STOCHASTIC ASPECTS OF HEAVY-ION REACTIONS

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The most characteristic features of the heavy-ion reactions are:

- The wave length of relative motion is small as compared to characteristic lengths of the interaction potential.

- A considerable amount of mass, energy and angular momentum can be transfered during the reaction.

- Together with coulomb and grazing (direct) collisions for larger impact parameters and compound nucleus (fusion) reaction for very small impact parameters, the dissipative reaction are found for impact parameters in between. The latter reactions are characterized by gradual loss of relativ kinetic energy and angular momentum, but the identity of projectile and target are preserved.

- The angular distribution of dissipative reactions are essentially nonisotropic which means that the time of the reaction is smaller than the rotation time of the composite system.

Relative motion of the colliding ions, as a consequence of the small wave length, can be described by the trajectory r(t) such that we are left with the Schrödinger equation for separated projectil and target interacting via a time dependent potential on the trajectory. This equation can be transformed, by a coarse-graning procedure, into the master equation for quantity:

$$f_\nu(t) = \sum_{i \in D_\nu} \rho_{ii}(t),$$

representing a macroscopic occupation probabilities, where $\rho(t)$ is the density matrix, ν convinient macroscopic variable and $D=\Sigma_\nu D_\nu$ the total channel space. The approximation of the master equation by a transport equation for macroscopic variables allows solution of the problem.

Reference:

1. M. Lefort, Ch. Ngo, Ann. de Physique Vol. 3, No 1 1978.