Breaking of Axial and Reflection Symmetries in Spontaneous Fission of Fermium Isotopes

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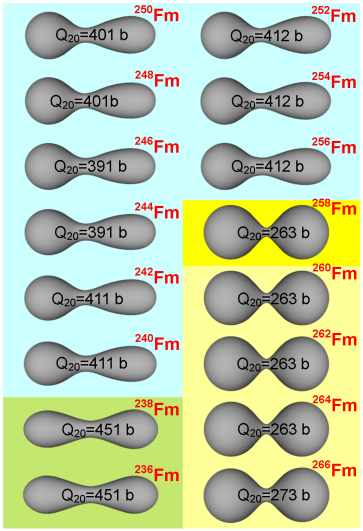
Spontaneous fission barriers as well as other characteristic properties of nuclei calculated in the Skyrme Hartree-Fock-Bogoliubov (HFB) theory reflect distinctive symmetries of the mass distribution along the pathways to fission. Especially, the heights of an inner barrier and an outer barrier are changed when one considers a nonaxial degree of freedom or breaks reflection symmetry by inclusion of an octupole type deformation. These features are demonstrated within the Skyrme HFB theory with SkM* force in the case of even-even fermium isotopes.

The HFODD code employed allows for an arbitrary symmetry breaking. This feature is of crucial importance when discussing spontaneous fission where the reflection-asymmetric and triaxial shapes can play a role.

The main conclusions of this work can be summarized as follows:
a) for heavy fermium isotopes ($A \geq 256$), the breaking of axial symmetry leads to the decrease of the inner barrier heights of about 3–3.5 MeV
b) in the case of light fermium isotopes ($A \leq 240$) axial symmetry is preserved,
c) for $A = 236$ and $A = 238$ the symmetric elongated fission (sEF) is observed,
d) for $A = 240$ to $A = 256$ the asymmetric elongated fission (aEF) is found,
e) for $A = 260$ to $A = 266$ the symmetric compact fission (sCF) is found,
f) for A=258 the bimodal fission (sEF+sCF).



Pre-scission shapes of fermium (A=236−266) isotopes