

MASS DISTRIBUTION IN DISSIPATIVE REACTIONS INDUCED  
BY HEAVY IONS  
STATISTICAL ASPECTS OF FUSION - FISSION - QUASI-FISSION

M. LEFORT  
IPN-Orsay - GANIL-CAEN, France

In a first approach two classes of dissipative collisions were proposed:

i) Those leading to complete fusion where a single excited ensemble of nucleons is formed and lasts for a duration much longer than a single rotation period. The subsequent decay may follow various channels amongst which fission processes.

ii) Those corresponding to higher  $\ell$ -waves, where an in-complete fusion occurs and the intermediate system keeps a two center potential, so that disruption into two fragments follows shortly after an exchange of nucleons and a large kinetic energy loss. The life time of this composite system is long enough for applying statistical transport concepts.

But in addition to these two classes, a third category seems to be found, which resembles experimentally fission after complete fusion in many respects. However, the usual statistical criteria for fission of a compound nucleus are not strictly fulfilled because:

- Either the fission barrier has been lowered to a value close to zero by the high spin for high  $\ell^2/A$  composite systems.

- Or, on the contrary, the fission barrier is still so high for light compound nuclei that the fission yield is expected to be much lower than the measured cross section for fragments emitted with a symmetric mass distribution and a  $1/\sin \theta$  angular distribution.

Two typical cases are given, one for a very heavy composite system,  $^{237}\text{Bk}$  produced by  $^{40}\text{Ar} + ^{197}\text{Au}$ , and the other one for a medium mass,  $^{108}\text{Sn}$ , resulting from the reaction ( $^{56}\text{Fe} + ^{52}\text{Cr}$ ).

A number of characteristics define this new class of

fission-like events, particularly the width of the symmetric component of the mass distribution, and also the relationship between fragment masses and the number of emitted neutrons in the subsequent de-excitation stage.

A reaction mechanism is proposed which is based on the existence of a plateau or a shallow pond in the two dimensional potential energy map, so that, like in the second well of fission, the configuration may proceed either towards a spherical shape and a single well, or towards scission into two fragments.