

Photons From Relativistic Heavy Ion Collisions

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by
Lusaka Bhattacharya
High Energy Nuclear & Particle Physics Division
Saha Institute of Nuclear Physics
1/AF Bidhannagar, Kolkata-700 064
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Abstract

It is believed that a novel state of matter - Quark Gluon Plasma (QGP) will be transiently produced if normal hadronic matter is subjected to sufficiently high temperature and/or density. In this thesis, we have investigated the possibility of QGP formation in the ultra-relativistic collisions of heavy ions through the electromagnetic probes (mainly photons). There are several sources of photons. Photons can arise from the partonic interactions of colliding nuclei. After the formation of the QGP, considerable amount of photons originate from the thermal interaction of plasma partons as well as from the hadronic matter. The last class of photon emission process is the jet-conversion mechanism which occurs when a high energy jet interact with the medium constituents via annihilation and Compton processes. In the first work, we investigate the role of collisional energy loss of the jet parton on the jet photon yield and then compared it with the high p_T photon data measured by PHENIX collaboration. In an another work, the effects of running coupling have also been incorporated in the evolution dynamics.

There is a possibility that the QGP may not become isotropic in momentum-space quickly enough. To study the early time momentum-space anisotropy, we need some observables, which would be sensitive to the anisotropies in the quark and gluon distribution functions. Due to the “weak” interaction of photons with the surrounding strongly interacting matter, photons may carry information about the early time momentum space anisotropy. We calculate medium photon yields due to Compton and annihilation processes in anisotropic media. The effects of time-dependent momentum-space anisotropy of QGP on the medium photon production are discussed. In the next work, the transverse momentum distribution of direct photons from various sources by taking into account the initial state momentum space anisotropy and late stage transverse flow effects are calculated. The total photon yield, calculated for various combinations of initial conditions and transition temperatures, is then compared with the recent measurement of the photon transverse momentum distribution by the PHENIX collaboration. We also calculate the rapidity distribution of photons from an anisotropic QGP. We have also investigated the effects of anisotropy on the photons from jet-plasma interaction. We have compared our evaluation of the photon spectra with experimental data obtained by the PHENIX collaborations. Predictions of photon spectra for LHC energies have also been made in this thesis.

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