

# Symmetry energy from nuclear reaction dynamics

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We present new features of isospin dynamics during the transient states explored by the composite nuclear system in heavy ions collisions. Within a microscopic transport model, Stochastic Mean Field, we investigate the transition from nuclear multifragmentation to neck fragmentation at Fermi energies. Hierarchy phenomena associated to some kinematic observables were observed and the origin of these effects is discussed. We suggest new fragment mass-velocity-isospin correlations particularly sensitive to the various mechanisms as well as to the isovector part of nuclear equation of state [1].

In the entrance channel along the fusion path the pre-equilibrium dipole mode appears as a collective motion excited on top of non-equilibrium states explored by the system towards the formation of the compound nucleus. We show that the corresponding gamma yield is sensitive to the density dependence of symmetry energy around and below the saturation density. Photon angular distribution from this fast collective mode can probe its excitation mechanism and the early stages of the nuclear dynamics [2].

These investigations may add complementary constraints on the symmetry part of the nuclear effective energy functionals below saturation.

- [1] M. Di Toro, V. Baran, M. Colonna, and V. Greco, J.Phys G: Nucl. Part. Phys. 37 083101 (2010).
- [2] V. Baran, C. Rizzo, M. Colonna, M. Di Toro, and D. Pierroutsakou, Physical Review C 79 021603(R) (2009).