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Dynamical Dipole Mode in the 40,48Ca+152,144Sm fusion-evaporation and fission reactions and perspectives with RIBs

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The Dynamical Dipole mode (DD) is a pre-equilibrium large amplitude collective oscillation of protons against neutrons of the dinucleus formed in charge asymmetric heavy-ion collisions [1-4]. The study of its gamma decay gives us valuable information on the reaction dynamics and could shed light on the density dependence of the symmetry energy in the nuclear matter Equation of State at sub-saturation densities [5]. We will present results on the DD excitation in a heavier composite system than those studied up to now: the 192Pb nucleus formed in the fusion-evaporation and fission 40Ca + 152Sm and 48Ca +144Sm reactions at Elab = 440 MeV and 485 MeV, respectively. The experiment was performed at Laboratori Nazionali del Sud, Italy. The gamma rays and the light charged particles emitted in the reaction were detected by using the MEDEA apparatus [6] while the heavy reaction fragments were detected by position sensitive Parallel Plate Avalanche Counters placed symmetrically around the beam direction. The analysis of the gamma ray spectra and angular distributions evidenced in a model independent way the DD excitation in such a heavy composite system in both exit channels: fusion-evaporation and fission. The possible implications of observing DD gamma radiation in the evaporation channel of a heavy composite system in the super-heavy element quest will be discussed. On the other hand, the observation of DD gamma radiation also in the fission exit channel (never observed before) provides innovative information on the DD excitation at higher partial waves, setting thus new severe constraints on theoretical models.
The use of radioactive beams permits to reach much larger N/Z asymmetries in the entrance channel than previously done with stable beams while the combination of radioactive and stable beams results in a very large number of target-projectile combinations giving us the opportunity to perform a systematic study of the DD features and to probe the Equation of State of the nuclear matter. Ideas in this direction will be discussed.

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