The 7th International Conference on Chirality, Vorticity and Magnetic Field in Heavy Ion Collisions

Contribution ID: **18** Type: **not specified**

The direct photon puzzle and the weak magnetic photon emission

In heavy ion collisions, the measured spectrum of direct photons at RHIC and the LHC has been found as azimuthally anisotropic as pions. In particular, a large elliptic flow of the direct photos has been observed, which strongly contradicts theoretical predictions, leading to the well-known “direct photon puzzle”. Although it is quite challenging in the conventional hydrodynamical modelings to incorporate a significant photon emission anisotropy, the presence of an external magnetic field in quark-gluon plasma, could bring in a plausible solution to the puzzle.

In this work, instead of a strong magnetic field assumption which has been considered extensively, we propose the effect of weak magnetic photon emission, originated from the interplay of a weak external magnetic field and the longitudinal dynamical evolution of the quark-gluon plasma. The weak magnetic photon emission results in an extra source of photon production from the qurak-gluon plasma, with a large elliptic flow. In both cases of 0+1D Bjorken flow and 3+1D hydrodynamical evolution simulated via MUSIC, the effect of weak magnetic photon emission are verified. Given this novel effect, under realistic conditions with respect to heavy-ion collisions carried out at RHIC and the LHC, especially that a weak magnetic field satisfying $|eB| \ll m_\pi^2$, the experimentally measured direct photon elliptic flow can be well reproduced. Accordingly, we found that the direct photon elliptic flow provides a probe to the magnetic field at very early stages. For the top energy of RHIC collisions, right after the pre-equilibrium evolution, an estimate the upper bound of the magnetic field can be given to be a few percent of the pion mass square.

arxiv:2302.07696

Primary authors: SUN, Jing-An (Fudan University); YAN, Li (Fudan University)

Presenter: SUN, Jing-An (Fudan University)