

RIBF and KEK WNSC Joint Nuclear Physics Seminar

Speaker: Dr. Taiki Tanaka
(GANIL)

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

*The seminar will be given in *English*

Date: From 13:30 on March 5, 2024

Place: Nishina Hall

Abstract

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 seminar, 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, zeptosecond (10^{-21} sec) order, on the angular momentum, $L\hbar$, 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 zeptosecond 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].

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- [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.*, Phys. Rev. C **107**, L021601 (2023).

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