RIBF ULIC Symposium/mini-WS Report

*** English only**

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Title	[RIBF-ULIC-miniWS:021] Study of isovetor t- spin-monopole excitation in 90Zr and 208Pb
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Summary of discussions and its (expected) results:

Background of discussion

The isovector spin monopole (IVSM) resonance is a key excitation mode in the study of spin-isospin properties of nuclear matter. In the recent experimental studies at RI Beam Factory, our group has successfully obtained the cross section spectra about the IVSM resonance of $t^{+/-}$ types by using the charge-exchange (CE) reaction with high selectivity on IVSM. Taking this good opportunity, we would like to further advance the theoretical understanding of CE reaction mechanism for IVSM excitation. It has been known that the “absorptive” probe, such as composite particles [^{3}He, t, etc] can strongly excite IVSM owing to its surface sensitivity, but this effect has not been well evaluated in a quantitative manner. In this mini-workshop, we took t^- IVSM excitation by (^{3}He,t) and (p,n) reactions as examples and discussed the sensitivity of these reactions on IVSM by using a microscopic picture. Our goal is to find out key parameters to characterize IVSM cross section and its probe dependence.

Discussion and result

The discussion contained the following items.

1. Clarify the definition of IVSM excitation
2. Review present status of IVSM studies
3. Understand the CE reaction mechanism on IVSM excitation
4. Evaluate the sensitivity of (^{3}He,t) and (p,n) reactions on IVSM.

Firstly, in item 1, we discussed the definition of IVSM excitation. The definition of IVSM is often complicated because the usual IVSM operator $r^2\sigma\tau$ can excite not only IVSM (2hω) but also GT (0hω)

components. After the discussion, we decided to use the definition of IVSM component as $\Sigma_{f:\Delta n=1}|f><f|r^2\sigma\tau|g.s.>$, where we still use the $r^2\sigma\tau$ operator but limit the final state in the $\Delta n=1$ space.

Secondly, in item2, we reviewed previous studies on IVSM to remind ourselves the present status of theory and experiment. It reconfirmed that the theoretical quantitative analysis is scarce for the IVSM cross section especially on its probe dependence. It also recalled us that it was necessary to study the incident energy dependence of the IVSM sensitivity. Our group usually uses the CE reaction around 200-300MeV/u, but others in RCNP or NSCL around 100MeV/u. Therefore, the study of the incident energy dependence is crucial to compare the existing various experimental data quantitatively on equal footing.

In item 3, we discussed the reaction mechanism of CE reactions qualitatively by using a microscopic picture. We introduced a factorized representation of the reaction T-matrix, taking the effect of momentum transfer and distortion by optical potential simultaneously into account, and deduced the IVSM cross section formulae in a simple parameterization. As a result of discussions, we recognized two key ingredients to characterize the IVSM sensitivity. One is the cross section ratio between IVSM and GT at the zero momentum transfer (q). This corresponds to the “absorption” effect referred in the previous studies. The other is the q-dependence of the IVSM cross section. The IVSM cross section drops rather rapidly as a function of q, while that of the GT cross section slowly decreases. Thus, the relative magnitude of the IVSM cross section to the GT one, i.e. the sensitivity to the IVSM, can be strongly suppressed for larger q values.

In item 4, based on the discussion in item3, we started to evaluate the sensitivity on the IVSM quantitatively for the following reactions: (3He,t) at 300MeV/u, (p,n) at 300MeV, and (3He,t) at 140MeV/u. The last one was included according to the discussion in Item 2. We use fully microscopic calculations employing a self-consistent Hartree-Fock plus random phase approximation in conjunction with a distorted wave impulse approximation. The calculations are now being performed mainly by C. L. Bai (Sichuan Univ., not present in the workshop), H. Sagawa, and K. Miki. The result of calculations will be published in a paper, which is expected to be a base of further studies of IVSM via the CE reactions.

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Please attach other documents as needed.