The 5th International Workshop on Compound-Nuclear Reactions and Related Topics (CNR*15)

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Abstract

The 5th International Workshop on Compound-Nuclear Reactions and Related Topics (CNR*15) took place in Tokyo, Japan, 19-23 October 2015. This workshop is the follow-up of the workshops CNR*07 organized in California in 2007 by the LLNL and LANL (USA), CNR*09 organized in Bordeaux in 2009 by CENBG Bordeaux (France), CNR*11 organized in Prague in 2011 by Charles Univ. (Czech), and CNR*13 organized in Sao Paulo by ITA/USP/UFF (Brazil) in 2013. We report the activities in this workshop briefly and for our presentations.

1 Introduction

The 5th International Workshop on Compound-Nuclear Reactions and Related Topics (CNR*15) was held in Tokyo Institute of Technology, Tokyo, Japan 19-23 October 2015. The previous conferences in this series were held in 2007, 2009, 2011 and 2013. The CNR*15 aims to provide, compound nuclear reactions play a crucial role in nuclear physics, reactor physics and astrophysics. However, even though the concept of the compound nucleus is rather old, further research is necessary in order to establish a comprehensive, quantitative picture of the processes involved in the formation and decay of the compound nucleus. This requires a deep understanding of the fundamental aspects of nuclear physics such as reaction mechanisms and nuclear structure.

CNR*15 was assessed the status of knowledge of compound-nuclear reactions, review current theoretical and experimental efforts aimed at understanding compound-nuclear reactions, identify areas in need of development, and outline possible strategies for addressing these needs. The meeting's objective was to advance the field of compound nuclear reactions and related physics by encouraging collaboration between experts in nuclear theory, experiment, and data evaluation. The sessions were organized to stimulate interactions between these groups and time will be allocated for discussions. There were 64 oral and 19 poster presentations during 5 days of the conference. The conference covers a wide range of topics which can be found following topics divided into several sessions:

- Nuclear Fission
- Nuclear mass
- Shell Model
- Neutron-induced Reactions
- Particle Emission from Fission
- Novel Experiments with Neutrons,

- Cluster Models
- Few-body Systems
- Nuclear Structure
- Strength Functions
- Nuclear Reactions
- Nucleosynthesis
- Microscopic Theories
- Light Nuclei
- Surrogate Reactions
- Compound Nuclei.

2 Objectives

The conference includes many sessions. After opening speech of Prof. S.Chiba (Tokyo Institute of Technology), the first session "Nuclear Fission" was started by Jean-Luc Sida (CEA Saclay, France). He talked about a new statistical scission-point model based on microscopic ingredients to predict fission fragment observables. The conference summary was presented by Jutta Escher (LLNL, USA) and closing remarks were done.

There were two participants (D. Ichinkhorloo and S. Ebata) from Nuclear Reaction Data Centre (JCPRG), Hokkaido University. Ichinkhorloo presented a study of low-energy nuclear reactions of light nuclei based on cluster structures, in the frameworks of the coupled discretized continuum-channels (CDCC). Ebata presented an application study with a Monte Carlo simulation for the transmutation reaction in a thick target, which includes radioactive isotopes. The Monte Carlo simulation was performed by PHITS code [1].

2.1 Data evaluation using microscopic method

The microscopic calculations of cross sections for ^{6,7}Li+n reactions are presented in the oral presentation. The energy region of the reactions corresponds to the threshold of the compound nucleus to separate into an incident particle and a target nucleus.

Ichinkhorloo introduces the CDCC analysis of the integrated elastic and inelastic scattering cross sections for ^{6,7}Li at incident neutron energies below 10 MeV by using optical model potential (OMP) and above 10 MeV by using Jeukenne-Lejeune-Mahaux potential (JLM). We adjust the normalization constants for the OMP because the agreement of the calculated cross sections with the data in very low incident energies of the neutron is insufficient without any adjustments. The energy dependent normalization constants, real part λ_v and imaginary part λ_w, of the OMP and JLM are determined explicitly from the integrated elastic cross section data, respectively.

Comparing the results of calculations with experimental data, we discuss that the present CDCC calculations, which reproduce the experimental data observed in incident energies higher than 10 MeV with the single folding potential of the JLM and in lower energies with introducing the normalization factors for the cluster folding potential of the OMP.

2.2 Application studies with Monte Carlo simulation

The transmutation of long-lived fission products (LLFP) in the nuclear wastes is an important technique to dispose of them and is also a significant task of nuclear physics and engineering. However due to the chemical property and high radioactivity of LLFP, the experiments are limited, and there is no data for the transmutation reaction with a charged particle. Therefore, we proposed a feasible method to obtain the thick-target yield (TTY) of the reaction with radioactive targets.

Although the radioactive target can not be used to obtain the data, the radioactive isotope beam is available at present. To obtain the TTY of the reaction with radioactive targets and charged

particle projectile, we use the inverse kinematics [2]. Our method shows the relation between TTYs of "forward" and "inverse" kinematics reactions. In both reactions, the cross section is same, physically. When we consider the TTY of them, they have differences in atomic numbers and stopping powers. The stopping power of charged particle can be reproduced by SRIM code with high accuracy [3].

We show the availability of TTY conversion between ^{nat}Cu(^{12}C,X)^{24}Na and ^{12}C(^{nat}Cu,X)^{24}Na reactions actually. We applied PHITS simulation to the transmutation reaction with ^{135}Cs and ^{12}C. Indeed the TTY of ^{135}Cs(^{12}C,X)$^{A\neq135}$Cs reaction is evaluated by the TTY conversion using stopping powers by SRIM.

3 Participants

Participants attending this conference were from USA, France, Ukraine, Japan, Belgium, Sweden, Romania, Austria, Italy, Norway, China, Algeria and Egypt. Group photo of all the participants shown in Fig.1.

Figure 1: Group photo of the conference

4 Summary

The 5th International Workshop on Compound-Nuclear Reactions and Related Topics (CNR*15) took place in Tokyo, Japan 19-23 October 2015. The workshop was held in the Ookayama campus of the Tokyo Institute of Technology.

In this workshop, two activities of JCPRG are presented. One is the study of low-energy nuclear reactions of light nuclei based on cluster structures, in CDCC, and the other is the application study with PHITS for the transmutation reaction in a thick target.

The previous conferences in this series had been held in 2007, 2009, 2011 and 2013, it would be continuously organized in the future and could be a good opportunity for expert workings on various topics of Compound-Nuclear Reactions to discuss the latest research activities, to consider the prospects of applications and to simulate interdisciplinary exchanges.

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References

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