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Investigating the early magnetic field of QGP via heavy-flavour polarisation studies with ALICE

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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 large initial 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 initial magnetic field, the charm quark can be polarised. The quark polarisation is expected to be transferred to the hadron in 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 ρ00 parameter from ⅓ can be attributed to the spin alignment of D^{*+} meson.

We will present the first measurement of the ρ_{00} parameter of D^{*+} meson in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV, exploiting the large data sample collected by the ALICE Collaboration during the LHC Run 2 in 2018. A comparison with the J/ψ polarisation measurement will also be reported to investigate the effect of the magnetic field. In this study, one of the main background sources is represented by the feed-down contribution from B-meson decays, as vector mesons which decay from scalar B mesons are expected to be longitudinally polarized due to the helicity conservation in weak decays. In this context, the final measurement of the spin alignment of prompt and non-prompt D^{*+} mesons in pp collisions at $\sqrt{s} = 13$ TeV, used to quantify the effect of the feed-down in the Pb–Pb measurements, will be presented.

Category

Experiment

Collaboration (if applicable)

ALICE

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