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Shell effects in fission and quasifission

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Fission of atomic nuclei is often affected by quantum effects leading to asymmetric mass splits. These shell effects can be investigated at the mean-field level with single particles level densities, indicating that several proton and neutron shell effects are usually at play prior to scission [1]. 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 in actinide fission [2].
Shell effects have also been identified in the quasifission process [3]. Quasifission occurs in fully damped heavy-ion collisions following a significant mass transfer from the heavy to the light fragment, without formation of a compound nucleus. Microscopic calculations recently showed that similar shell effects were to be expected in both fission and quasi-fission [4,5].
Here, we use static and time-dependent mean-field approaches to investigate and compare the shell effects affecting fragment formation in both fission and quasifission. In particular, we discuss the possibility to use quasifission to obtain some information on fission modes in superheavy nuclei, which would benefit from the fact that quasifission cross-sections are much larger than for fusion-fission.

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