RCNP EXPERIMENT E244

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE:
Precise measurement of alignment correlation term of ^{13}B

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Masako Ogura	Department of Physics, Osaka University	D3
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RUNNING TIME: Data runs 8 days
(Total Beam Time 8 days)

BEAM LINE: Ring : EN course

BEAM REQUIREMENTS:

Type of particle	^{15}N
Beam energy	70 MeV per nucleon
Beam intensity	$\sim$ 6 pnA

BUDGET: We need enriched ^{15}N gas.

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Precise measurement of alignment correlation term of ^{13}B

SPOKESPERSON: Kensaku Matsuta and Mototsugu Mihara

SUMMARY OF THE PROPOSAL

A set of alignment correlation terms in β-ray angular distribution of $T = 3/2$ mirror pair ^{13}B ($I^\pi = 3/2^-, T_{1/2} = 17.36$ ms) and ^{13}O($I^\pi = 3/2^-, T_{1/2} = 8.9$ ms) is one of the best candidates to examine the G-parity conservation law in the weak interaction. As a first step forward the final goal, we propose the measurement of the alignment correlation term for ^{13}B within the statistical error 0.02%/MeV. The induced tensor term f_T, which is obtained from the difference between the alignment correlation coefficients of the mirror pair, is a G-parity breaking term in the weak nucleon axial vector current. The f_T may have a finite value caused by the difference between the masses of u and d quarks, e.g. $2Mf_T/f_A \sim \frac{m_u - m_d}{M} \sim 0.004$, which is predicted by the QCD-sum rule. It is so small that we have to take account of higher order effects such as the meson exchange effects and the off-mass-sh! ell effect, so the observable obtained from this measurement is described as $L\lambda + \zeta$ in KDR model instead of just $\zeta = f_T + f_T'$, where L is the matrix element depending on nucleus. In order to know both λ and ζ, systematic studies on several mass-number systems are necessary, and $A = 8, 12, 13$ and 20 systems are good candidates. Among them, $A = 13$ system is the most promising one, because the L in $A = 13$ is the smallest and the observable directly represents the G-parity breaking induced tensor term.

We had already established all necessary techniques for the experiment, e.g. the studies of the nuclear moments, the hyperfine interactions in a single crystal which used as a stopper and the spin manipulation to convert the nuclear polarization to alignment. So we can start the measurement very soon.