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Nuclear Fission and the Nonequilibrium Green's Function Method :A Novel Microscopic Approach/核分裂と非平衡グリーン関数法：新しい微視的記述法

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To describe nuclear fission, phenomenological approaches, including statistical models and the Langevin method, have been widely employed. On the other hand, microscopic theories of nuclear fission are still under development and contain many aspects that require improvement. In particular, no method has been established for deriving nuclear fission cross sections from a microscopic nuclear Hamiltonian.
To address this issue, we have developed a microscopic nuclear fission model based on the Non-equilibrium Green's Function (NEGF) method, which is widely used to simulate electronic currents in nano-devices. Using the NEGF method, we first discuss the microscopic origin of the Porter–Thomas fluctuations in 235U(n,f)[1]. We then analyze the fission cross sections of 235U(n,f) and 236U(γ,f) and examine the quantitative performance of the NEGF fission model[2]. In particular, we focus on the applicability of the theory in the tunneling region. Finally, we introduce the probability current in the nuclear fission model space spanned by Slater determinants labeled by different deformations and excitation energies. This allows us to microscopically clarify the transition dynamics of nuclear fission and to compare them with the Langevin picture.

References
[1] K. Uzawa and K. Hagino, Phys. Rev. C 110, 014321 (2024).
[2] K. Uzawa and K. Hagino, Phys. Rev. C 112, 014326 (2025).

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