Direct photons – basis for characterizing heavy ion collisions

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Direct photons are emitted from all the stages of collisions, and don't interact strongly with medium once produced. Therefore, they can directly carry out kinematical and thermodynamical information on the stages. Photons are primarily produced through a Compton scattering of quarks and gluons ($qg \rightarrow q\gamma$) or an annihilation of quarks and anti-quarks ($q\overline{q} \rightarrow g\gamma$) as leading order processes, and the next leading order (NLO) process is dominated by bremsstrahlung (fragment) ($qg \rightarrow qg\gamma$).

High transverse momentum (p_T) hard photons are produced in initial hard scatterings of partons, and have been observed in various hadronic collisions. In relativistic heavy ion collisions, in addition to the hard photons, thermally emitted photons from a quark gluon plasma (QGP) state are expected to dominate in $\sim 1 < p_T < 3\,\mathrm{GeV}/c$, and a jet-photon conversion process for $p_T > \sim 4\,\mathrm{GeV}/c$ by a secondary interaction of a hard scattered parton with thermal partons in the medium.

Measurement of direct photons is extremely challenging in relativistic heavy ion collisions, but significant amount of efforts made in last decades established the measurement as a basis of characterizing collisional stages. For instance, unsuppressed hard photons have been observed at RHIC, which proved that the high p_T hadron suppression found at RHIC is as a consequence of an energy loss of hard-scattered partons in the hot and dense medium.

An overview of direct photon measurement in relativistic heavy ion collisions will be given in this presentation.