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Charm-hadron polarization in hadronic collisions at the LHC with ALICE

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Heavy quarks (charm and beauty) are mainly produced in hard-scattering processes among partons in ultra-relativistic hadronic collisions at the LHC. In heavy-ion collisions, where a quark-gluon plasma (QGP) state is produced, charm and beauty quarks are produced on a timescale shorter than the medium formation time, being sensitive to the initial angular momentum of the fireball and to the magnetic field produced perpendicularly to the reaction plane in non-central heavy-ion collisions. In the presence of a large angular momentum and initial magnetic field, the charm quark can be polarised, and the quark polarisation is expected to be transferred to the hadron during the hadronization process. Experimentally, heavy-flavour polarisation can be probed by measuring either the spin density matrix element ρ_{00} of spin-1 bosons (as the D^{*+} meson) or the longitudinal polarization P_z of spin ½ fermions (as the Λ_c^+ baryon). Measurements in pp collisions provide a crucial baseline to disentangle the amount of charm-hadron polarization induced by the charm-quark polarization inherited from the initial stage of heavy-ion collisions.

In this contribution, 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 data sample collected by the ALICE Collaboration during the LHC Run 2, is shown. Moreover, the ρ_{00} parameter of D^{*+} mesons and the longitudinal polarization P_z of Λ_c^+ baryon measured in pp collisions at $\sqrt{s} = 13.6$ TeV collected during the LHC Run 3 are presented. In this case, the measurements are performed also for charm hadrons originating from b-hadron decays, for which the helicity conservation in weak decays should imply a non-zero polarization of the produced charm hadrons.

Category

Experiment

Collaboration (if applicable)

ALICE

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