

E399

PROPOSAL FOR EXPERIMENT AT RCNP

July 17, 2012

TITLE:

Nuclear structure relevant to $0\nu 2\beta$ decay: Studies of the ($d, {}^3\text{He}$) reaction on isotopes of Te, Xe, and Ba

SPOKESPERSON:

Full Name	Benjamin P. Kay
Institution	Department of Physics, University of York
Title or Position	Research fellow
Address	York, YO10 5DD
Phone number	+44-1904-32-2237
E-mail	benjamin.kay@york.ac.uk

EXPERIMENTAL GROUP:

N. Aoi	RCNP, Osaka University, Japan	Professor
J. A. Clark	Argonne National Laboratory, USA	Assistant Physicist
C. M. Deibel	Louisiana State University, USA	Assistant Professor
S. J. Freedman	Lawrence Berkeley National Lab., USA	Professor
S. J. Freeman	University of Manchester, UK	Professor
B. Fujikawa	Lawrence Berkeley National Lab., USA	Postdoctoral Researcher
H. Fujita	RCNP, Osaka University, Japan	Researcher
Y. Fujita	RCNP, Osaka University, Japan	Associate Professor
S. Gillespie	University of York, UK	PhD Student
K. Han	Lawrence Berkeley National Lab., USA	Postdoctoral Researcher
T. Hashimoto	RCNP, Osaka University, Japan	Assistant Professor
E. Ideguchi	RCNP, Osaka University, Japan	Associate Professor
T. Ito	RCNP, Osaka University, Japan	PhD student
O. H. Jin	RCNP, Osaka University, Japan	Assistant Professor
T. Kawabata	Kyoto University, Japan	Associate Professor
B. P. Kay	University of York, UK	Research Fellow
B. Liu	RCNP, Osaka University, Japan	D1 student
H. Matsubara	RIKEN, Japan	Postdoctoral Researcher
S. A. McAllister	University of Manchester, UK	PhD Student
Y. Mei	Lawrence Berkeley National Lab., USA	Postdoctoral Researcher
A. J. Mitchell	University of Manchester, UK	PhD Student
K. Miki	RCNP, Osaka University, Japan	Postdoctoral Researcher
T. O'Donnell	Lawrence Berkeley National Lab., USA	Postdoctoral Researcher
J. P. Schiffer	Argonne National Laboratory, USA	Senior Physicist
C. Sofiatti	Lawrence Berkeley National Lab., USA	PhD Student
T. Suzuki	RCNP, Osaka University, Japan	Assistant Professor
A. Tamii	RCNP, Osaka University, Japan	Associate Professor
J. S. Thomas	University of Manchester, UK	Postdoctoral Researcher
T. Yamamoto	RCNP, Osaka University, Japan	Masters Student

RUNNING TIME: 8 days
BEAM LINE: Grand Raiden
BEAM REQUIREMENTS: Type of particle: ${}^2\text{H}$, ${}^4\text{He}^+$
Beam energy: 100 MeV (${}^2\text{H}$), 10 MeV (${}^4\text{He}^+$)
Beam intensity: < 100 nA (${}^2\text{H}$), ~ 1 -2 nA (${}^4\text{He}^+$)
Other requirements: Dispersive mode for high resolution

BUDGET: Experimental expenses: ¥200,000 for preparation of 4 cells

TITLE:

Nuclear structure relevant to $0\nu 2\beta$ decay: Studies of the $(d, {}^3\text{He})$ reaction on isotopes of Te, Xe, and Ba

SPOKESPERSON: Benjamin P. Kay

SUMMARY OF THE PROPOSAL

Measurement

Measurements of the $(d, {}^3\text{He})$ reaction on nuclei involved in neutrinoless double beta decay are proposed. Measurements of the ground-state properties of the parent and daughter nucleus, such as the proton occupancies and single-particle energies we aim to determine here, can provide important constraints on theoretical calculations of nuclear matrix elements for this process. To date, there are between factors of 2-5 uncertainty in such calculations. The candidates we consider here are the ${}^{130}\text{Te} \rightarrow {}^{130}\text{Xe}$ and ${}^{136}\text{Xe} \rightarrow {}^{136}\text{Ba}$ systems, both of which are the subject of promising searches for this decay process. Given each system has a gaseous partner, we wish to make use of the RCNP gas target for high resolution measurements. Measurements on the solid Te and Ba targets will also be made at the same time. Consistency checks will be made on targets of ${}^{128}\text{Te}$, ${}^{132,134}\text{Xe}$, and ${}^{138}\text{Ba}$, the respective isotones of the nuclei in these decay systems.

Apparatus and beam properties

We will use the RCNP gas cell in the target chamber of the Grand Raiden spectrometer. Measurements will be performed with a 100-MeV deuteron beam in dispersive mode to achieve high resolution. Low energy scattering measurements, to determine the product of the target thickness and solid angle, will be made with a singly-charged helium beam.

Beam time required

We request 8 days of beam time to perform this measurement.