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Photon production in high-energy heavy-ion collisions: thermal photons and radiative recombination

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Electromagnetic probes are one of promising tools to investigate properties of the hot and dense matter created in high-energy heavy-ion collisions. However, even the state-of-the-art phenomenological models which can correctly explain spectra and anisotropic flows of charged hadrons underpredict yield and elliptic flow of photons [1]. It is known as "photon puzzle".

Here, we propose photon emission at hadronization as a possible resolution to the photon puzzle [2].
First, we calculate yields and collective flows of thermal photons at RHIC and the LHC, using a relativistic viscous hydrodynamical model which is combined with a hadron-based event generator, UrQMD [3]. Initial conditions are given by TRENTO. Our calculated yields and elliptic flows of thermal photons are smaller than those of experimental data at RHIC and the LHC, which is consistent with the previous study [1].

Then, we discuss the effect of radiative hadronization on thermal photons from fluid. We find that radiative hadronization enhances both direct photon yields and elliptic flows as the same time and reproduces experimental data at RHIC and the LHC. The ratio of yield of pions produced through the radiative hadronization to that from the original recombination model at RHIC is 20 %. It means that the radiative recombination does not break the nature of quark number scaling in elliptic flow which is expected from the original recombination model [4]. On the other hand, in spite of the small contribution in hadron production, the radiative recombination process increases both the yield and collective flows of direct photon. The ratio at the LHC is 5 % which is smaller than that at RHIC. We show the detailed analyses on photon production during space-time evolution of fluid and at hadronization in high-energy heavy-ion collisions.

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