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Photon emission at hadronization: possible resolution to the direct photon puzzle

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We discuss photon emission at the stage of hadronization as a possible resolution to the direct-photon puzzle. In an ordinary plasma, it is well known that photon emission occurs when a plasma goes back to a normal state through recombination processes such as $e^- + p^+ \to H + \gamma$ for an electron-proton plasma. This is called the "radiative recombination". A similar process should take place when a QGP hadronizes. For example, meson formation from a quark and an antiquark will be accompanied by photon emission $q + \bar{q} \to meson + \gamma$ to compensate the energy difference between the initial and final states.

In order to compute the number of photons emitted at hadronization, we employ the "recombination model" developed by the Duke group. There, the number of produced hadrons is computed under the assumption that coalescence of valence (anti)quarks just occurs without emission of additional particles, which surely violates energy and entropy conservation. With the photon emission added in this coalescence process, however, energy and entropy can be made conserved. We reinterpret the production formula of hadrons in the original recombination model as that of artificial "resonant states"whose invariant masses are not necessarily equal to the masses of any physical hadrons. We further assume that the "resonant state"decays into a physical hadron and a photon.

This "improved"recombination model has a potential to resolve the direct-photon puzzle: (1) a larger yield of photons since we add photon production at hadronization, which has been overlooked so far, and (2) radiated photons flow similarly as hadrons because photons are emitted in a collimated way with the resonant state's motion. Moreover, the pt distribution of emitted photons mimics thermal distribution whose effective temperature is essentially given by blue-shifted quark's temperature and thus becomes much higher than critical temperature.

Preferred Track

Electromagnetic Probes

Collaboration

Not applicable

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