A next generation study of the low density nuclear equation of state

K. Hagel, B. Harvey, A. Jedele, R. Wada, A.B. McIntosh, S.J. Yennello, J. Gauthier, L.A. McIntosh, A. Hood, A. Hannaman, Z. Tobin, A. Abbott, M. Sorensen, and Y.-W. Lui

Characterization of the nuclear equation of state ranks among the most sought after information in all of nuclear physics. In particular, understanding the behavior of nuclear matter at low density has important implications in nuclear astrophysics because it has been shown that core collapse supernovae sample similar low density and temperature regions as those that can be created in the lab with heavy ion collisions [1-3].

A recent study reactions of 47 MeV/u ^{40}Ar + ^{112,124}Sn isolated a so-called femtonova, a hot source of early emitted light particles [4-8] that result from nucleon-nucleon collision. Coalescence analysis with an equilibrium assumption suggests that a very low density region is formed and that the time evolution of the reaction can be followed [9]. In particular, references [4, 7, 8] employed equilibrium constants of d, t, ^{3}He, and ^{4}He to compare to those of various astrophysical calculations and provided constraint on the assumptions of those models.

To study low density nuclear matter in more detail we note that correlation functions are another method that can be employed to extract an estimate of the size of the source. The size of the source extracted from a correlation function should reflect the size extracted using the coalescence model. If the two agree we will be able to put both methods on a firm footing. If the two methods are shown to not agree, we will be presented with an opportunity to gain further insight into results from coalescence analyses.

We have performed simulations that suggest that strip detectors in the angular region where particle production is dominated by products from the femtonova source provide adequate angular resolution to reconstruct a correlation function with sufficient accuracy.

To begin this process, we have acquired some sample silicon wafers that are of the same specifications as the silicon detectors used in the FAZIA [10] detector array. We are in the beginning stages of mounting and then testing these detectors to ensure that they meet the resolution needs to extract the correlation functions. Assuming a positive outcome, we are in discussion with CIS [11] in Germany to construct strip detectors using silicon wafers of similar specifications.

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