Light meson production in d+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV measured by PHENIX experiment at RHIC

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Motivation

• High p_T particle suppression in central heavy ion collisions [1,2] is one of the most exciting discoveries at RHIC and is attributed to the jet-quenching via partonic energy loss in a hot and dense matter [3,4].

• Another key observation is species dependent suppression in the intermediate p_T range [5] which involves another particle production mechanisms in addition to jet fragmentation.

• The interpretation of these phenomena requires insight in cold nuclear matter effects which can be studied with d+Au collisions since it can be safely assumed that no hot and dense medium is being created.

Experimental setup

Charged particle tracking

1. Drift chambers (DC): $\delta p/p = 0.7\% + 1.1\% \cdot p$
2. Pad chambers (PC): σ_z =1.7 mm, σ_φ = 2.4 mm

Energy measurements

1. EMCal: $\delta E/E \approx 4.5\% + 8.0\%/\sqrt{E}$ (GeV)

Particle identification

1.Time of flight (TOF): $\sigma_\tau \sim 100$ ps, 1/3 of arm

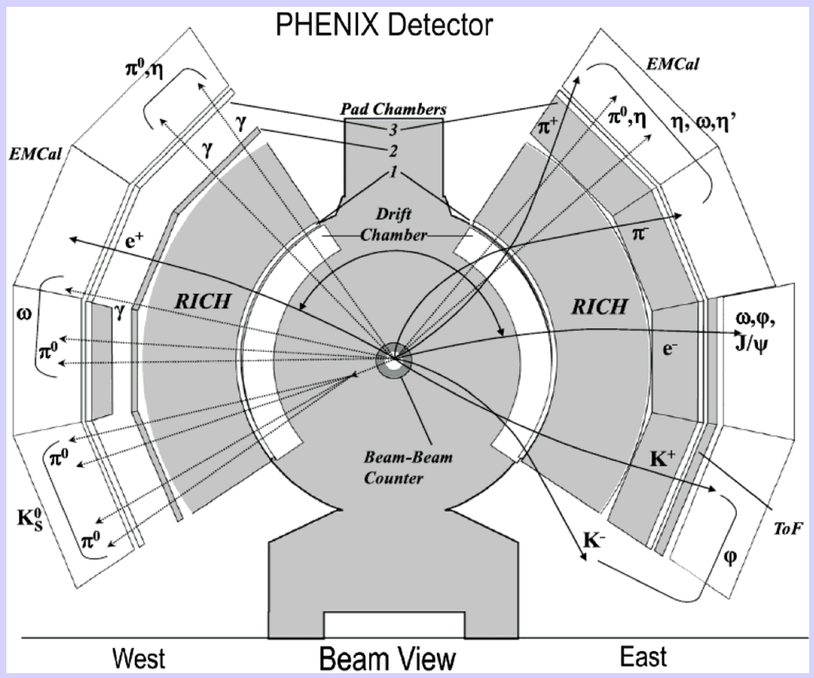
π/K separation range: $0.3 < p_T$ (GeV/c) < 2.2

2. EMCal: $\sigma\tau \sim 500$ ps

Electron identification

1. RICH: e/π rejection > 1000
2. E/p matching in EMCal (e/π rejection > 10)

Central arm acceptance: $\Delta\varphi=2\pi$, $|y| < 0.35$



Briefs of analyses

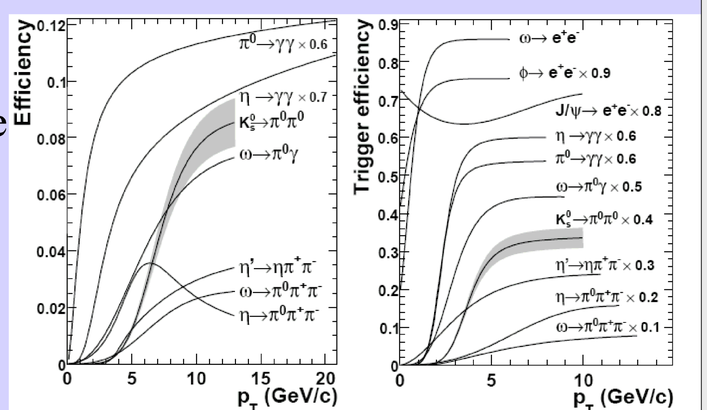
Datasets

d+Au @ $\sqrt{s_{NN}}$ = 200 GeV		
Year	2003	2008
$\int$Ldt	2.74 nb^{-1}	80 nb^{-1}

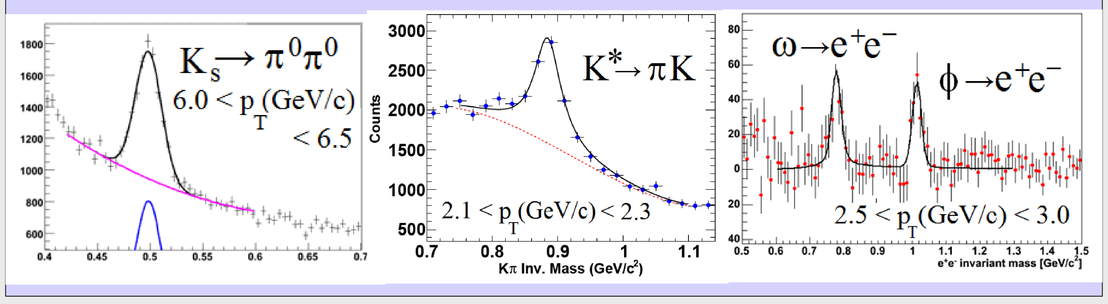
• Minimum Bias and Electron-Rich (ERT) triggers

