E390

PROPOSAL FOR EXPERIMENT AT RCNP

23 January, 2012

TITLE: Understanding Nucleon Stripping Reaction Mechanisms from Exotic Nuclei at Intermediate Energy

SPOKESPERSON:

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CO-SPOKESPERSONS:

Full Name: Alexandre Obertelli / Yanlin Ye

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EXPERIMENTAL GROUP (Not completed):

Full Name	Institution	Position
H. Liu	RIKEN, Nishina Center	M2
M. Matsushita	RIKEN, Nishina Center	D3
S. Takeuchi	RIKEN, Nishina Center	Researcher
H. Wang	RIKEN, Nishina Center	D2
J. Zenihiro	RIKEN, Nishina Center	Research Associate
J. Chen	State Key Lab., Peking University	D1
Y. Ge	State Key Lab., Peking University	Researcher
R. Qiao	State Key Lab., Peking University	D1
Z. Tian	State Key Lab., Peking University	M2
Y. Sun	State Key Lab., Peking University	M2
C. Louchart	CEA Saclay	D2
A. Corsi	CEA Saclay	Postdoctoral researcher
L. Nalpas	CEA Saclay	Researcher
F. Flavigny	KU Leuven	Postdoctoral researcher
N. Aoi	RCNP, Osaka University	Professor
T. Hashimoto	RCNP, Osaka University	Research Associate
K. Miki	RCNP, Osaka University	Research Associate
H. J. Ong	RCNP, Osaka University	Assistant Professor
A. Tamii	RCNP, Osaka University	Associate Professor
J. Tanaka	RCNP, Osaka University	M2
T. Yamamoto	RCNP, Osaka University	M1
T. Wasaka	Kyushu university	Associate Professor
T. Fukunaga	Kyushu university	M1
J. Yasuda	Kyushu university	M1

THEORETICAL GROUP:

Full Name (Reaction Model)	Institution	Position
C. Bertulani (Eikonal Model)	Texas A&M-Comm	Professor
A. Bonaccorso (TDSE/Beyond-Eikonal)	INFN, Sez. di Pisa	1st Researcher
R. Crespo (AGS/Faddeev)	University of Lisboa	Professor
D. Mancusi (INC Model)	CEA Saclay	Postdoctoral researcher
J.A. Scarpaci (TDSE/Beyond-Eikonal)	IPN Orsay	Researcher

RUNNING TIME:

Installation time without beam: 1 month

Beam tuning, Development of device & Test running time for experiment: 3 days

Data runs: 240 hrs (10 days)

Total beam time: 288 hrs (13 days)

BEAM LINE: Ring: EN course

BEAM REQUIREMENTS: Beam : ^{16}O at 85 MeV, 25 pnA

BUDGET:

1. Transportation of Equipment from RIKEN to RCNP
(including Reaction Chamber and Plastic Scintillator Hodoscope, vacuum pump and associated electronics)

                                                                    800 k yen

2. New support frames for reaction chamber and plastic scintillator hodoscope

                                                                    1,500 k yen

3. Flanges and platform inside the reaction chamber for the arrays of silicon detectors

                                                                    400 k yen

4. Miscellaneous (including targets etc)   300 k yen

                                                    Total budget: 3,000 k yen

*Travel and local expenses for the participants from institutes in Japan are to be provided by RCNP.

 *Local expenses for the Peking group are to be provided by RCNP.

Collaborations with Peking University:

1. Peking University will provide Silicon Detector Array and CsI(Tl) crystals as well as some associated electronics dedicated to the proposed experiment.

2. Peking University will provide the appropriate assembly and mounting frames of the detector array.

3. Peking University will cover the shipping cost for the detectors and assembly. Peking group had experiences in shipping the same detectors between China and Japan in 2009 for RIKEN experiment (Phys. Lett. B 707 (2012) 45).

4. Peking group including professors and graduate students will join the preparation and data-taking at RCNP. Travel expense will be covered by Peking group.

5. Parts of the experiment will form the PhD theses of students in Peking University.

TITLE: Understanding nucleon stripping reaction mechanisms from exotic nuclei at
intermediate energy

SPOKESPERSONS: Jenny Lee, Alexandre Obertelli, Yanlin Ye

SUMMARY OF THE PROPOSAL

The aim of the experiment is two-fold: *(i)* To determine the missing strength in the cross section of intermediate-energy one-neutron removal $^{12}C(^{14}O,^{13}O+X)$ by measuring the indirect population of (unbound) excited states in ^{13}O via proton-decay detection with Peking-U double-side Silicon Array coupled to plastic scintillator hodoscope. This fully exclusive measurement aims at determining the origin of the discrepancy between eikonal+shell-model predictions and inclusive experimental cross section of $^{9}Be(^{14}O,^{13}O_{gs}+X)$. *(ii)* To determine the dynamics of proton-induced deeply-bound nucleon breakup reactions at intermediate-energy and their deviation from direct reaction models by performing $^{1}H(^{14}O,^{13}O)$ and $^{1}H(^{14}O,^{13}N)$ with an exclusive detection of protons using Peking-U Silicon Array.

The proposed experiment would provide a set of appropriate data for investigating the knockout reaction mechanisms involving deeply-bound nucleons and clarifying the long-standing puzzle in the isospin dependence of nucleon correlations, by data-to-data comparison from different reaction channels. With the aid of various associated reaction models, the stripping reaction mechanisms from very asymmetric nuclei at intermediate energies can be studied in detail.

Data from the proposed experiment at RCNP, in addition with the transfer data at GANIL and inclusive knockout data at NSCL on the same nucleus ^{14}O, will represent a benchmark for direct nuclear reaction mechanisms involving deeply-bound nucleons and may shed light into a unified description of nucleon correlations with different experimental techniques.

DETAILED DESCRIPTION OF PROPOSED RESEARCH

I. Physics justification

A full understanding of nuclear properties requires an accurate knowledge of correlations between the nucleons. The correlations spread the contributions from single-particle orbits and result in the reduction of the nucleon occupancies relative to the independent-particle-model values [1]. Nucleon occupancies can be quantified by the spectroscopic factor (SF), and the correlation effects can therefore be studied through the reduction factor Rs=SF(expt)/SF(theory).