RCNP EXPERIMENT E227

PROPOSAL FOR EXPERIMENT AT RCNP

14 July 2003

TITLE:
Measurement of the Reflection and Transmission of Ultra-Cold Neutrons by a Filter Method

SPOKESPERSON:

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RUNNING TIME:	Installation time without beam	3 days(for each beam time)
	Data runs	16 days
BEAM LINE:		Ring : ES course
BEAM REQUIREMENTS:	Type of particle	p
	Beam energy	400 MeV
	Beam intensity	0.5μA DC
BUDGET:	Experimental expenses	970 kYen

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SUMMARY OF THE PROPOSAL

Our previous test run at RCNP was successfully done. It proved the production of Ultra-Cold Neutrons(UCN) in the He-II UCN source using the spallation neutrons, and we obtained fundamental parameters such as the production rate and life time of UCN in the He-II source. It practically opened the door for the UCN physics in Japan. However, the following items are required at this time:

a. Further improvement of the UCN source,

b. Understanding of the interactions of UCN with matter precisely.

For nickel the Fermi potential and corresponding critical velocity are 2.4 10^{-7} and 6.8 m/s respectively. The UCN are the neutrons with an energy lower than the Fermi potential and they can be confined in a vessel. It is a noble feature for fundamental physics. On the other hand, the behaviour of UCN is sensitively affected by the conditions of surrounding materials. In consequence, the flux of UCN and the detection efficiencies of UCN detectors are not well known in general. In order to solve such problems, we present this proposal, "the measurement of reflection and transmission of UCN", which is a detailed study on the interactions between UCN and matter.

An experimental box is connected to the UCN guide tube, which is used for both monitoring of the UCN flux produced in the He-II source and simultaneous measurement of the reflection and transmission from target layers. The box contains a collimator, filter disk, transmission detector and reflection detectors. Six kinds of filter, Black,Ni,Cu,Ge,Al and None will define the velocity intervals of UCN. The UCN irradiate the converter of the first detector and the transmission and reflection are simultaneousely measured by the transmission and reflection detectors. First, we will measure the converters of our UCN detectors, those are the strongly absorptive layers for UCN. Later, we will measure other kind of layers such as titanium, polypropylene and etc., those are so called transparent layers for UCN. This simultaneous measurement of the reflection and transmission adds an additional constraint, and we will be able to obtain the transmission probabilities of UCN in! to layers for each velocity interval, which reveals the condition of surfaces.