Fusion hindrance and quasi-fission in heavy-ion induced reactions: disentangling the effect of different parameters

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The dynamics of heavy-ion fusion at energies around the Coulomb barrier is an open problem in the field of low energy nuclear physics. In particular, when the compound nucleus is heavy the quasi-fission reaction channel becomes increasingly important and may lead to a large hindrance for fusion, therefore affecting the probability of producing superheavy elements. Therefore, it is important to understand which are the main parameters playing a role in the onset of quasi-fission reactions.

In this framework, fusion-evaporation and fusion-fission cross sections have been measured in a large energy range for different entrance channels leading to the same ^{192,202}Pb*, ^{210}Rn* and ^{216}Ra* compound nuclei. Light (^{12}C, ^{16}O) and relatively heavier (^{34}S, ^{40,48}Ca) projectiles were chosen to bombard both spherical and deformed targets (^{144,154}Sm, ^{168}Er, ^{176}Yb, ^{194}Pt). The comparison of reduced evaporation data for the same compound nuclei put in evidence a fusion hindrance effect in reactions induced by heavier projectiles with respect to light beams. Such fusion hindrance is consistent with a noticeable contribution coming from quasi-fission events observed in the mass-energy distribution of fission fragments. The anisostropy in angular distrtibutions of fission fragments confirmed the pre-equilibrium character of the mechanism involved.

The role of mass asymmetry, nuclear deformation and shell effects on the onset of the quasi-fission mechanism will be discussed.