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Evidence of tensor interactions in ^{16}O observed via (p,d) reaction

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The tensor interactions which originates from the pion exchange are essential interactions that provide the most significant two-body attraction in nuclear interactions. The tensor interactions induce nucleons with high momenta [1] through the D-wave component. The neccessity to include the tensor interactions in theoretical calculations to reproduce the quadrupole moment of the deuteron [2] as well as to explain the binding energies of the deuteron and alpha particles [3] provides decisive evidences on the importance of the tensor interactions. For heavier nuclei, recent ab-initio calculations [4] on light nuclei also show essential importance of the tensor interactions for binding nuclei up to mass number $A = 12$. Results from recent experiments with radioactive-isotope beams [5] and the subsequent theoretical studies [6] have also hinted at a possible important role of the tensor interactions in the changes of the magic numbers and the orders of single-particle orbitals in neutron-rich nuclei. However, despite the generally accepted fact that the tensor interactions play a dominant role in nuclei, no clear experimental evidence has been reported for nuclei heavier than the alpha particles.

In this talk, we report ^{16}O(p,d) reaction measurements using 198-, 295- and 392-MeV proton beams at RCNP, Osaka University to search for a direct evidence on an effect of the tensor interactions in light nucleus. Differential cross sections of the one-neutron transfer reaction populating the ground states and several low-lying excited states in ^{15}O were measured. Comparing the ratios of the cross sections for the $5/2^+$ (and/or $1/2^+$) excited state(s) and the $3/2^-$ excited state to the one for the ground $1/2^-$ state over a wide range of momentum transfer, we found a marked enhancement of the ratio for the positive-parity state(s). This observation is consistent with large components of high-momentum neutrons in the initial ground-state configurations explainable by the tensor interactions. We will discuss in detail how we come to this conclusion.

[1] K. Ikeda *et al.*, *Lecture Note in Physics* (Springer) **818**, 165 (2010);
[2] J. Schwinger, Phys. Rev. **55**, 235 (1939); J. M. B. Kellog *et al.*, *ibid* **56**, 728 (1939);
[3] H. A. Bethe, Phys. Rev. **57**, 390 (1940); V. Rarita and J. Schwinger, *ibid* **59**, 436 (1941);
[4] S. C. Pieper and R. B. Wiringa, Annu. Rev. Nucl. Part. Sci. **51**, 53 (2001);
[5] A. Ozawa *et al.*, Phys. Rev. Lett. **84**, 5493 (2000);
[6] T. Otsuka *et al.*, Phys. Rev. Lett. **95**, 232502 (2005).