COMPETITION BETWEEN FUSION AND QUASIFISSION IN THE FORMATION OF SUPERHEAVY ELEMENTS

D.J. Hinde
Department of Nuclear Physics, Research School of Physics and Engineering, Australian National University, Canberra, ACT 2601, Australia

Quasifission is a non-equilibrium dynamical process resulting in rapid separation of the dinuclear system initially formed after capture and sticking of two colliding heavy nuclei. This can inhibit fusion by many orders of magnitude, thus suppressing the cross section for formation of superheavy elements. Measurements with projectiles from C to Ni, made at the Australian National University Heavy Ion Accelerator Facility, have mapped out quasifission characteristics and systematics using mass-angle distributions (MAD) - the fission mass-split as a function of centre-of-mass angle. These provide information on quasifission dynamics in the least model-dependent way. Quasifission time-scale information in the MAD has been compared with TDHF calculations of the collisions, with good agreement being found. Most significantly, the nuclear structure of the two colliding nuclei has a dramatic effect on quasifission probabilities and characteristics in gentle collisions at near-barrier energies. The effect of static deformation alignment, closed shells and N/Z matching can completely change reaction outcomes. The realization of this strong dependence makes modelling quasifission and superheavy element formation a challenging task, but should ultimately allow more reliable prediction of superheavy element formation cross sections.