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Femtoscopy of p – Λ system obtained in heavy-ion collision in the HADES experiment

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Over the past decades, the properties of hyperons in dense matter have been widely concerned about in connection with hypernuclei and the hyperon component in neutron stars. Hyperons are supposed to possibly exist within the inner layer of neutron stars whose structure depends strongly on the equation of state (EOS) of nuclear matter at supersaturation densities. The appearance of hyperons in the core softens the EOS, resulting in neutron stars having masses lower than 2M, where M is the sun's mass. In contrast, soft EOS typically predicts small radii, which cannot support large neutron star masses. The conflict is called the" hyperon puzzle in neutron stars." In order to understand the hyperon-nucleon interactions experimentally, the two-body system is taken into consideration. Femtoscopy, the technique of two-particle correlations in momentum space, is one method for exploring such phenomena and has proven to be a powerful tool for determining parameters of strong interaction and lifetimes in heavy ion physics. It allows for the measurement of the collision-generated system's spacetime features, which has a lifespan of 10^{-23} seconds and a lifetime of femtometers (10^{-15} m).
The analysis uses the HADES detectors, one of several experiments at the GSI Helmholtz Center for Heavy-Ion Research in Darmstadt, Germany. Experiments data include Ag-Ag heavy-ion collision at EKin at 1.58 AGeV. In order to study more about strong interactions, particles with strange quarks are perfect for this study, i,e. Λ, K0s etc. The particles containing strangeness are produced very rarely in heavy-ion collisions at typical HADES energies.
The Lambdas are reconstructed through the decay channel $\Lambda \longrightarrow \pi - + p$, with a branching ratio of 64%. The invariant mass range of the lambda candidates is 1115 MeV/c2 . Pions and protons (i.e., lambda daughters) are selected using their specific energy loss. Mainly, using so-called off-vertex-decay or V0 topology, the secondary vertex is reconstructed. The p – Λ correlation function is measured for HADES for the first time in a heavy-ion collision and will be presented. It is also found that the strong interaction induces a prominent peak in the correlation function and provides more sensitive source size measurements than pp correlations under some circumstances.

Collaboration

HADES

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