RCNP EXPERIMENT E

PROPOSAL FOR EXPERIMENT AT RCNP

12 February 2016

TITLE:

Systematic study of neutron production in deuteron-induced reactions

SPOKESPERSON:

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EXPERIMENTAL GROUP:

Full Name	Institution	Title or Position
Yukinobu WATANABE	IGSES, Kyushu Univ.	Professor
Tadahiro KIN	IGSES, Kyushu Univ.	Assistant Professor
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Daiki SATOH	JAEA	Assistant Principal Researcher
Masayuki HAGIWARA	KEK	Assistant Professor
Hiroshi YASHIMA	Kyoto University	Assistant Professor
Tatsushi SHIMA	RCNP, Osaka Univ.	Associate Professor

*) Grade in April, 2016

RUNNING TIME: Installation time without beam 1 day
Data runs 3 days

BEAM LINE: Ring, N0 course

BEAM REQUIREMENTS:

Type of particle	deuteron
Beam energy	200 MeV
Beam intensity	10-100 nA
Any other requirements	halo-free, small emittance, and beam pulsing

BUDGET: Targets 140,000 JPY
Breakdown: Be (100,000JPY),
C, Al, Cu, and Nb (10,000JPY for each)

SAFETY CONTROLLED ITEMS:

- Beryllium for target
- An Am-Be neutron source for detector checking
- A laser for detector alignment

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SUMMARY OF THE PROPOSAL

We propose a systematic measurement of (d,xn) reactions for energies up to 200 MeV in order to develop an evaluated nuclear reaction database required for the design of accelerator-driven neutron sources in various applications, such as production of radioisotopes for medical use, irradiation testing of fusion reactor materials, transmutation of long-lived radioactive nuclear waste, *etc*. In addition, such measurements will provide us with the basic data of a new (d,n) neutron field complementary to two standard neutron fields which can be currently used at RCNP: the quasi-monoenergetic Li(p,xn) neutron source (100 to 400MeV) and the W(p,xn) spallation neutron source (up to 400MeV).

In our previous experiment (E400), double-differential neutron production cross sections (DDXs) were successfully measured over the broad range of angles (0°, 5°, 10°, 15°, 20°, 25°) for six targets (Li, Be, C, Al, Cu, and Nb) at an incident energy of 100 MeV using the neutron TOF facility (N0-course). The measured data were used to verify theoretical models used in nuclear data evaluation and deuteron transport simulation, and some points to be improved were revealed. As a next step, it is of our interest to investigate the incident energy dependence of neutron production in deuteron-induced reactions in order to develop deuteron nuclear data library up to 200 MeV. Thus, we propose a series of systematic measurement of neutron production DDXs for the above six targets at an incident energy of 200 MeV which is the maximum deuteron energy accelerated at RCNP. Both the DDX data measured at 100 and 200 MeV will be useful to enhance our understanding of neutron production mechanism in deuteron-induced reactions and to improve theoretical reaction models.

Our required beam time will be total 3 days for the proposed measurements of DDXs at 200 MeV.