Present status of the theory of fission of hot nuclei

P. Fröbrich[1,2]

[1] *Hahn-Meitner Institut Berlin, Theoretical Physics (SF5), Glienicker Strasse 100, 14109 Berlin*
[2] *Institut für Theoretische Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany*

Fission is one of the main decay channels after fusion of two heavy ions. We review the status of our understanding of the fission of hot nuclei and its acompanying processes (light particle and γ-ray emission) with emphasis on work appearing after the the review article [1], and list a number of open problems. Whereas there is no doubt that a Langevin description plus a Monte Carlo treatment of the evaporation processes provides the most adequate dynamical description (one obtains physical insight by e.g. sampling at which time which particle with which energy at which position is emitted along the fission path), there is less agreement on the input quantities which enter the description. (i) A fusion model has to be applied in order to obtain the initial spin distribution for fission. (ii) A choice of the relevant variables has to be made for the shape parametrization with which the driving force is constructed (it is not yet common practice to use the free energy or the entropy). (iii) An evaporation model has to be coupled to the dynamics. (iv) After reaching a stationary value for the fission width, a modified statistical model has to be added for computational reasons. (v) Most controversial is the choice of the friction form factor: In [1] a *universal* phenomenological deformation-dependent form factor, consistent with many experiments, was used. A more microscopic one-body dissipation (OBD) model is applied with no reduction of the friction strength of the wall formula in [2], whereas a considerable reduction is found to be necessary in [3] (where also a detailed treatment of the mass asymmetry is given) and in [4] (in an analysis of fission times). A chaos reduced wall formula is applied in [5] which supports the friction form factor of [1]. We see no convincing arguments for introducing a temperature- dependent friction form factor in nuclear fission, whereas a temperature dependence seems to be reasonable in the fission of metallic clusters [6]. A few critical remarks will be made concerning the use of approximate analytical formulas, which are still frequently in use in the data analysis, but are only valid under certain conditions and are therefore only of restricted value. In general a dynamical model should be preferred which describes simultaneously as many observables as possible. The necessity of introducing a dynamical friction model instead of a purely statistical model was first proved by the simultaneous reproduction of experimental neutron multiplicities and fission probabilities. We discuss the different sensitivity of various other observables to the friction form factor: evaporation residues, γ- multiplicities and fission times are more sensitive probes than neutron multiplicities.

[1] P. Fröbrich, I.I. Gontchar, Physics Reports 292 (1998) 131.
[2] B. Bouriquet, Y. Abe, G. Kosenko, nucl-th/0308019 (2003), and references therein.
[3] P.N. Nadtochy, G.D. Adeev, A.V. Karpov , Phys. Rev. C 65 (2002) 064615.
[4] I. Gontchar, M. Morjean, S. Basnary, Eur. Phys. Lett. 57 (2002) 355.
[5] G. Chaudhuri, S. Pal, nucl-th/0306003 (2003), and references therein.
[6] P. Fröbrich, Proc. of the Int. Workshop "Fission Dynamics of Atomic Clusters and Nuclei", Luso, Portugal, World Scientific, 2001, p. 135.