Employing ternary fission of ^{242}Pu as a probe of very neutron rich (Yp=0.036) matter

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Detailed assessments of the ability of two recent theoretical approaches to modeling existing experimental data for ternary fission [1,2] confirm earlier indications that the dominant mode of cluster formation in ternary fission is clusterization in *very neutron rich, very low density, essentially chemically equilibrated*, nucleonic matter [2-4]. An extended study and comparison of these approaches applied to ternary fission yields in the thermal neutron induced reaction ^{241}Pu(n,f)^{242}Pu [5] was recently undertaken to resolve some apparent differences of density, mass fractions and free neutron to free proton ratios obtained in the previous work. Resolution of these issues leads to a refined characterization of the source matter. Within the ideal resonance gas approximation in both approaches we find that a temperature of 1.29 MeV, density of 6.6 x 10^{-5} nucleons/ fm^3 and proton fraction Yp = 0.036 provide a good representation of yields of the ternary emitted light particles and clusters. See results for Z= 1 and 2 isotopes presented Figs. 1 and 2. The derived properties are comparable to that predicted for the

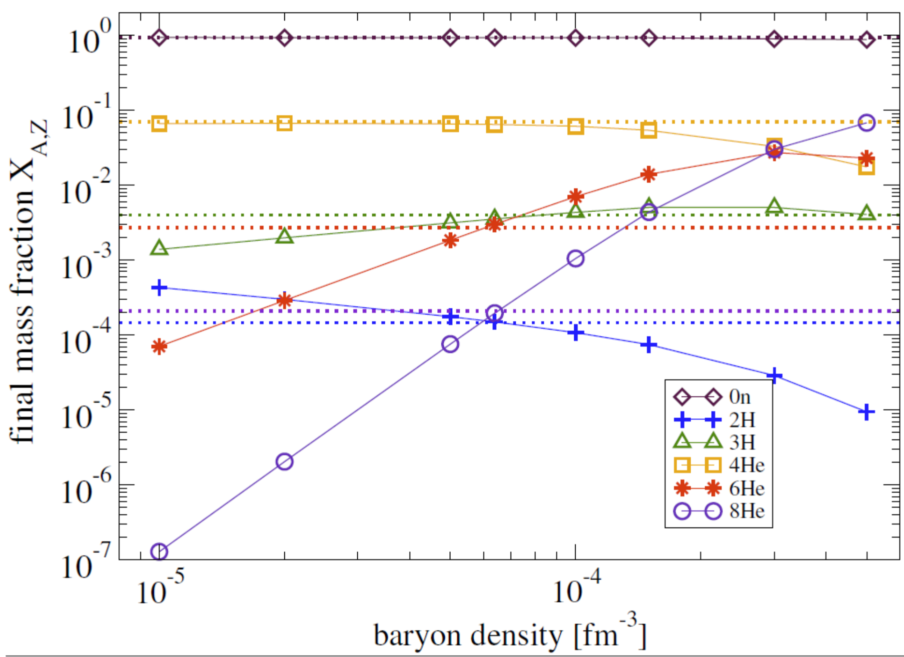

Fig. 1. Calculated light isotope yields (resonance-gas approximation) as a function of density (fixed temperature T= 1.288 MeV and proton fraction Yp = 0.0355) for Z=1,2 isotopes (represented by symbols) are compared with the observed experimental yields [5,6] represented by horizontal dotted lines. Optimum agreement based on a fit metric proposed by J. Lestone [7] is found

crystalline region in neutron star skins. This baseline calculation provides a foundation for the exploration of possible in-medium effects on the binding energies of larger clusters, even at such low densities. Those investigations are currently underway.

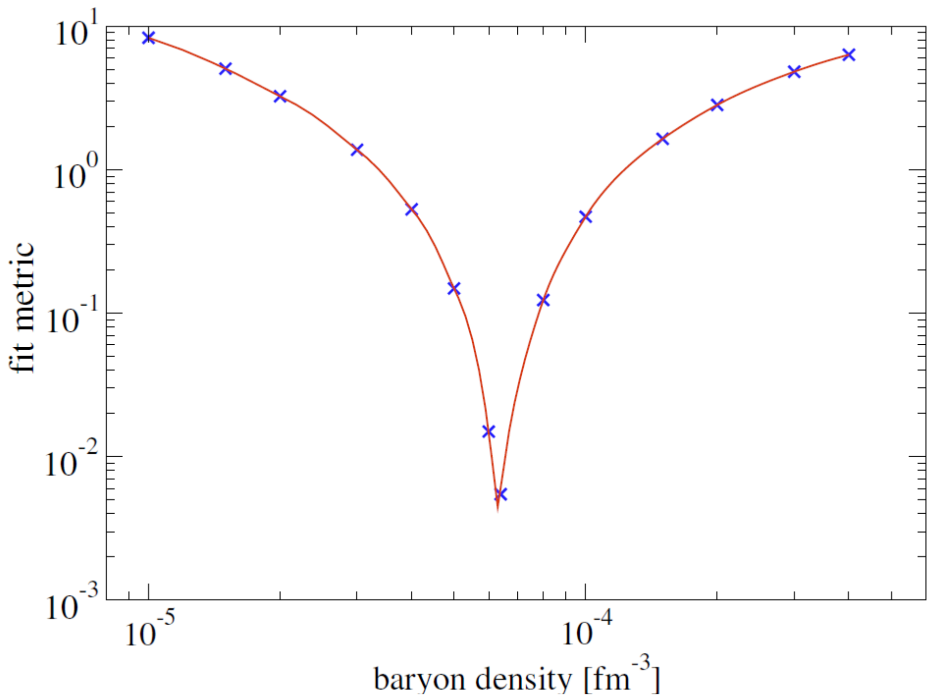

Fig. 2. Fit metric [7] vs. baryon density for T= 1.288 MeV and Yp = 0.0355.

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