Contribution ID: **65** Type: **not specified**

Is charmonia a good probe to investigate on hot QCD matter in ultra-relativistic $p-p$ collisions at the LHC energies?

Recent observations on the high-multiplicity $p-p$ collisions suggest
possible formation of the strongly interacting quark-gluon plasma (QGP), based on the phenomenon similar to those observed in heavy-ion (A−A)collisions. Inspired by these observations, we attempt to investigate the existence of a QGP-like medium in $p-p$ collision. However, unlike A−A collisions, the system size is expected to be much smaller $p-p$ collisions, which implies comparable transverse and longitudinal dimensions, leading to rapid cooling of the medium. Consequently, it changes the dynamics of charmonium states, which is highly unlike the charmonium dynamics in heavy-ion collisions. As medium dynamics affect charmonium yield, we first employ second-order viscous hydrodynamic to obtain the medium evolution and its thermal velocity. As charmonium traverses through the medium, the relative velocity between charmonium and medium induces the relativistic Doppler shift, leading to an effective temperature for charmonium. The implicit temperature of the particle depends on its velocity and medium thermal velocity. In this work, we observed that quarkonia traversing through the medium does not carry the same temperature as a medium due to the relativistic Doppler shift effect. Here we show how particle velocity (v_Q) or transverse momentum (p_T) influences the suppression and regeneration of the charmonium in the medium. The present study incorporates the QGP-induced suppression effects, such as collisional damping, which arises because of the energy loss due to interactions of the charmonium with the medium and gluonic dissociation as the consequence of quarkonium states into a color octet lead interactions with gluons. It also includes the regeneration of charmonium states within the medium due to the transition from the color octet state to the color singlet state. Additionally, we observe that the temperature evolution is fast enough in $p-p$ collision, which induces rapid changes in the Hamiltonian of the system, causing the transition from J/ψ to ψ(2S) state. This transition between charmonium states is obtained by considering the non-adiabatic framework for evolving charmonium states. Through these combined effects, we explore the dependence of charmonium yield on transverse momentum (p_T) and event multiplicity in $p-p$ collisions, providing new insights into the dynamics of strongly interacting matter and serving as a potential probe for the existence of a thermalized QCD medium in small collision systems.

Author: Dr SINGH, Captain Rituraj (Indian Institute of Technology Indore)

Co-author: SAHOO, Raghunath (Indian Institute of Technology Indore (IN))

Presenter: Dr SINGH, Captain Rituraj (Indian Institute of Technology Indore)

Track Classification: 3. Hard probes - jets and electromagnetic probes, heavy flavor, quarkonia