Contribution ID: **17** Type: **Talk**

Correcting the B_A coalescence factor at GSI-HADES and RHIC-BES energies

Monday 24 October 2022 10:55 (25 minutes)

We investigate the coalescence factors B_2 and B_3 at low collision energies ($\sqrt{s_{\rm NN}} < 6$ GeV) with special focus on the HADES and RHIC-BES experiments. It is shown that, in order to properly interpret the coalescence factors B_A, two important corrections are necessary: I) B_2 has to be calculated using the proton $\times$ neutron yields in the denominator, instead of the square of the proton yield, and II) the primordial proton (neutron) densities have to be used for the normalization and not the final state (free) protons (neutrons). Both effects lead to a drastic reduction of B_2 and B_3 at low energies. This reduction decreases the discrepancy between the volumes extracted from HBT measurements and the volumes extracted from the coalescence factor ($V \propto 1/B_2$). While at HADES and low RHIC-BES energies these corrections are substantial, they become irrelevant above $\sqrt{s_{\rm NN}} > 6$ GeV. The proposed correction method is model independent and is only based on the measurement of protons, clusters and charged pions.

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Session Classification: Contribution talks