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Phenomenological modelling of energy dissipation in near-barrier fusion reactions

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Since the discovery of deep inelastic scattering in 1970s, it has been recognized that energy dissipation plays a crucial role in fusion reactions at energies well above the Coulomb barrier. In order to simulate its effects on the dynamics of relative motion, the Langevin method has successfully been applied to various dissipative nuclear reactions including fusion [1].

Recent experimental studies of multi-nucleon transfer have shown an importance of energy dissipation at slightly above barrier energies [2] and even at sub-barrier energies [3]. Since quantum treatment is required to describe fusion reactions in this energy region, the Langevin method, which is based on the classical equation of motion, is inapplicable. The conventional coupled-channels approach, on the other hand, is based on quantum mechanics [4], but it fails to describe energy dissipation.

To incorporate energy dissipation into the formalism of quantum mechanics, we utilize the bath-oscillator model, which has extensively been employed to study quantum non-equilibrium systems [5]. With a new numerical technique developed by us [6], we carry out a benchmark calculation of dissipative fusion reactions. In the present presentation, we shall describe the details of the model and discuss the role of energy dissipation.

References:

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Field of your work

Theoretical nuclear physics

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