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Recent Hypernuclei Measurements in the High Baryon Density Region with the STAR Experiment at RHIC

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Light nuclei and hypernuclei are expected to be abundantly produced in intermediate to low energy heavy-ion collisions due to the high baryon density. However, their production mechanisms are currently not well understood. Measurements of the yield and collective flow are sensitive to their production mechanisms and the dynamics of the produced medium. In particular, hypernuclei measurements may also bear implications on the hyperon-nucleon interaction, which is critical to understanding the nuclear equation of state in high baryon density medium including strangeness degrees of freedom.

The STAR Beam Energy Scan Phase II program, including fixed target Au+Au collisions and carried out during 2018-2021, is particularly suited for such studies. In this talk, the collision energy dependence of light hypernuclei ($^{3}_{\Lambda}$H, $^{4}_{\Lambda}$H, $^{4}_{\Lambda}$He) production yields in $\sqrt{s_{\rm NN}} = 3, 19.6$ and 27 GeV Au+Au collisions will be presented. We will also report the energy dependence of light nuclei directed and elliptic flow as well as the first observation of hypernuclei ($^{3}_{\Lambda}$H, $^{4}_{\Lambda}$H) directed flow in 3 GeV collisions. These results will be compared to thermal and transport model calculations. Furthermore, precision measurements of the $^{3}_{\Lambda}$H, $^{4}_{\Lambda}$H and $^{4}_{\Lambda}$He lifetime and the relative branching ratio R_3 of $^{3}_{\Lambda}$H and $^{4}_{\Lambda}$H will be presented. We will also present studies of hypernuclei binding energy and Dalitz decays. The physics implications of our measurements in the context of hypernuclear structure and their production mechanisms will be discussed.

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