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Report from PHENIX

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Abstract

This talk will briefly report the PHENIX status and focus on the newest results from the PHENIX experiment.

Keywords: Jet, direct photon, gamma-hadron correlation, flow, heavy flavor

1. Introduction

The PHENIX experiment at the Relativistic Heavy Ion Collider (RHIC) has successfully completed its data-taking mission and ended on June 27, 2016 after sixteen years of running. A huge amount of data have been recorded from p+p, p+Al, p+Au, d+Au, He+Au, Cu+Cu, Cu+Au, U+U in a wide range of colliding energies kudos to the unprecedented highly flexible operation of the RHIC facility for accelerating asymmetric colliding particles. The results from the PHENIX experiment together with the results from other RHIC experiments [1] and the experiments at LHC have clearly demonstrated the formation of hot and dense media in relativistic heavy ion collisions.

The PHENIX experiment consists of four detector arms as shown in Fig. 1. Two arms in the central rapidity region ($|\eta| < 0.35$) are for the measurements of electrons, photons, pions and kaons. The other two arms (one in the forward rapidity and one in the backward rapidity, $1.2 < |\eta| < 2.4$) are for the muon measurements. The details about the PHENIX detector can be found in [2].

In this talk, I will briefly summarize the most recent results from the PHENIX experiments including γ-hadron correlation in Au+Au collisions, jet measurements in d+Au and Cu+Au, π^0 measurements in d+Au, ^{3}He+Au, and Cu+Au, ψ(2S) to ψ(1S) ratios and direct

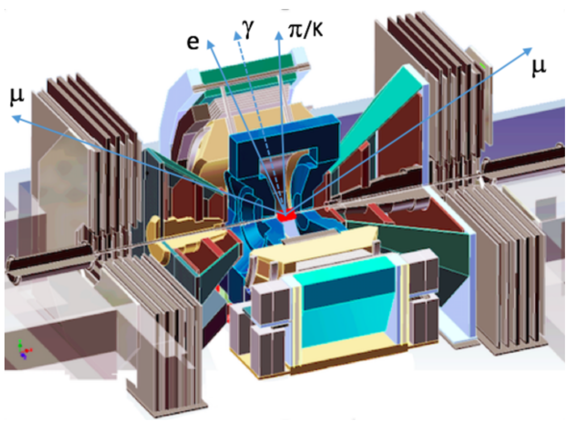

Figure 1: Four-arm detector system of PHENIX. Two arms cover the central rapidity region ($|\eta| < 0.35$) and two arms cover the forward/backward rapidity ($1.2 < |\eta| < 2.4$). Photons, electrons, π^0s and charged hadrons are measured in the central rapidity arms. Muons are measured in the forward/backward rapidity arms.

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photon flow in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV. The details of these results can also be found in the reports from other PHENIX presenters in this proceedings.

2. γ-hadron correlation

Given the color-transparency of photons, the study of photon-jet correlation reveals the details of parton energy loss in the hot and dense medium created in heavy ion collisions (see the cartoon in Fig. 2) [3]. With the momentum of the photon (called trigger photon) as a proxy for the away-side jet momentum, the effective fragmentation function can be measured and expressed in terms of z_T ($z_T \sim p_T^h/p_T^\gamma$). To focus more on the low z_T region for studying the enhancement in soft particle production, we can express the fragmentation function in terms of variable ξ ($\xi = \ln(z_T)$). Figure 2 shows an example of angular ($\Delta\phi$) distribution of direct photon-hadron pairs measured for the 0−40% most central Au+Au collisions (black solid dots), compared with p+p baseline (blue open squares), for trigger photon p_T range within 7 to 9 GeV/c corresponding to ξ range of 1.2 - 1.6.

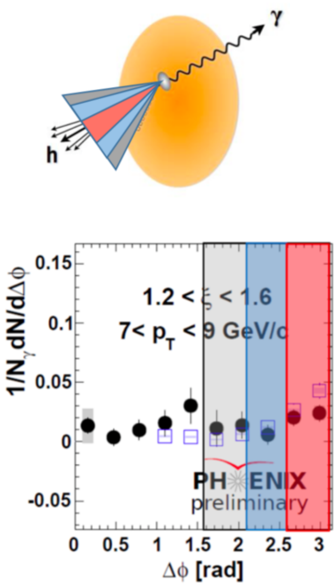

Figure 2: $\Delta\phi$ distribution of direct photon-hadron pairs measured in Au+Au (black solid dots), compared with p+p baseline (blue open squares), for trigger photon p_T range within 7 to 9 GeV/c corresponding to ξ range of 1.2 - 1.6.

In order to explore the parton energy loss mechanism, PHENIX has new results on jet-induced medium response in Au+Au collisions. The medium response is characterized an observable I_{AA}, which is defined as the ratio of the photon-jet pair yields between A+A and p+p collisions. Figure 3 shows I_{AA} as a function of ξ for trigger photon p_T within 5 − 7, 7 − 9 and 9 − 12 GeV/c. While the associated hadron yields are smaller than those in p+p at low ξ , we see an enhanced particle production at higher ξ for trigger photon p_T in the range of 5 − 7 GeV/c.

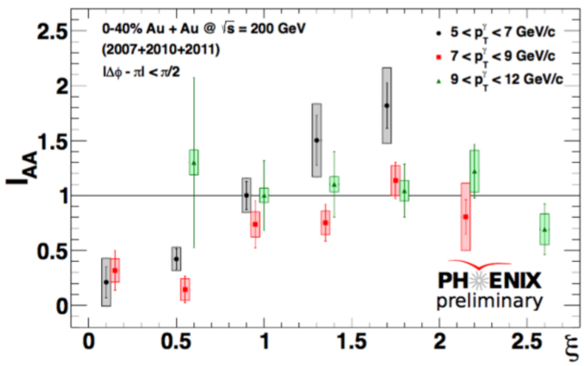

Figure 3: I_{AA} as a function of ξ for trigger photon p_T within 5 − 7, 7 − 9 and 9 − 12 GeV/c.

To quantify the effect of the relative enhancement at high ξ vs low ξ region, Fig. 4 shows the I_{AA} ratio between $I_{AA,\,\xi>1.2}$ and $I_{AA,\,\xi<1.2}$ which indicates that jets with lower energy are more broadened than harder jets. This seems consistent with the observation of minimal jet shape modification for very high p_T jets measured at LHC.

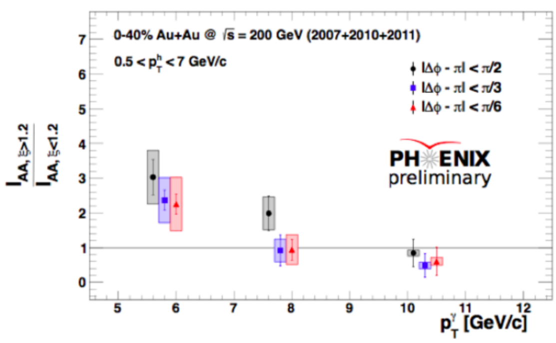

Figure 4: Ratios of I_{AA} at high ξ to I_{AA} at low ξ as a function of trigger photon p_T bins.