RCNP EXPERIMENT E338

# PROPOSAL FOR EXPERIMENT AT RCNP

September 16, 2009

**TITLE:**
**Additional Measurements for E252: High Resolution Study of Isospin mixing in Fermi Excitation via $^{56}$Fe($^{3}$He,$t$) Reaction at 100MeV/nucleon**

**SPOKESPERSON:**



| | |
|---|---|
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**EXPERIMENTAL GROUP:**

| Full Name | Institution | Title or Position |
|---|---|---|
| Y. Fujita | Osaka University | Associate Professor |
| G.P.A. Berg | University of Notre Dame, USA | Senior Researcher |
| T. Adachi | KVI, Netherlands | Researcher |
| R.W. Fearick | University of Cape Town, South Africa | Researcher |
| J. Carter | University of the Witwatersrand, South Africa | Professor |
| K. Hatanaka | RCNP, Osaka University | Professor |
| H.J. Ong | RCNP, Osaka University | Assistant Professor |
| R. Neveling | iThemba LABS, South Africa | Researcher |
| Y. Shimbara | Niigata University | Researcher |
| F.D. Smit | iThemba LABS, South Africa | Senior Researcher |
| G. Süsoi | Istanbul University | Master Student |
| T. Suzuki | RCNP, Osaka University | Researcher |
| A. Tamii | RCNP, Osaka University | Associate Professor |
| J. Thies | Muenster University | Ph.D. Student |
| M. Yosoi | RCNP, Osaka University | Associate Professor |

**RUNNING TIME:** Beam tuning for the dispersion matching 1.5 day
+ Data taking time including calibration run 0.5 day

**BEAM LINE:** Ring : WS course

**BEAM REQUIREMENTS:**

| | |
|---|---|
| Type of particle | $^{3}$He |
| Beam energy | 300 MeV |
| Beam intensity | $\leq$ 20 nA |
| Other requirements | energy spread $\leq$ 100 keV |
| | halo-free, small emittance |

**BUDGET:** No special budget is required.

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## SUMMARY OF THE PROPOSAL


As an additional study of E252, we propose a high resolution measurement of the $^{56}$Fe($^{3}$He,$t$)$^{56}$Co reaction at 100 MeV/nucleon. In the E252 beam time, the $^{56}$Fe($^{3}$He,$t$) reaction was measured at 140 MeV/nucleon using the Grand Raiden spectrometer to study isospin mixing between the isobaric analog state (IAS, mainly $T = 2$) and the neighboring $0^+$ state (mainly $T = 1$). With a dispersively transported $^{3}$He beam, an energy resolution of 19 keV (FWHM) was realized. Owing to the high resolution, three peaks were clearly separated from the IAS at 3.60 MeV. We tried to identify the $T = 1$ $0^+$ state from their angular distributions, however, they have similar shapes for all these states and the IAS. Although $J^\pi$ values of these states could not be determined, the $\Delta L = 0$ character was confirmed from the $0^\circ$ dominated shapes of the angular distributions.

Since the strength of the Fermi and Gamow-Teller interactions are different at different energies, we propose to measure the same reaction at $0^\circ$ at the lower energy of 100 MeV/nucleon. This will allow to distinguish the $0^+$ and $1^+$ transitions. At 100 MeV/nucleon it is expected that Fermi strength is about 40 % stronger compared to the strength measured previously at 140 MeV/nucleon. Although an even larger difference is expected at lower energy, we choose 100 MeV/nucleon in order to avoid multi-step reaction effects. We also plan to take data for the $^{54}$Fe and $^{58}$Ni targets for calibration purposes.

The Grand Raiden spectrometer and the standard VDC focal plane detector system will be used for the magnetic analysis and the detection of the outgoing tritons. This experiment requires a good quality single-turn extracted 100 MeV/nucleon $^{3}$He beam of up to 40 nA. Complete matching conditions and over-focus mode will be applied to realize an energy resolution comparable to the 19 keV obtained in E252.