

ID de Contribution: 99

Type: Talk

Investigation of early magnetic field and angular momentum in ultrarelativistic heavy-ion collisions via D^{*+} -meson spin alignment with ALICE

mercredi 5 juin 2024 09:50 (20 minutes)

Heavy quarks, i.e. charm and beauty, are produced at the initial stage of heavy-ion collisions, on a time scale shorter than the medium formation time, and are sensitive to the initial angular momentum of the system and the magnetic field produced perpendicular to the reaction plane (defined by the impact parameter direction and beam direction) in non-central heavy-ion collisions. In the presence of a large angular momentum and initial magnetic field, the charm quark can be polarised. The quark polarisation is expected to be transferred to the hadron during the hadronisation process. Experimentally, the heavy-flavour polarisation can be probed by measuring the spin density matrix element of spin-1 hadrons (as the D^{*+} meson). Any deviation of the ρ_{00} parameter from $\frac{1}{3}$ can be attributed to the spin alignment of the D^{*+} meson.

We will present the first measurement of the ρ_{00} parameter of D^{*+} meson in Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, exploiting the large data sample collected by the ALICE Collaboration during the LHC Run 2. A comparison with the J/ψ polarisation measurement will also be reported to investigate the effect of the magnetic field.

Moreover, the ρ_{00} parameter of D^{*+} mesons measured in high-energy pp collisions will also be presented, including the first studies with Run 3 data. In this case, the measurement is performed also for D^{*+} mesons originating from B-meson decays. As vector mesons which decay from scalar B mesons, they are expected to be longitudinally polarised due to the helicity conservation in weak decays.

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Classification de Session: Track4-Bulk&Phase

Classification de thématique: Heavy-Flavours & Quarkonia