RCNP EXPERIMENT E177

PROPOSAL FOR EXPERIMENT AT RCNP 28/5/01

TITLE: **Nuclear Responses for Double Beta Neutrinos and Double Spin Isospin Resonances.**
"Updated Proposal of E115"

SPOKESPERSON:

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EXPERIMENTAL GROUP:

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Kichiji Hatanaka	RCNP, Osaka University	Professor

RUNNING TIME:

Installation time without beam	2
Test running time for experiment	1
Data runs	5 (in taking unit of days)

BEAM LINE: WS

BEAM REQUIREMENTS:

Type of particle	Boron 11
Beam energy	780MeV
Beam intensity	5nA

BUDGET:

Summary of budget request	1.3milion yen
Experimental expenses	1milion yen
Travel plan	0.3milion yen

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SUMMARY OF THE PROPOSAL

Double beta decays ($\beta\beta$) are of current interest in view of particle, astro and nuclear physics. Neutrino-less double beta decays ($0\nu\beta\beta$), which require the neutrino helicity mixing, are sensitive to the Majorana masses of light and heavy neutrinos(ν), right-left mixings of weak currents, and to SUSY-neutrino couplings. Therefore, the findings of the neutrino-less double beta decays provide difinite evidence for the unified theories beyond the standard theory. Finite ν-masses give contributions to non-baryonic hot dark matters in the universe.

Nucleon (quark) sectors of double beta decays include double isospin-flip and double isospin flip nuclear weak responses. The nuclear isospin symmetry operator τ leads to the sharp isobaric analog state (IAS) and double IAS. On the other hand, the nuclear spin-isospin operator $\sigma\tau$ results in the broad GT (Gamow Teller 1^+) resonance and double GT ones. These GT resonances at the high excitation region exhaust most of the transition strengths and leave a small fraction of the isospin-spin strength at the low excitation region. Recently, $\beta\beta - \nu$ responses have been analyzed in terms of couplings of single particle-hole GT states and GT giant resonance (GTR). Here double GT resonances play crucial roles for the $\beta\beta - \nu$ responses.

Double giant resonances are of great interest to see resonance features at high excitation energy regions. At present moment, some new giant resonances standing on the excited resonances are found experimentally. Double isobaric analogue resonances, and double isobaric dipole resonances have been studied using pion probes at LAMPF. Double dipole resonances standing on the single dipole resonances are also found via the heavy ion-heavy ion collision with the great advantage of the strong Coulomb excitation. Double GT resonances standing on the GTR, however, have not well studied. It is shown that nuclear weak responses relevant to the isospin and isospin-spin mode are investigated by studying strong processes of charge-exchange(isospin-flip) spin-flip nuclear reaction. Actually, charge-exchange (^{3}He,t) reactions with E(^{3}He) = 450MeV are used to study isospin spin responses for $\beta\beta$-nuclei. The charge-exchange reactions at the intermediate energy excite preferentially the isospin spin modes.

The present proposal aims at studies of double spin-isospin responses in view of the $\beta\beta - \nu$ decays. The double isospin spin giant resonances are investigated by means of double charge-exchange nuclear reactions. At the present, ^{11}B(E=780MeV) beam by RING-cyclotron was available. Therefore, (^{11}B,^{11}Li) double charge exchange reaction is possible. The experimental results will directly provide the information on nuclear double-weak responses, which are crucial in getting the physics quantities beyond the standard theory.