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Untangling the evolution of heavy ion collisions using direct photon interferometry

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Recently, two scenarios have been proposed to resolve the discrepancy between photon yield and the flow coefficients measured in nuclear collisions at RHIC and the LHC. In the first, additional photons are produced from the early pre-equilibrium stage computed from the "bottom-up" thermalization scenario [1-3]. In the second, the thermal rates are enhanced close to the pseudo-critical temperature $T_c \sim 155\,\mathrm{MeV}$ using a phenomenological ansatz [4]. We investigate the measurement of Hanbury Brown-Twiss (HBT) photon correlations [5] as an experimental tool to discriminate between such scenarios. By enhancing standard hydrodynamical simulations with these scenarios, we compute the correlators in terms of the relative momenta of the pair for different values of its transverse momenta, $K_\perp$. We find that the longitudinal correlation is the most sensitive to different photon sources. We compliment this theoretical exploration with a study of the feasibility of measuring a direct photon HBT signal in the upcoming high-luminosity LHC runs. Considering only statistical uncertainties, we find that with the projected $\sim 10^{10}$ heavy ion events a measurement of the HBT correlations for $K_\perp < 1\mathrm{GeV}$ is statistically significant.

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Collaboration (if applicable)

Track

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