Lambda-Lambda interaction from two-particle intensity correlation in relativistic heavy-ion collisions

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Interaction between $\Lambda\Lambda$ is important to the understanding of the flavor singlet dibaryon, H, as well as to the equation of state of dense hyperonic matter. If we can access the $\Lambda\Lambda$ interaction at zero baryon density, comparison with the $\Lambda\Lambda$ interaction obtained from the double Λ hypernucleus may reveal in-medium effects in the $\Lambda\Lambda$ interaction or equivalently the $\Lambda\Lambda N$ three-body interaction.

We investigate the $\Lambda\Lambda$ interaction [1] by using the two-particle intensity correlation of Λ in relativistic heavy-ion collisions recently measured by the STAR collaboration [2]. We find that the behavior of the $\Lambda\Lambda$ correlation function at small relative momenta is sensitive to the interaction potential. Longitudinal expansion of the source is found to modify the shape of the correlation function at low momenta significantly. Based on the longitudinal Bjorken expansion and the transverse flow strength determined from the measured Λ spectra, we find that the recent STAR data gives a strong constraint on the scattering length and effective range of $\Lambda\Lambda$ interaction as, $-1.8\ \mathrm{fm}^{-1} < 1/a_0 < -0.8\ \mathrm{fm}^{-1}$ and $3.5\ \mathrm{fm} < r_{\mathrm{eff}} < 7\ \mathrm{fm}$, respectively, if the identified Λs do not include feed-down contribution from long-lived particles. Feed-down correction for Σ^0 decay reduces the sensitivity to the detail of the $\Lambda\Lambda$ interaction, and we obtain a weaker constraint $1/a_0 < -0.8\ \mathrm{fm}^{-1}$. Higher statistics data can narrow down the scattering parameter region. Our conclusion contradicts the STAR analysis, which suggests a positive scattering length, a_0 ($\delta(k) = -a_0 k + \mathcal{O}(k^3)$).

In the presentation, we discuss the $\Lambda\Lambda$ interactions proposed so far and their effects on the $\Lambda\Lambda$ intensity correlation function in high-energy heavy-ion collisions. We also discuss the reasons of the contradiction of our analysis and that by the STAR collaboration.

[1] K. Morita, T. Furumoto, A. Ohnishi, Phys. Rev. C **91** (2015), 024916.

[2] L. Adamczyk et al. (STAR Collaboration), Phys. Rev. Lett. **114** (2015), 022301.