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Directed flow of D mesons at RHIC and LHC energy within a transport approach: non-perturbative dynamics, vorticity and electromagnetic fields

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Ultrarelativistic heavy-ion collisions are characterized by the presence of very intense electromagnetic fields, which attain their maximal strength in the early stage and interplay with the strong vorticity induced in the plasma by the large angular momentum of the colliding nuclei. As a promising observable influenced by these phenomena we study the directed flow v_1 of neutral D mesons by means of a relativistic Boltzmann transport approach. Confirming recent theoretical and experimental studies, we find that the v_1 for D mesons is surprisingly much larger than that of light charged hadrons and we clarify its different origin with respect to the one of the bulk matter. We point out that the very large v_1 for D mesons can be generated only if there is a longitudinal asymmetry between the bulk matter and the charm quarks and if the latter have a large non-perturbative interaction in the QGP medium. It is moreover associated to the small heavy-quark formation time expected to be more sensitive to the initial high-temperature dependence of the charm diffusion coefficient. We discuss also the splitting of v_1 for D^0 and \bar{D}^0 due to the electromagnetic field that is again much larger than the one observed for charged particles. We find a v_1 splitting of D mesons in agreement with the data by STAR that have however still error bars comparable with the splitting itself. We highlight the role of the D -meson v_1 as a powerful observable connected to the transport properties of the hot QCD matter produced in high-energy collisions: the magnitude of the v_1 gives information on the heavy-quark diffusion coefficient whereas the v_1 splitting is associated to the electric conductivity of the QGP medium.

Collaboration

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