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Probing three-body dynamics of Λ and Ξ^- hyperons with nucleons in ALICE

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Understanding the interaction of strange baryons with nucleons is a key ingredient for describing dense baryonic matter, where the appearance of hyperons in the cores of neutron stars is expected to strongly soften the equation of state, hence limiting the maximum stellar mass. New constraints, not only on two-body but also on multi-body hyperonic interactions, are necessary to address this problem. So far, several attempts to include three-body forces have relied on scarce experimental information from hypernuclei, where existing data on Λ hypernuclei are far less precise than theoretical predictions, and only a few Ξ^- hypernuclei events have been observed.

In this contribution, new high-precision femtoscopic measurements from the ALICE experiment are presented, probing three-body systems containing protons and hyperons via the Λ–p–p and Ξ^-–p–p correlation functions in pp and Pb–Pb collisions. Preliminary theoretical studies indicate that the effect of three-body forces on the p–p–Λ correlation function could reach 40%, a level achievable with Run 3 statistics. Comparisons across different collision systems and centralities provide information on the extent to which three-body forces can be tested with increasing source size. The coupled-channel nature of p–Ξ^- pairs is addressed by confronting recently updated calculations with the p–Ξ^- correlation function measured in pp collisions at 13.6 TeV. These results open a new path toward quantifying three-body effects in the strangeness sector, with direct implications for modeling dense nuclear matter and the neutron star equation of state.

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