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How does the angular momentum of fission fragments depend on their mass? An insight from microscopic theory

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Recent experiments have provided strong evidence that the angular momentum of fission fragments follows a sawtooth pattern as a function of their mass. Reproducing this behavior without fitting it explicitly requires microscopic models capable of describing the physics of scission without adjustable parameters. Using the Hartree-Fock-Bogoliubov theory and symmetry restoration techniques, we recently reported the first microscopic calculation of angular-momentum distributions for a wide range of fragment masses observed in experiments. For the benchmark case of the neutron-induced fission of 239Pu, we found that the angular momentum of the fragments is largely determined by the nuclear shell structure and deformation, and that the heavy fragments therefore typically carry less angular momentum than their light partners. The obtained distributions can also be used as ingredients to phenomenological models that describe deexcitation of the fragments, thus paving the way toward the modeling of fission based on inputs from microscopic theory. In the particular case of 239Pu(nth,f), the calculated dependence of the angular momenta on fragment mass after the emission of neutrons and statistical photons is linear for the heavy fragments and either constant or weakly linear for the light fragments, consistent with recent experiments.

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