Structure properties of even-even actinides

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Structure studies of heavy mass nuclei near and at the limits of stability

⇒ Key informations amenable to reliable extrapolations into the SHE region

Here: model studies extended to $A = 226 - 262$
• Comparison with a large amount of experimental data:
  • fission barriers
  • shape isomers: energy and multipole moments
  • inner barrier heights
  • shape isomer half-lives
  • states at triaxial inner barriers N~ 154

• Tools: mean field and beyond mean field methods with D1S Gogny force

• Playgrounds: $^{226-236}$Th, $^{228-242}$U, $^{232-246}$Pu, $^{238-250}$Cm, $^{238-256}$Cf, $^{242-258}$Fm, $^{250-262}$No
Hartree Fock Bogoliubov calculations
Using the Gogny D1S force

What do we learn?

- First barrier: triaxial
- Second barrier: asymmetric N < 152
- SD minima washed out for N > 156
What do we learn?
- two theoretical methods
  -> uncertainty 500 keV
- Good agreement with Exp. Data
  * Bell-shape structures maximum for $N = 146$
Collective states from the microscopic Generator Coordinate method using the Gogny D1S force

What do we learn?
• Good agreement with experimental data
• Global lowering of isomer energies as $A$ increases

• Superdeformed ground states?
Stability of these states:

As these states are only a few hundred keV below the octupole unstable barrier, they may not survive as bound states.

Contemporary interest:

SD ground states of SHE ??
Multipole moments

What do we learn?

- Regular increase of Q20 and leveling for Nobelium.
- Disagreement for Q40 with exp. Data
Shape isomer half-lives

What do we learn?

- Shape isomers in Th, and U decay by $\gamma$-emission.
- Fission and $\gamma$-back decay competing for Pu and Cm
- Cf, Fm and No decay through fission
- Longer half-lives for N=146 for Th, U, Pu and Cm

N=146 as a magic number at superdeformation
Potential minima predicted on top of the triaxial inner barriers for $^{246}$Pu, $^{248,250}$Cm and $^{252,254}$Cf.

$\rightarrow$ manifest as broad structures in fission probability measurements.
Conclusion

• Rich structure information collected over the years in experimental studies

• They serve as playgrounds to systematically challenge mean field based methods predictions through the actinide region, the gateway to superheavy nuclci.

• More results in J.P. Delaroche, M. Girod, H. Goutte and J. Libert, accepted in Nucl. Phys. A

Ex: spin isomers, SD and ND phonons, moments of inertia ...)

* FUTURE : study of even-odd and odd-odd heavy actinides