# Possible effect of tensor interactions in $^{16}$O(p,d) reactions at forward angles including zero degrees

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The importance of the tensor interactions has been demonstrated to reproduce the properties of nuclear matter as well as to explain the binding energy of deuterons [1, 2] and alpha particles [3]. In our previous experiment [4], $^{16}$O(p,d) reactions were measured at finite deuteron scattering angles equal to or more than 10 degree. The results show large components of high-momentum neutrons in the initial ground-state configuration, which indicate a possible evidence on the effect of the tensor interaction in $^{16}$O. Although any multi-step process is not expected to contribute significantly to the observed (p,d) reaction cross section, confirmation by the measurement at 0 degree is necessary. Here, we report new additional measurements on the same reaction at extremely forward angles of 0 ~ 10 degree.

The experiment was performed at RCNP WS beam-line using the Grand Raiden spectrometer [5]. Proton beam with 392 MeV was injected onto a carbon ($CD_2$) and an oxygen (Mylar; $(C_{10}H_8O_4)_n$) targets placed at the center of the scattering chamber for the GR spectrometer. The scattered deuteron particles were momentum analyzed and transported to the focal plane detectors. For the detection and identification of the scattered deuterons, we used the standard focal plane detector system with two VDCs and two 10-mm-thickplastic scintillation counters tilted at an angle of 45$^o$ with respect to the central ray of the spectrometer. The measurements were performed at 4 scattering angles of 0$^o$, 2$^o$, 5$^o$ and 10$^o$. Fig. 1 shows a typical excitation energy ($E_{ex}$) spectrum of $^{15}$O (for the Mylar target shown in black line) at zero degree overlapped with the one obtained with the $CD_2$ target (red line). Subtracting the $CD_2$ spectrum from the Mylar spectrum, the cross sections populating the$^{15}$O ground state ($1/2^-$), positive-parity excited states ($5/2^+$ and/or $1/2^+$) and negative excited state ($3/2^-$) were determined. Their angular distributions are shown in Fig. 2. Theoretical analysis is in progress.

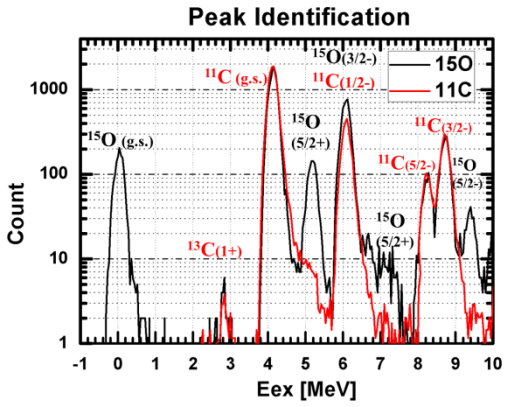


Fig.1: The deuteron energy spectrum at zero degreeof $^{15}$O excited states overlapped with $^{11}$C excited states.

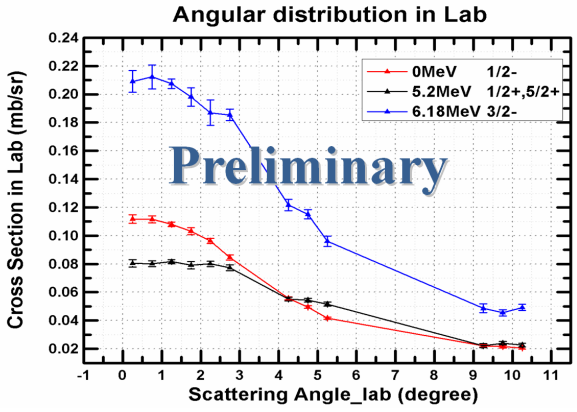


Fig.2: Angular distributions for the $^{16}$O(p,d)$^{15}$O reaction populating the $1/2^-$ground state, $3/2^-$ and $5/2^+$ (and/or $1/2^+$) excited states.

**References**

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