

E453

PROPOSAL FOR EXPERIMENT AT RCNP

February 25, 2015

TITLE:**The $\nu 0h_{9/2}$ and $\nu 0i_{13/2}$ single-particle energies at ^{137}Xe** **SPOKESPERSON:**

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EXPERIMENTAL GROUP:

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A. Tamii	RCNP, Osaka University, Japan	Associate Professor
R. Tang	RCNP, Osaka University, Japan	Postdoctoral researcher

RUNNING TIME:		2.5 days
BEAM LINE:		Grand Raiden
BEAM REQUIREMENTS:	Type of particle:	${}^4\text{He}^{2+}$
	Beam energy:	100 MeV
	Beam intensity:	<50 nA
	Other requirements:	
BUDGET:	Experimental expenses:	

TITLE:

The $\nu 0h_{9/2}$ and $\nu 0i_{13/2}$ single-particle energies at ^{137}Xe

SPOKESPERSON: Benjamin P. Kay

SUMMARY OF THE PROPOSAL

Measurement

A measurement of the $(\alpha, ^3\text{He})$ reaction on the $N = 82$ isotope ^{136}Xe is proposed. The goal is to accurately determinate the $\nu 0h_{9/2}$ and $\nu 0i_{13/2}$ single-particle energies at ^{137}Xe . Earlier work has shown that in heavier $N = 83$ nuclei, ^{139}Ba , ^{141}Ce , ^{143}Nd , and ^{145}Sm , these single-particle strengths are fragmented always into two states, arising from the coupling of the $1f_{7/2}$ neutron state to the 2^+ and 3^- vibrations with appropriate spin. To date, only the excitation energy of the two fragments of the $0h_{9/2}$ strength have been observed in ^{137}Xe and that of the lower $13/2^+$ state. Spectroscopic information is limited to data from the (d,p) reaction and heavy-ion transfer reactions, neither of which reliably extracted the spectroscopic factors necessary to reconstruct the single-particle energies of these high- j states as had been done in the heavier nuclei. The $(\alpha, ^3\text{He})$ reaction is the ideal probe, being well matched in momentum for the transfer of $\ell = 5$ and 6 .

The data will allow for a more robust extrapolation of these excitations to ^{135}Te and ^{133}Sn , better guiding future radioactive-ion-beam experiments. The data will also impact and be impacted by recent works relating to the neutrinoless double beta decay of ^{136}Xe . A recent determination of the proton occupancies of ^{136}Xe and ^{138}Ba at RCNP have greatly reduced the uncertainties of these properties. They are combined with the calculated tensor matrix elements to describe the relative changes of the single-neutron energies due to the tensor interaction and thus allowing for a more detailed comparison between experiment and theory. Further, it will place more stringent limits on the assumption that the $N = 82$ neutron shell gap is a robust closure, which is important for a recent measurement concerning the neutron occupancies of this neutrinoless-double-beta-decay candidate. A consistency check will be carried out by re-measuring the same reaction on the well-studied ^{144}Sm target under the same conditions as for the ^{136}Xe target.

Apparatus and beam properties

We will use the RCNP gas target in the scattering chamber of the Grand Raiden spectrometer. Measurements will be performed with a 100-MeV ^4He beam.

Beam time required

We request 2.5 days of beam time to perform this measurement.