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ALICE measurements of Ξ- and Ω-nucleon interactions and constraints on lattice QCD potentials

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A precise understanding of the Equation of State of dense objects like neutron stars is limited by the knowledge about hyperon interactions and the precision of the models describing the latter. Recently, the ALICE Collaboration has demonstrated that two-particle correlation measurements, which are sensitive to the source of particle emission and to the interaction of the particle pair, can provide precise data on hyperon-nucleon and hyperon-hyperon interaction potentials. In small collision systems this makes it possible to map the core of the potential at small distances and is currently the only viable way to provide a sensitive experimental measurement against which theoretically predicted potentials can be tested. In this talk we show the first precise study of the pΞ and pΩ interactions, measured in pp collisions at 13 TeV with the ALICE detector. For the first time, clear signatures of the strong attractive interaction can be observed for these particles.

Traditionally, meson exchange models are used to describe the hyperon sector and are constrained by the scarce scattering and hypernuclei data, almost exclusively available for Λ hyperons. Recently the HAL-QCD collaboration conducted calculations without relying on constraints by data and with quarks and gluons as degrees of freedom. Their results converge for the interactions between heavier Ξ and Ω hyperons and nucleons, and in the pΩ system they predict a bound state. The potentials provided by HAL-QCD calculations and meson-exchange are applied to describe the experimentally measured correlation function. For the pΞ interaction the HAL-QCD prediction is strongly favoured by the data compared to the meson-exchange model. For the pΩ channel, strongly bound systems are largely excluded and the comparison between data and calculations only leaves room for binding energies below 1 MeV.

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