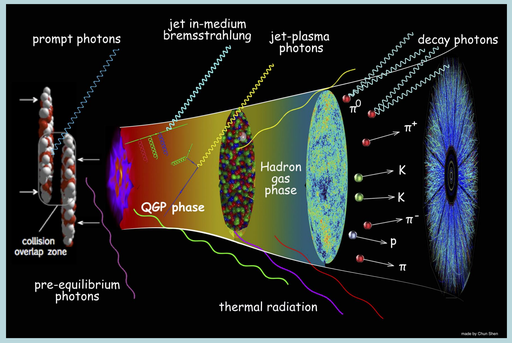
ω/π^0 Ratio in the High-p_T Limit in Heavy-Ion Collisions

Konstantin Bauer, Axel Drees, and Roli Esha
Department of Physics and Astronomy, Stony Brook University

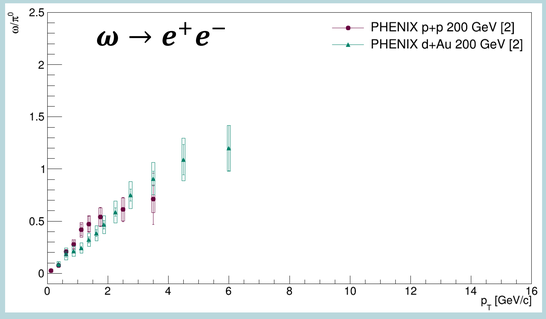
Introduction

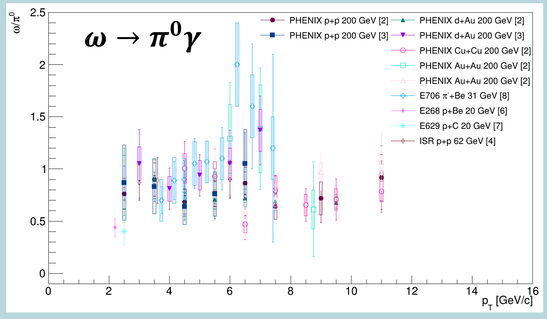
- **Quark-gluon plasma (QGP)** is a state of matter in which quarks and gluons are not bound together in baryons.

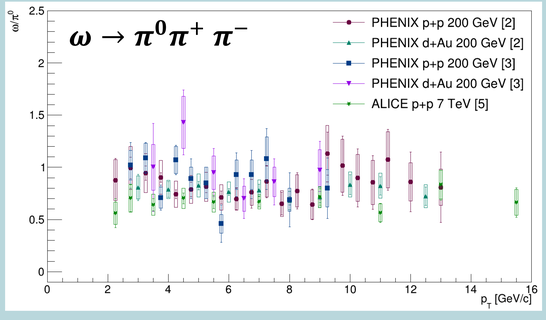


- Relativistic heavy-ion collisions are employed to recreate QGP in a laboratory setting. Photons are a unique probe to study properties of QGP as they do not interact with the medium strongly.
- All the photons produced during the evolution of heavy-ion collision can be classified into **decay photons and direct photons**.
- It is desired to study the direct photons - **must isolate the decay photons** and subtract them.
- Decay photons constitute about 80-90% of all photons - hadrons that contribute the most are the π^0, η, and ω mesons.
- π^0 spectrum is well-constrained experimentally; for η meson, a universality in η/π^0 ratio has been empirically observed, independent of collision system and energy [1]. This ratio is constant in the high-p_T limit.
- **We examine the ω/π^0 ratio to see if a similar universal trend occurs**.

Data sets

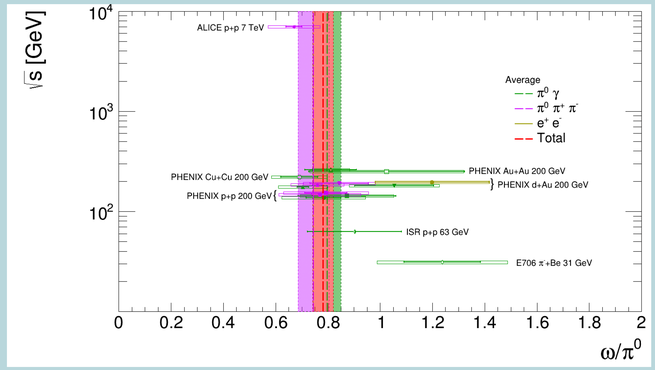


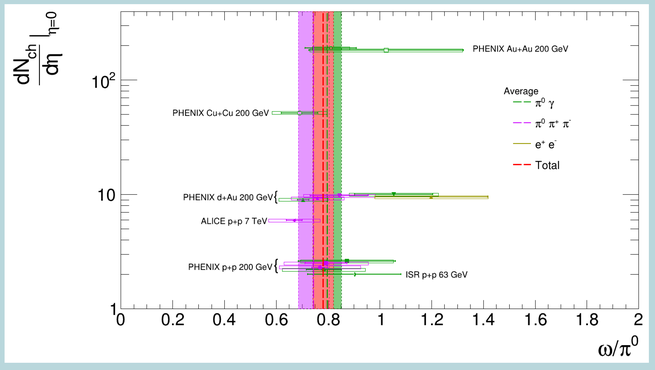


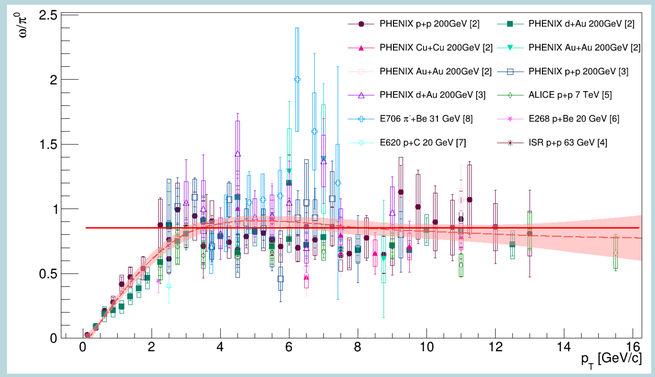


- In order to constrain the high p_T limit, data sets, sorted by their decay channels, are fitted with a constant above 5 GeV/c
- Machine learning-based regression tool, Multi-Layer Perceptron (MLP), is used to obtain the universal ω/π^0 fit

Results







$$\frac{dN_\omega}{dp_T} = \left(\frac{\omega}{\pi^0}\right)^{universal} \left(\frac{dN_{\pi^0}}{dp_T}\right)^{data}$$

$\pi^0\,\gamma$ fit: 0.797 ± 0.0535
$\pi^0\,\pi^+\,\pi^-$ fit: 0.745 ± 0.0592
MLP fit: 0.852 ± 0.00179

Combined fit: 0.781 ± 0.0394

Discussion

Comparison of all data for p_T above 5 GeV/c

- Individual data sets show no p_T dependence
- No evidence for multiplicity dependence

Comparison of all ω data

- Drop at low p_T roughly consistent with m_T scaling
- Full evaluation of systematic uncertainties needed
- High p_T dependence possibly due to systematic difference between PHENIX/ALICE
- Effect of radial flow needs to be investigated

References

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