

## Recent theoretical activities of heavy-ion fusion reactions in Sendai

N. Takigawa, Tamanna Rumin, T. Masamoto, T. Takehi, K. Washiyama and S. Ayik<sup>b</sup>  
*Department of Physics, Graduate School of Science, Tohoku University, Sendai 980-8578, Japan*  
<sup>b</sup>*Physics Department, Tennessee Technological University, Cookeville, TN 38505*

Coupled-channels calculations are quite successful to explain the large enhancement of the cross section of heavy-ion fusion reactions at sub-barrier energies. Correspondingly, the so called fusion barrier distribution analysis is opening up a powerful new technique to explore the details of the nuclear structure and low energy collective nuclear excitations. These are the cases up to medium heavy systems. Also, the standard coupled channels calculations are performed by phenomenologically determining the interaction potential by fitting the experimental fusion cross section at high energies. In order to describe heavy ion fusion reactions of heavier systems, such as those used to synthesize super heavy elements, new developments are required. In this contribution, we discuss the applicability and implications of the double folding procedure in the coupled-channels formalism and also the quantum effects in the diffusion approach towards super heavy elements. We will also discuss our recent studies of the effects of the difference between the neutron and proton deformations on the fusion of unstable nuclei.