SYMMETRIES AND NUCLEAR FISSION

J. Cseh and A. Algora

Institute of Nuclear Research (ATOMKI), Debrecen
P.f. 51, Hungary-4001

The U(3) symmetry plays an important role in the study of nuclear structure in general [1], and in particular it can select the allowed cluster configurations in a specific nuclear state [2]. The newest experimental investigations, based on multiple gamma-coincidence techniques, are able to reveal the fine structure effects of the spontaneous fission of heavy atomic nuclei [3]. Since any fission channel uniquely defines a cluster configuration, the cluster model seems to be an appropriate tool for the description of the effects of the microscopic structure on the fission process. Recently, we have invented a group theoretical method for this purpose [4].

In heavy nuclei the U(3) symmetry is not valid in the approximation of the leading representaion, in which a single irreducible representation is associated to a nuclear state. However, two other approximations, called pseudo U(3) scheme [5], and effective U(3) symmetry [6], have been found to be valid in shell model calculations. Based on these concepts, we have extended the cluster considerations related to the U(3) symmetry to heavy nuclei [4]. In this way we were able to show, that from the viewpoint of the microscopic structure the relative preference of the different fission channels has a considerable (fragment) mass number dependence. Furthermore, it turns out that the pole-to-pole configuration, which is preferred by the penetrability calculations, is very unfavorable from the viewpoint of the Pauli exclusion principle. This indicates that in the decay process a delicate balance is realised between the macroscopic forces, like Coulomb repulsion, surface tension, and microscopic effects.

[1] P. Elliott, Proc. Roy. Soc. A245 (1958) 128 and 562.
[2] J. Cseh and W. Scheid, J. Phys. G18 (1992) 1419; J. Cseh, J. Phys. G19 (1993) L97.
[3] J. Hamilton et.al., J. Phys. G20 (1994) L85.
[4] J. Cseh, R. K. Gupta and W. Scheid, Phys. Lett. B299 (1993) 205; A. Algora and J. Cseh, J. Phys. G22 (1996) L39. A. Algora, J. Cseh and P. O. Hess, to be published.
[5] J. P. Draayer, Nucl. Phys. A520 (1990) 259c.
[6] M. Jarrio, J. L. Wood and D. J. Rowe, Nucl. Phys. A528 (1991) 409.