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Electromagnetic Probes; Direct Photons and Dileptons in Heavy Ion Collisions

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Abstract: *The available enthralling corroboration indicates the creation of a non-confined plasmonic phase when the heavy ions undergo collision at sublimated energies whether at relativistic heavy ion collider or at large hadron collider. The electromagnetic probes, which comparatively possess longer mean-free-path than that of plasmonic system's magnitude. Consequently they could be decamped to set foot on detectors getting into least interaction to system and potentially impart information regarding preliminary plasmonic phases. Here the photonic and dileptonic-outflow is inspected along with experimental data analysis.*

Keywords: *Detectors Dileptonic-outflow, Heavy ion collision, Large hadron collider, Plasmonic Phase*

I. Introduction

Typically the outcome of bulky ion impinging is studied in terms of the plasmonic phase signatures. To detect them one picks out the discrepancies in distinct particle spectra else multiple particle correlation in the collisions, which take account of creation of Quark Gluon Plasma to those arrangements where plasma formation doesn't happen. One requires a clear hadronic explanation as a fundamental need for the transition comes into view. Looking over rare experimental traces, suggested to investigate the system established (Quark-gluon plasma) during the encounter of heavy ions at very high energies. These rare investigational signals help out for comprehending about the QGP origination and consequences.

Here in this paper we are discussing about one of the electromagnetic probe i.e. direct photons and dileptons as they are least altered during interplays amongst particles and is able to endow the speculation of plasmonic phase.

II. Direct Photons

The feasibility of out-turn of photons in the plasma consisting mixture of quarks and gluons is by means of the annihilation mechanisms ($q + \bar{q} \rightarrow \gamma + g$) else because of Compton type mechanism ($g + q\ \bar{q} \rightarrow \gamma + q(\bar{q})$. It is referred as tenet in [1] that the dispensation of the momentum of in medium gamma photons yield greatly analogical to the corresponding quarks and gluons dispensation from the plasma. Due to this analogous behavior the photon temperature may become a vital tool and it can be utilized like a pointer of the QGP's thermal magnitude. Although the factual portrait of collisions is somehow ill-defined as some other modes there which procreate the photons and interrupt the pure gauging of such perceptible rigorous, practically and theoretically too. Some of these modes are-

In stiff scatterings of preliminary partons ($q + \bar{q} \rightarrow \gamma + g$) the procreated photons keep the out-turn found to be nearly proportioned to the quark dispensation within nucleons;

jet bremsstrahlung alludes the discernible gamma prolificacy which is created due the jet interplay in the interior of the intensive and scalding plasma; **jet fragmentation or shred** in exterior of the fireball;

hadron vapor unfolding photons via the tracts like $\pi^+ + \pi^- \rightarrow \gamma + \rho^0$;

hadron dilapidations (e.g. π^0, ρ, η, ω) this govern the inclusive photon expansion.

For better understanding of the above mentioned photon yield contributions from different sources, let's have a look at the experimental consequences-

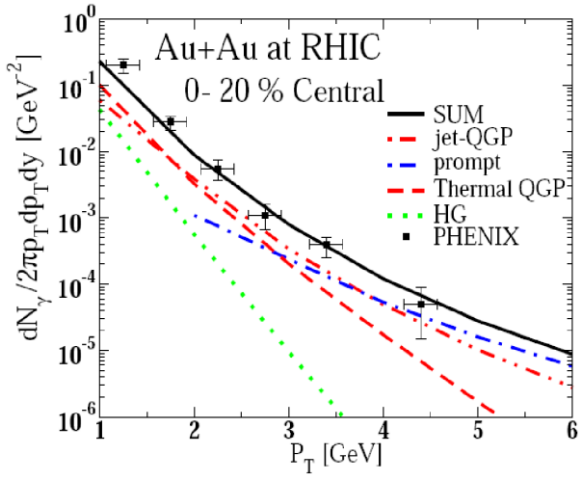

Fig. 1: The metered unalterable photon prolificacy distribution also similitude this to the theoretical numerations for the direct gamma blend [2].

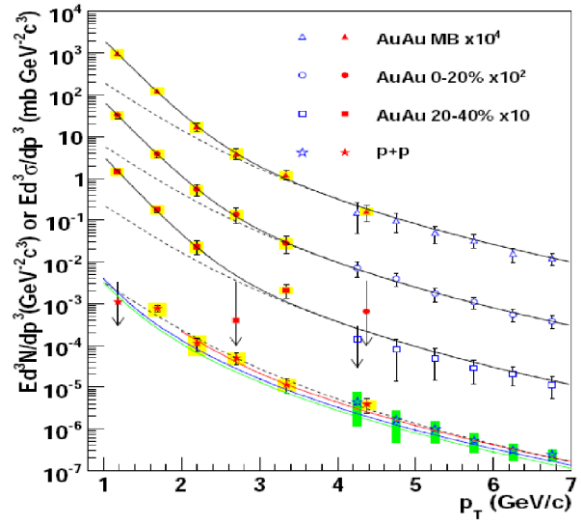

Fig. 2: The photon dispensation outgrowth opted with p+p and Au+Au impacts at $\sqrt{s_{NN}}$= 200 GeV and weighed to NLO-pQCD computations [3].

The figure 1. set forth the photon yield outturned as per the multiple modes referred above, when numerations performed theoretically [4] ,matched with the experimental metering from centric Au+Au encounters at maximal RHIC energy. The noteworthy thing in the profile is that, for p_T value below 3 GeV/c the significant share to the photon prolificacy is from QGP.

