国立研究開発法人理化学研究所　仁科加速器科学研究センター
第332回 RIBF核物理セミナー
RIKEN Nishina Center for Accelerator Based Science
The 332nd RIBF Nuclear Physics Seminar

Dynamics of Heavy and Superheavy Element Synthesis: Transition from Deep-Inelastic Collisions to Fusion via Quasifission

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Mass-angle distribution (MAD) measurements of nuclear fission fragments have illuminated many aspects of the physical variables controlling quasifission [1-3]. This tool has been exploited to probe the dynamics of the nuclear fusion reactions used for synthesizing heavy and superheavy elements. A fundamental understanding of quasifission, and how it can be minimized, is sought to optimize the synthesis of new superheavy isotopes.

In this seminal, I will discuss our recent results related to the quasifission process. A new experimental method [4,5], involving the subtraction of two measured MADs, has enabled the first direct determination of the dependence of the fast quasifission sticking time, zeptsecond (10^-21 sec) order, on the angular momentum, Lh/2pi, as well as obtaining new information on fast quasifission mass evolution. The results are consistent with a transition from slow quasifission (and fusion) at the lowest L, through fast quasifission at intermediate L, to deep-inelastic collisions at the highest L. Time-dependent Hartree-Fock theoretical calculations [6] show good agreement with the experimental relationship between the sticking time and L.

I will also introduce our future studies of quasifission at GANIL utilizing the Variable Mode Spectrometer (VAMOS++) and inverse kinematics method. The approach enables us to study the isotopic-dependent reaction dynamics in zeptsecond order, which can be a probe to study the correlations of neutron-proton equilibration [6], kinetic energy dissipation, shell effect [7], and even-odd effect [8].

[1] J. Toke et al., Nucl. Phys. A 440, 327 (1985).
[2] W. Q. Shen et al., Phys. Rev. C 36, 115 (1987).
[3] D. J. Hinde et al., Phys. Rev. Lett. 101, 092701 (2008).
[4] T. Tanaka et al., Phys. Rev. Lett. 127, 222501 (2021).
[5] T. Tanaka et al., Phys. Rev. C 107, 054601 (2023).
[6] C. Simenel et al., Phys. Rev. Lett. 124, 212504 (2020).
[7] C. Simenel et al., Phys. Lett. B 822, 136648 (2021).
[8] D. Ramos et al., Phy. Rev. C 107, L021601 (2023).

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via Nishina Hall

＊ The talk will be given in English language.

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