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Symmetry Energy Dependence of Light Fragment Production in Heavy Ion Collisions

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The density dependence of the nuclear symmetry energy is of large actual interest in nuclear physics with important implications in astrophysics, particularly in the properties of neutron stars. It is not well determined in microscopic calculations, and therefore has been investigated in heavy ion collisions. Here also the momentum dependence of the symmetry energy enters, which determines the effective mass difference between protons and neutron. Here we discuss sensitive observables in the region of densities around and below saturation. A promising observable has been the difference in the pre-equilibrium emission of neutrons and protons, which directly depends on the strength of the symmety potential. We extend these studies to the emission of light fragments, in particular to 3He and tritium, which are more easily determined in experiments. We discuss stochastic transport calculations for collisions of different Xe+Sn isotopes in the energy range of 32 to 150 AMeV, varying both the symmetry potential and the effective masses. We find, in particular, that the yield ratios n/p and 3He/t as a function of the emission energy is a promissing observable to disentangle the density and momentum dependence of the symmetry energy. We also compare to preliminary INDRA data.