The figure 2. exhibits the prolificacy of photons received from Au+Au impingement noticed for various centrality spectrums, also the same outturn instated from p+p percussions [3]. In order to make the prolificacy of photons in p+p encounter, coequal to the Au+Au outturns, the contour line with dashes which is an apt to the p+p data is gauged. The clamant thing which should be noticeable is that the effective and swingeing share to the photon prolificacy from the plasma is detected in the lower flank of p_T spectrum as guessed.

III. Dileptons

The dileptons in QGP stuff are originated during distinct mechanisms, like photons. For example through the annihilation mechanism $q+\bar{q} \rightarrow \gamma^* \rightarrow l^+ l^-$. Also the lepton duo hold their mass unaltered throughout the mechanism, thus like photons, they too bring in or tote clue of the quark distribution [4] and regarding the thermal magnitude and thermal attributes of the deconfined phase of the substance. There are some other contrivances by which generation of dileptons is possible, like the annihilation mechanisms with quarks from the primary nuclei(this contrivance of annihilation amidst primary nucleons generated quark and a sea anti-

quark is denominated by Drell-Yan mechanism), hadronic interspersing like $\pi^+ + \pi^- \rightarrow l^+ l^-$ or particles dilapidation mechanism like π^0, η, ρ, ω, φ, $\frac{J}{\varphi}$,φ

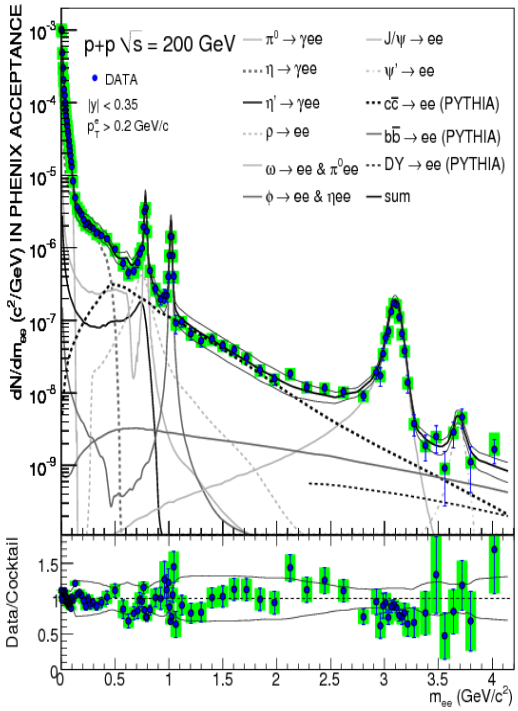

Fig. 3a: (painted counter) Inclusive mass breathe of e + e − duo within the PHENIX assent for p+p collisions at$\sqrt{S_{NN}}$= 200 GeV similitude to the prospected from the dilapidations of less weighted hadrons and co-concerned decays of charm, bottom, and Drell-Yan and the ratings of data to the blend of familiar modes with p + p collisions [5].

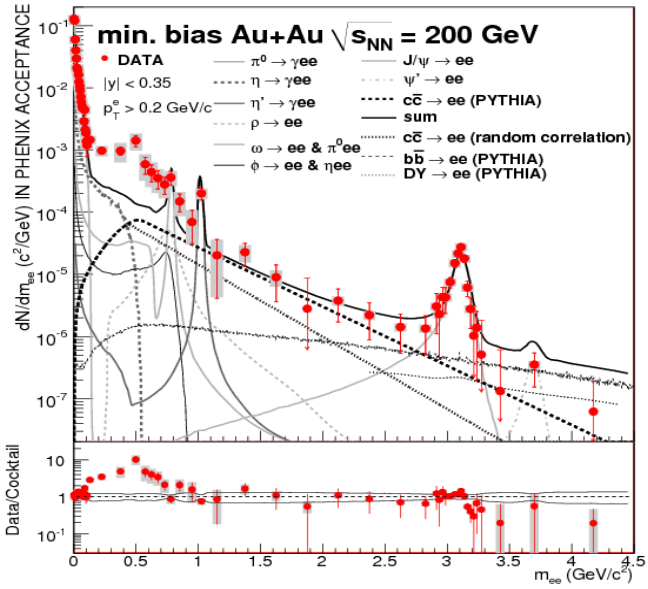

Fig. 3b: Minimum bias Au + Au impacts from [6].

It is noticeable that for large unaltered or invariant masses the prime share is from correlated heavy quark dilapidations, but if the original depicture and the net effect of the QGP is to be remarked, then all these factors should be pondered. The above figures 3a & 3b also illustrates the dileptons dispensation from variant sources said as cocktail. The profile displays that the entire non-QGP sharing is fit up well to the p+p

observations. The sequels of Au+Au impact, point out that the heap of the dielectron duos output in the extent $0.2 < p_T < 0.8$ GeV/c and hopefully endue the capital grant for the QGP.

IV. Summary

The origination of direct photon in plasma is a consequence of annihilation of quark and its anti-particle also due to scattering amidst gluon & quark duo. Dispensation of rapidity in case of direct photon is a good tool to suggest regarding preliminary rapidity dispensation of mesons created, therefore contemplates to plasmonic phase[7]. In the same manner dileptons are able to depart from the superdense reactance arena unaltered and they usually come in picture when quark annihilated with its anti-particle else turned out through virtual photon and fetch preliminary system's acquaintance about its thermo-dynamical status [8]. Thus these two electromagnetic probes provide a very good idea about the plasma state as well as much beneficial to unlock the unexplored description of heavy ion impacts.

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