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Photons as a signal of deconfinement in hadronic matter under extreme conditions

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The study of the hadron matter properties under extreme conditions of high baryon density, energy and strong electromagnetic fields in heavy ion collisions is one of the most important problems in modern high-energy physics. The striking example of such state of matter is the quark-gluon plasma (QGP). One of the possible ways to study the properties of quark-gluon plasma is the so-called electromagnetic probes - photons and leptons. Since these particles freely leave the plasma volume practically without interacting with hadron matter, they can carry direct information about the processes in the QGP.

The report is devoted to the specific mechanism of photon production by conversion from two gluons $gg \to \gamma$ in the framework of the mean-field approach to the QCD vacuum. According to the domain model of QCD vacuum, the confinement phase is dominated by Abelian (anti-)self-dual gluon fields, while the deconfinement phase is characterized by a strong chromomagnetic field. In the confinement phase, the production probability of two gluons into a photon vanishes due to the random orientation of the statistical ensemble of confining vacuum fields. In contrast, strong magnetic field with singled direction is generated by relativistic heavy ion collisions and plays the role of a trigger for the deconfinement phase transition. This transition is accompanied by chromomagnetic field with the same direction as the magnetic field. As a consequence, the conditions of Furry theorem are violated, and the conversion probability of two gluons into photon is nonzero, and their distribution has a strong angular anisotropy. Thus, the photon production in the investigated process can act as one of the important signals of transition of hadronic matter to the deconfinement phase.

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