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Shell effects in Quasi-fission: a theoretical perspective

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Quasifission occurs in fully damped heavy-ion collisions following a significant mass transfer between the fragments, without formation of a compound nucleus. It is the primary reaction mechanism hindering the formation of a superheavy compound nucleus after the collision partners have reached contact. As in fission, quasi-fission is expected to be affected by quantum effects leading to asymmetric mass splits.

In addition to shell effects in the compound nucleus, quantum shells stabilising fission fragments with octupole shapes have been invoked as a factor determining the distribution of nucleons between the fragments at scission, explaining the fact that the centroid of the heavy fragment charge distribution is found around $Z=54$ protons in fission of actinides. A supersymmetric fission mode influenced by shell effects in the 208Pb region is also predicted in superheavy nuclei.

Similar shell effects are predicted in microscopic studies of quasi-fission. In particular, time-dependent Hartree-Fock (TDHF) calculations have been performed for reactions forming actinides and superheavy compound nuclei, favouring formation of fragments with $Z\sim 54$ and 82 , respectively. In the absence of clear experimental confirmation, however, one should ask whether the strong influence of shell effects in quasi-fission predicted by TDHF would still persist in beyond-mean-field approaches. Perspectives for such calculations will be discussed.

Type of contribution

Invited Speaker

Primary author: SIMENEL, Cedric (Australian National University)

Presenter: SIMENEL, Cedric (Australian National University)

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