Dynamical Dipole Mode in Fusion heavy-Ion Reactions by Using Stable and Radioactive Beams

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An experimental overview [1-6] on an interesting feature of dipole excitation in heavy-ion collisions, the dynamical dipole mode, predicted to occur between interacting ions with a large charge asymmetry will be presented. In a campaign of experiments where the same compound nucleus in the ^{132}Ce region was probed through different charge asymmetry entrance channels, a larger γ-ray emission from the more charge asymmetric channel was evidenced, in the Giant Dipole Resonance energy range. The beam energy dependence of this extra γ yield was extracted by comparing the results obtained at different beam energies [2-5]. The first angular distribution data taken at E_{lab}= 16 MeV/nucleon support its prompt dynamical nature [2,3]. Our data [2-5] are compared with theoretical calculations performed within a BNV transport model and based on a collective bremsstrahlung analysis of the entrance channel reaction dynamics [7] and with recent data [6] obtained for compound nuclei in the same mass region but formed from entrance channel with a lower charge asymmetry.

Using the prompt dipole radiation as a probe and employing radioactive beams, new possibilities for the investigation of the symmetry energy at sub-saturation density are foreseen and will be discussed [5].

As a fast cooling mechanism on the fusion path, the prompt dipole radiation could be of interest for the synthesis of superheavy elements through hot fusion reactions. The entrance channel charge asymmetry could provide a way to cool down the hot fusion paths, so ending up with a larger survival probability. To shed light in this direction and to study if pre-equilibrium effects survive in heavier systems, we extended our study to the ^{192}Pb compound nucleus, formed at an excitation energy of 232 MeV, by using the ^{40}Ca + ^{152}Sm and ^{48}Ca +^{144}Sm reactions at E_{lab}= 440 MeV and 485 MeV, respectively. Preliminary results of this measurement, done with the aim to search for the dynamical dipole mode in both fusion-evaporation and fusion-fission events for the first time in this mass region, will be presented.

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