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Progress in Fission Investigated in Complete Kinematic Measurements

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The observation of asymmetric fission in 1948 was one of the main discoveries promoting the nuclear shell model. However, more than 75 years after its discovery fission still represents a challenge for nuclear physicists. In particular, the stabilization of the heavy fission fragment around A~140 initially explained in terms of the double shell closure around Z=50 and N=82 or N~88 was questioned by K.H. Schmidt and collaborators ten years ago. More recently, asymmetric fission partitions around 180Hg were observed by A. Andreyev and collaborators and interpreted by P. Moller without any shell effects.
Concerning the dynamics of fission the situation is not better. Pre- and post-scission particle emission and fission probabilities indicate that simple statistical approaches are not valid and models describing the dynamics of the process are required. Because of the complexity of time-dependent microscopic approaches, models based on transport equations (e.g. Fokker-Planck or Langevin) including dissipative and stochastic terms where the main ingredients are the potential landscape and the friction and inertia tensors are used. The friction or viscosity parameter is particularly interesting since it quantifies the magnitude of the coupling between collective and intrinsic degrees of freedom in fission.
The complete isotopic and kinematic identification of both fission fragments recently achieved using coulex induced fission in inverse kinematics should represent a real breakthrough in the investigation of fission providing answers to many of the open questions. In the near future this experimental progress could even improve taking advantage of quasi-free nucleon scattering inducing fission, e.g. (p,2pf).

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