• Particle yields are measured in different decay modes

Reconstruction and trigger efficiencies are derived based on full Monte-Carlo simulation of the PHENIX experiment:



M_{inv} spectra:



Particle spectra, Tsallis fits

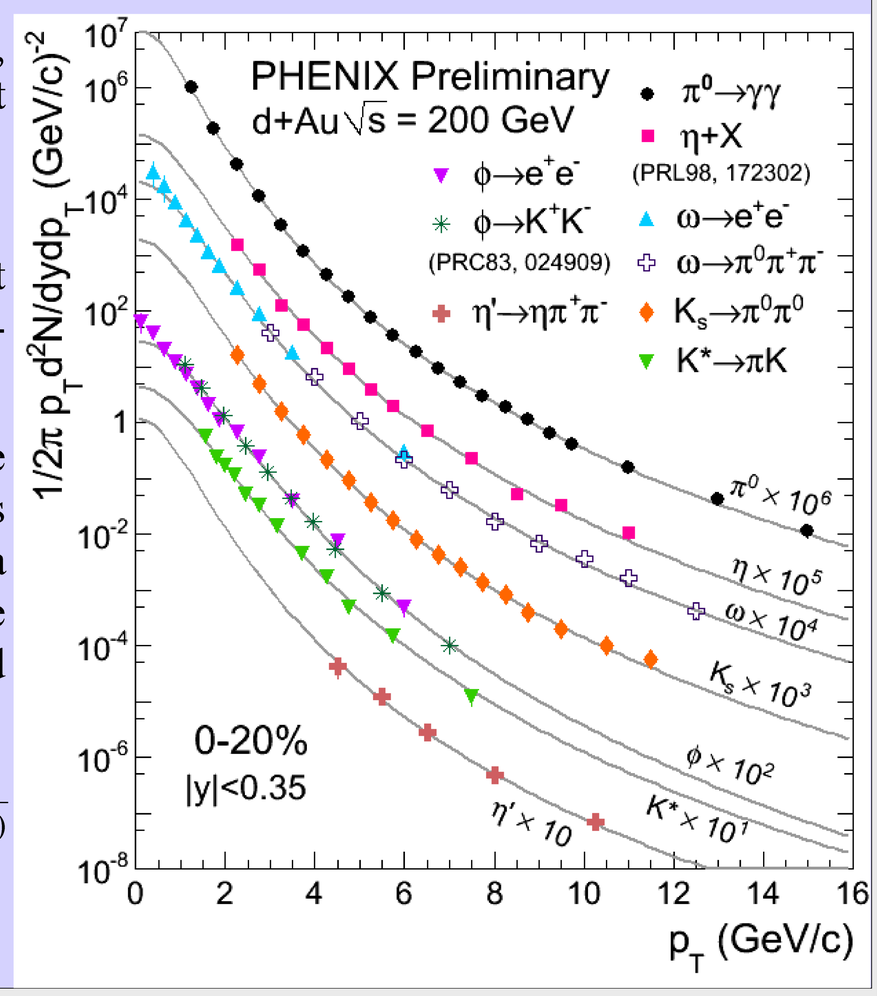
• Large variety of particles, different decay modes, different RHIC runs

• Spectra cover wide p_T range

• Power law-like behavior at high p_T, with exponential law-like behavior at low p_T

• All obtained spectra can be described with Tsallis distribution [6] using a minimum number of three parameters (m, n, Λ) derived from data:

$$\frac{1}{2\pi}\frac{d^2N}{dydp_T} = \frac{1}{2\pi}\frac{dN}{dy}\frac{(n-1)(n-2)}{(nT+m(n-1))(nT+m)} \times\left(\frac{nT+m_T}{nT+m}\right)^{-n}$$



