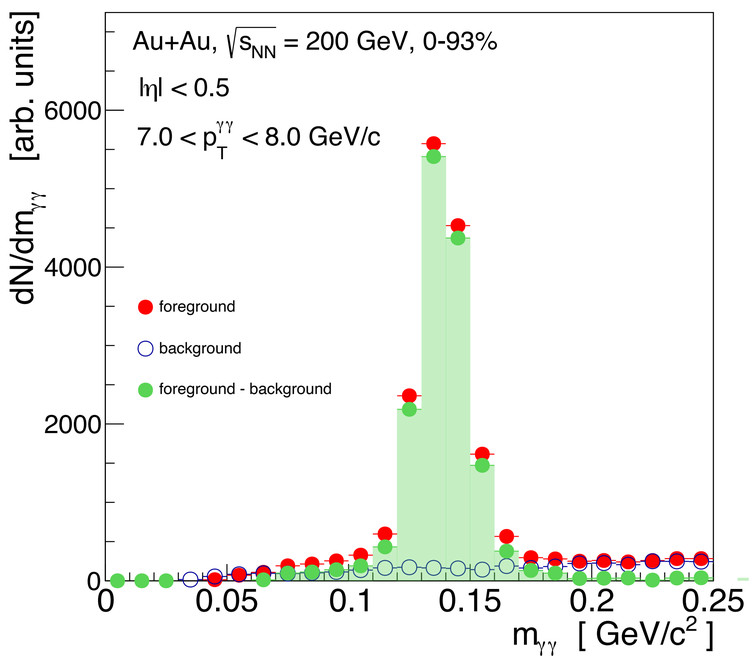
η/π^o exhibits a universal behavior independent of collision energy in p+p collisions



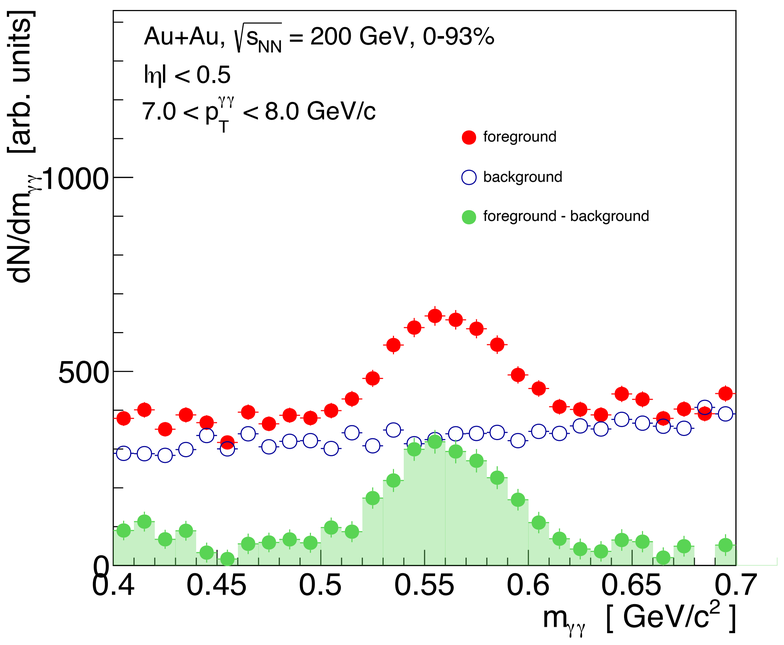
Peak extractions for π^o and η

π^o and η are reconstructed through their decays into two photons, where the photons are measured in the Electromagnetic Calorimeters.

