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Proton-deuteron and deuteron-deuteron correlation functions and origin of light nuclei from relativistic heavy-ion collisions

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Production of light nuclei in relativistic heavy-ion collisions is well described by the thermal model, where light nuclei are in equilibrium with all other hadron species present in a fireball, and by the coalescence model, where light nuclei are formed due to final state interactions after the fireball decays. A method is proposed to falsify one of the models. We suggest to measure a hadron-deuteron or deuteron-deuteron correlation function which carries information about the source of the deuterons and allows one to determine whether a deuteron is directly emitted from the fireball or if it is formed afterwards. The — and — correlation functions are computed to illustrate the statement. For — correlation function the source radius of deuterons formed due to final-state interactions is bigger by the factor of $\sqrt{4/3}$ than that of directly emitted deuterons and for — the factor is $\sqrt{2}$. To check how sizable is the effect we compute the — and — correlation functions taking into account Bose-Einstein statistics of deuterons in case of the — correlation function, ⊠-wave scattering due to strong interaction and Coulomb repulsion. The correlation functions are shown to be sensitive to the source radius for sources which are sufficiently small with RMS radii smaller than 3.5 fm. Otherwise the correlation functions are dominated by the Coulomb repulsion and weakly depend on the source radius.

Based on

1. St. Mrówczyński and P. Słoń, Acta Physica Polonica B **51**, 1739 (2020),
2. St. Mrówczyński and P. Słoń, Physical Review C **104**, 024909 (2021).

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