The isovector spin monopole resonance in ^{90}Nb excited via the $^{90}\mathrm{Zr}(^3\mathrm{He}, t)$ reaction

K. Nakanishi[1], R.G.T. Zegers[2], H. Akimune[3], M. Itoh[1], M. Uchida[1],S. Okumura[1], K. Kawase[1], M. Kinoshita[3], S. Gáles[4], S. Nakayama[5], H. Hashimoto[1], R. Hayami[5], G.W. Hitt[2],M. Fujiwara[1], Y. Fujita[6], T. Yamagata[3], M. Yosoi[7]

[1]*Research Center for Nuclear Physics (RCNP), Osaka University, Ibaraki, Osaka 567-0047, Japan*
[2]*National Superconducting Cyclotron Laboratory (NSCL), Michigan State University, East Lansing, Michigan 48824, USA*
[3]*Department of Physics, Konan University, Kobe, Hyogo 658-8501, Japan*
[4]*Institute de Physique Nucléaire, IN2P3/CNRS, Université de Paris-Sud, 91406, Orsay Cedex, France*
[5]*Department of Physics, University of Tokushima, Tokushima 770-8502, Japan*
[6]*Department of Physics, Osaka University, Toyonaka, Osaka 560-0043, Japan*
[7]*Department of Physics, Kyoto University, Sakyo, Kyoto 606-8502, Japan*

The isovector giant monopole resonance (IVGMR, $\Delta T = 1,\ \Delta L = 0,\ \Delta S = 1$) and its spin-flip partner, the isovector spin monopole resonance (IVSMR, $\Delta T = 1,\ \Delta L = 0,\ \Delta S = 1$), are collective motions at high excitation energies, which are described microscopically by coherent $2\hbar\omega \quad 1p-1h$ transitions [1]. The determination of its width and energy-location provides a crucial information for testing microscopic models. The IVGMR mediates isospin mixing and isospin-symmetry breaking in nuclei [2, 3].

It has been difficult to measure the IVGMR or IVSMR experimentally because the strength of these resonances are widely spread and the peaks are overlapped on non-resonant spectra. A few experiments insisted the existence of the IVGMR [4] in $\Delta \mathrm{T_z} = +1$ charge-exchange reactions. Additionally by using $^{208}\mathrm{Pb}(^3\mathrm{He}, t)$ reaction with coincidence to sequential decay protons it could have been succeeded to deduce the IVSMR in $\Delta \mathrm{T_z} = -1$ charge-exchange at the Research Center for Nuclear Physics (RCNP) in 2001 [5].

In order to confirm the systematics and the existence of IVSMR in other nuclei, we measured IVSMR in ^{90}Nb. The remarkable point of our experiment was the coincidence measurement with ejective triton and decay proton from the resonant state, which enabled us to reduce the non-resonant spectrum at high energy region and to stand out the shape of the giant resonances. The energy of decay protons from IVSMR become enough too high to punch through the detectors, we had to prepare $\Delta E - E$ sets of which both the ΔE and E detectors were 5 mm thick. To determine the vertical component of the scattering angle at 0°, the "over-focus" mode was employed [6]. Angle calibration were performed at 3 magnetic field setting using a sieve slit.

The angular distribution of isobaric analog state (IAS) had good agreement with the distorted-wave Born approximation (DWBA) calculation by using DW81 [7]. It could be an appropriate touchstone to calculate the distribution of IVSMR.

Although the spectra contain no small amount of backgrounds and coincidence analysis requires careful calibration, it could be verified that a forward-peak component exists around 30 - 50 MeV. Now more precise analyses are still going and the structure of IVSMR would be distinguished before long.

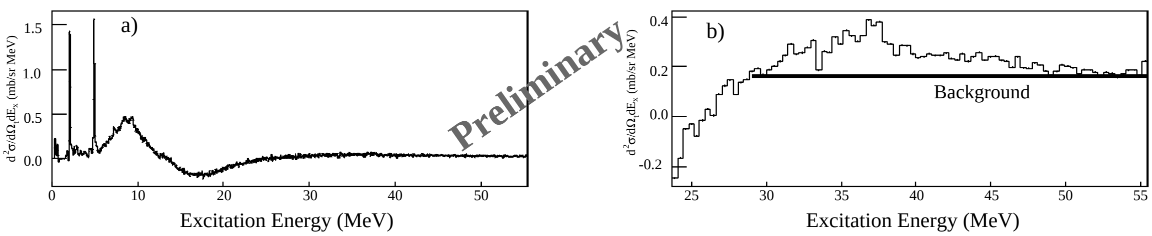

Figure 1: a) The difference spectrum between forward to backward angle measurement. b) The expanded spectrum around the IVSMR.

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The ^{90}Zr(^{12}N,^{12}C) reaction was measured and the excitation energy spectra up to about 70 MeV for both the spin-transfer and non-spin-transfer channels were deduced separately by tagging the decay by Î³ emission from the ^{12}C ejectile. Besides the well-known Gamow-Teller and isobaric analog transitions, a clear signature of the IVSMR was identified. By comparing with the results from light-ion reactions on the same target nucleus and theoretical predictions, the suitability of this new probe for studying the IVSMR was confirmed. Â‹ Measurement of the spin isovector monopole resonance via the (t,3He) reaction at 900 MeV (approved). Spokesperson: K. Miki Done in 2009. (First experiment!) Search for IVSM Î²+ direction.Â application to the observation of the isovector spin monoploe resonance in 90Nb Spokesperson: S. Noji Done in 2010. SÎ²-eadrcirhecfotiroInVSM. Â‹ Direct mass measurement of neutron-rich Calcium isotopes at Nâˆ¼34 Spokesperson: S. Michimasa.Â Â‹ Spin-isospin excitations of 12Be via the (p,n) reaction in inverse kinematics Spokesperson: K. Yako Done in June 2011. 2 months ago! (p,n) in inverse-kinematic. Search for the Î²+ IVSM by (t,3He) reactions at 300 MeV/A Spokesperson: K. Miki, Univ. Tokyo. Î². + Iso-Vector Spin-Monopole Resonance. Results are reported for angular distributions of the reaction Zr90(He3, t)Nb90 at 21 MeV. It is found that for targets in the f72 shell this reaction favors specific final states in which a neutron is replaced by a proton in the same shell-model orbit, coupled to any allowed angular momentum. The angular distributions differ in a systematic way depending on the spin of the final state. The nine states of the T< (g92)2 multiplet are tentatively identified. A multipole decomposition leads to coefficients very similar to those of the (f72)2 multiplet, showing an enhanced quadrupole coefficient.