$\pi^o \longrightarrow \gamma\gamma$, BR : 98.8%

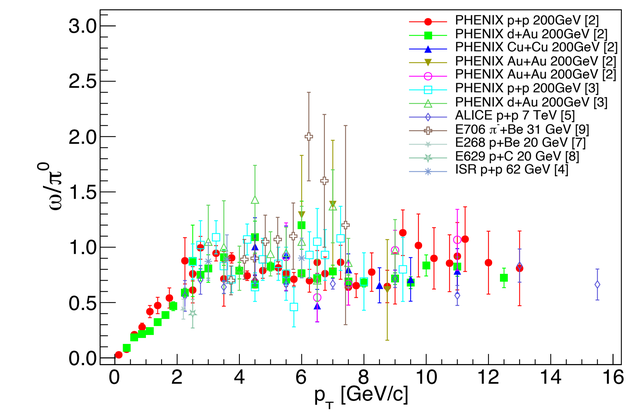


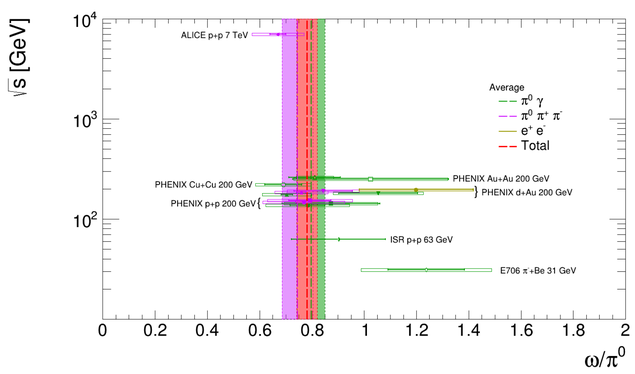
$\eta \longrightarrow \gamma\gamma$, BR : 39.4%

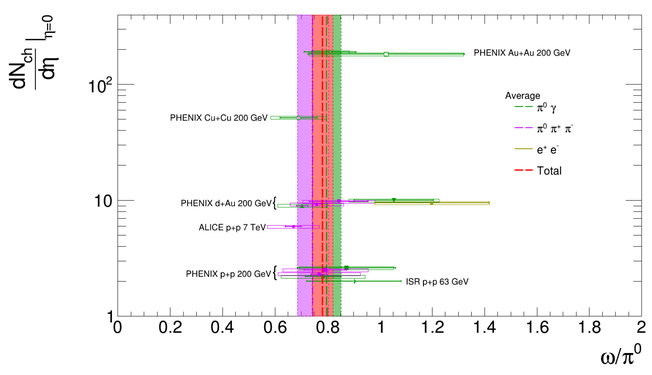


Universal behavior of ω/π^o

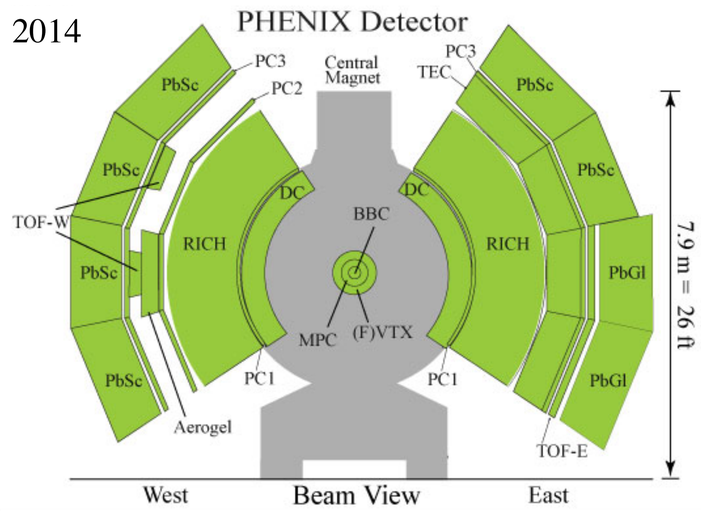
ω/π^o exhibits a universal behavior independent of collision energy and system size



