RCNP EXPERIMENT E

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE: Reaction Mechanism of Muon Nuclear Capture on Pd Isotopes

SPOKESPERSON:

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EXPERIMENTAL GROUP:

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Dai Tomono	RCNP	Researcher
Yoshitaka Kawashima	RCNP	Researcher
Kazuhiko Ninomiya	Osaka University	Associate Professor

RUNNING TIME:

Installation time without beam 2 day (for each beam time)

Development of device 1 day

Test running time for experiment 1 day

Data runs 5 days

BEAM LINE:

MuSIC muon beam line

BEAM REQUIREMENTS:

Proton beam

Beam energy: 400 MeV

Beam intensity: 20 nA

Muon beam

Other requirements energy resolution:

BUDGET:

Experimental expenses 0 yen

SAFETY CONTROLLED ITEMS:

None

RCNP EXPERIMENT E475

TITLE:

Reaction Mechanism of Muon Nuclear Capture on Pd Isotopes

SPOKESPERSON:

Teiichiro Matsuzaki

SUMMARY OF THE PROPOSAL:

Muon is an elementary particle belonging to the electron group, and is 207 times as heavy as an electron. The muon has positive or negative electric charge, and the lifetime is 2.2 μsec. The negative muon behaves as a heavy electron in materials and is caught by a nucleus with the atomic number of Z to form a muonic atom. The muon makes cascade-down to the 1s orbit of the muonic atom, and is captured by the nucleus. The negative muon is combined with a proton in the nucleus to create a neutron and a neutrino, and produces an excited state of nucleus with Z-1. The excited state continuously makes emissions of neutrons and γ-rays. Therefore, muon nuclear capture reaction produces nuclear isotopes with Z-1, and the phenomenon may be called “muon nuclear transmutation”. The nuclear reaction mechanism is very interesting, but is not yet well clarified experimentally and theoretically. The present proposal aims at obtaining the experimental data to understand the reaction mechanism of muon nuclear capture.

In the experiment, muon nuclear capture reactions are studied on five isotope-enriched palladium targets (^{104,105,106,108,110}Pd) by employing intense DC muon beam at MuSIC beam line. The γ–ray and neutron associated with muon nuclear capture are measured with time information relative to muon arrival. The γ-ray energy and the lifetime identify Rh isotopes created by the reaction. The neutron energy distribution and the yield give us information on the compound nuclear state created by the reaction. The neutron multiplicity distribution directly determines a reaction branching ratio of muon nuclear capture. Coincidence measurements of γ–γ, neutron–γ□□□□□□□□□□□□□□□□□□□□□are conducted with triggering by muon arrival signal.

By accumulating the experimental data on Pd targets, the muon nuclear capture reaction mechanism is studied experimentally, and the results are compared with theoretical calculations.