Nuclear modification factors

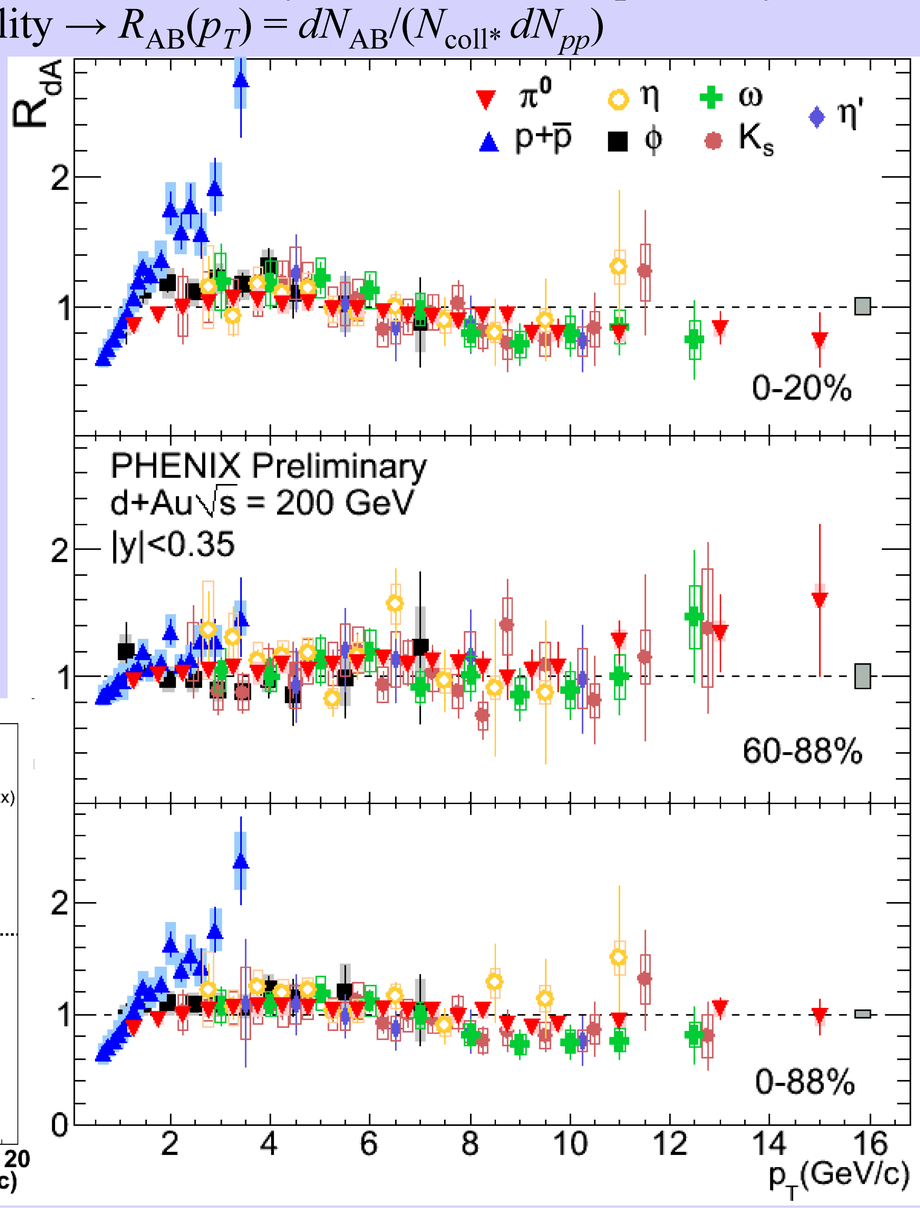
Nuclear modification factor R_{AB} is a tool to study modification of particle yields with momentum and collision centrality → $R_{AB}(p_T) = dN_{AB}/(N_{coll*}\, dN_{pp})$

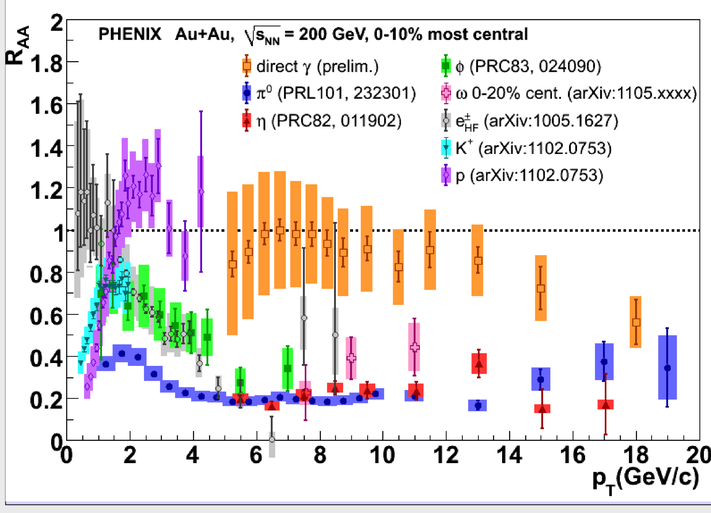
• R_{dA} behavior is similar for all mesons regardless of the mass. Mesons are different from baryons (protons)

• Non-zero Cronin like enhancement is observed for all hadrons in central d+Au collisions at intermediate p_T = 2-5 GeV/c.

•At higher p_T > 8 GeV/c there is an indication of suppression of meson production

• Difference in R_{AA} between π^0, φ and protons in Au+Au collisions cannot be fully explained by initial state effects





Conclusions

• Light meson spectra can be successfully described with Tsallis distribution [6] with only 3 free parameters

• The behavior of nuclear modification factors for mesons is different from baryons (protons) in central d+Au collisions which is difficult to explain in terms of multiple parton rescattering in the initial state → recombination models! [7]

• Difference in R_{AA} between π^0, φ and protons in Au+Au collisions cannot be fully explained by initial state effects which suggests that suppression observed in central Au+Au collisions clearly happens in the final state

Refs

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