Symmetry Energy Effects on Fusion Cross Sections

C.Rizzo[1,2], V.Baran[3], M.Colonna [2], A.Corsi[4], M.Di Toro[1,2]
[1]Physics and Astronomy Dept., Catania Univ.
[2] LNS-INFN, Via S.Sofia 62, 95123 Catania, Italy
[3]Theoretical Physics Center, Bucharest Univ.
[4]Physics Dept. and INFN, Milano

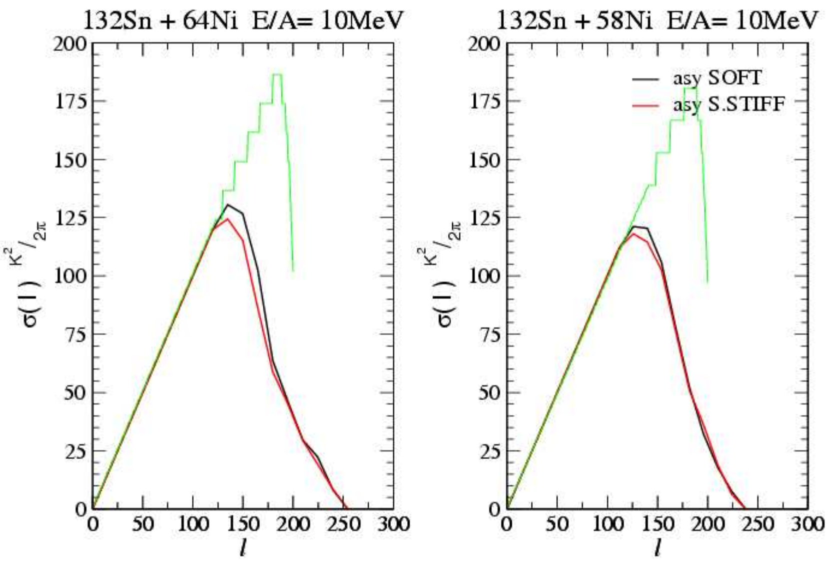
We study the interplay fusion vs. break-up (fast-fission, deep-inelastic) for Heavy Ion Collisions with exotic nuclear beams at low energies. The competition between reaction mechanisms can be used to study properties of the symmetry energy term at densities below and around the normal value. In particular since for dissipative collisions at low energy the interaction times are quite long we can have a large coupling among various mean field modes that eventually lead to a break-up of the system. The idea is to probe how the symmetry energy will influence such couplings in neutron-rich systems with direct consequence on the fusion probability.

The evolution of systems is described by a stochastic extension of the microscopic transport equation BNV, following a test-particle method where the time evolution of Gaussian phase space wave packets is considered. The mean field is built from Skyrme forces corresponding to a Soft Equation of State. We have considered two parameterizations for the density dependence of symmetry energy, asystiff, where the potential part shows an increasing behaviour with density, and asysoft, with a saturation around normal density. In the collision integral in-medium depending nucleon-nucleon cross sections, via a local density, are considered.

The method described here, based on the event by event evolution of quadrupole collective modes, in coordinate and momentum space, will nicely allow to extract the fusion probability at relatively early times, of the order of 200-300 fm/c, when the transport results are reliable.

In the Figure we present fusion probabilities for the neutron rich reaction 132Sn + 64Ni at 10 MeV/nucleon vs. the same reaction induced by a 132Sn beam on 58Ni target, for the two choices of the symmetry term. We nicely see measurable symmetry energy effects for intermediate impact parameters, where the competition fission-break-up is more important. Large differences are observed with respect to the predictions of the macroscopic PACE4 model (light grey curves).

Finally a collective charge equilibration mechanism (the Dynamical Dipole) is revealed in both fusion and break-up events, also depending on the stiffness of the symmetry term below saturation [1].



[1] V.Baran, C.Rizzo, M.Colonna, M.Di Toro, D.Pierroutsakou, Phys.Rev. C79 (2009) 021603.