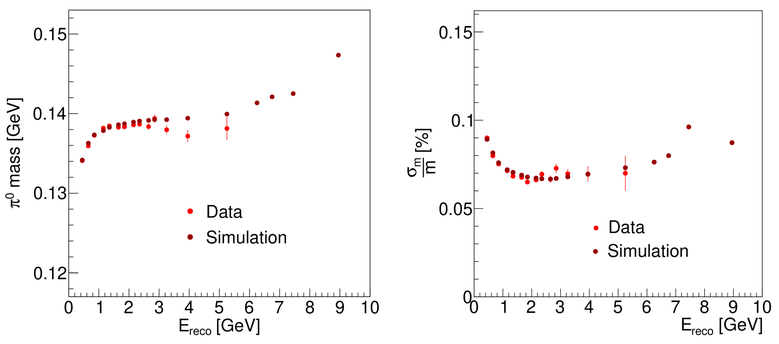




Simulation tune in with data



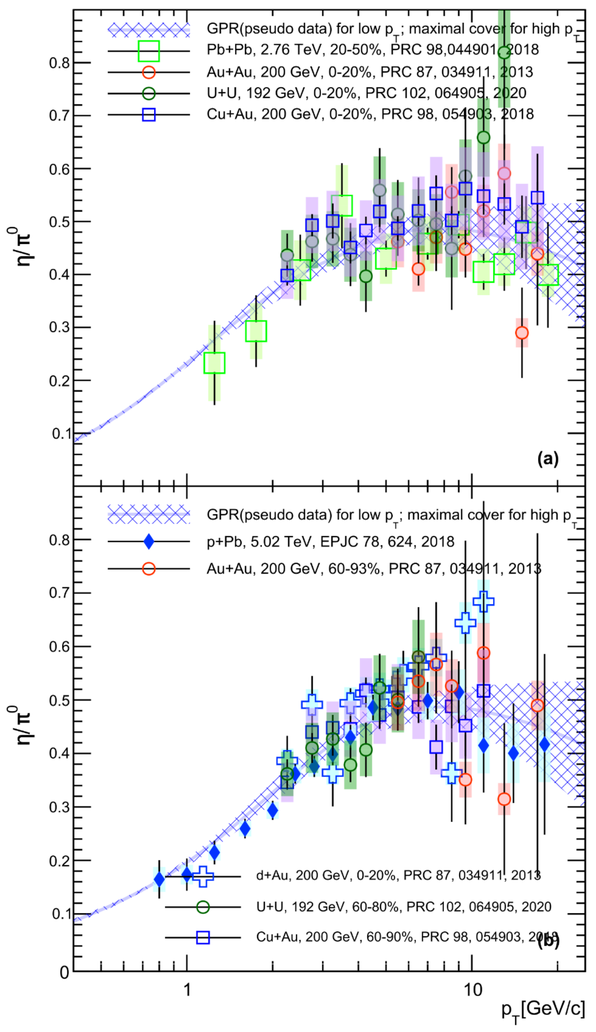
Energy scale and resolution of π^o are tuned for every sector between simulation and real data



η/π^o in *A+A*

η/π^o exhibits universal behavior at higher p_T but the behavior is inconclusive at lower p_T in A+A collision due to the absence of accurate η/π^o data

Double ratio for $K^{\pm}/\pi^{\pm}$ in A+A collisions is used to estimate the η/π^o at low p_T in A+A collisions



With large statistics of 2014 Au+Au data, η and π^o can be studied down to 1 GeV/c and radial flow effect on η/π^o ratio can be explored

Future work

Unfolding the p_T — spectrum of π^o and η for different centralities

Verifying whether $K^{\pm}/\pi^{\pm}$ can be used to determine η/π^o

Measuring the effect of radial flow on η/π^o in low momentum regime

Reference

[1] Y. Ren and A. Drees, Phys. Rev. **C104** 054902, (2021).
[2] A. Adare et al., Phys. Rev. **C84** 044902 (2011).
[3] S. Adler et al., Phys.Rev. **C75** 051902 (2007).
[4] M. Diakonou et al., Phys. Lett. **B89** (1980).
[5] S. Acharya et al., Eur. Phys. Jour. **C80** 1130 (2020).
[7] G. J. Donaldson et al., Phys. Rev. **D21** 3 (1980).
[8] J. Polvis et al., Phys. Rev. Lett. **51** 11 (1983).
[9] L.Apanasevich et al., arXiv:0004012 [hep-ex].