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Chemical freeze-out of light nuclei in high energy nuclear collisions and resolution of the hyper-triton chemical freeze-out puzzle

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A new strategy [1] to analyze the chemical freeze-out of light (anti-,hyper-)nuclei produced in high energy collisions of heavy atomic nuclei within an advanced formulation of the hadron resonance gas model will be presented. This strategy is based on two different, but complementary approaches to model the hard-core repulsion between the light (anti-,hyper-)nuclei and hadrons. The first approach uses an approximate treatment of the equivalent hard-core radius of a roomy nuclear cluster and pions, while the second approach is rigorously derived recently in [1] using a self-consistent treatment of classical excluded volumes of light (anti-,hyper-)nuclei and hadrons. By construction, in a hadronic medium dominated by pions, both approaches should give the same results. Applying this strategy to the analysis of hadronic and light (anti-,hyper-)nuclei multiplicities measured by ALICE at $\sqrt{s_{NN}} = 2.76$ TeV and by STAR at $\sqrt{s_{NN}} = 200$ GeV it was possible to avoid the existing ambiguity in the description of light (anti-,hyper-)nuclei data and to determine the chemical freeze-out parameters of such nuclei with very high accuracy and confidence.

Using this strategy it was also possible to resolve a long standing problem to describe the light (anti-,hyper-)nuclei multiplicities including the hyper-triton measured by the STAR Collaboration, known as the hyper-triton chemical freeze-out puzzle [2]. Its solution was found by employing the hard-core radius of the (anti-)Λ hyperons which was found in our earlier works. One of the most striking results of our analysis made in [2] is that for the most probable scenario of chemical freeze-out at the STAR energy of collisions the obtained parameters allow to simultaneously reproduce the values of the experimental ratios S_3 and $\overline{S}_3$ which were not included in the fit. Also we were able to elucidate some peculiar properties of the QGP bags at STAR and ALICE energies of collisions.

References

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