Study of pionic 0^- State in ^{16}O

T. Wakasa,[a] G. P. Berg,[b] H. Fujimura,[c] K. Fujita,[c] K. Hatanaka,[c] M. Itoh,[c] J. Kamiya,[c] T. Kawabata,[d] Y. Kitamura,[c] T. Noro,[a] E. Obayashi,[c] H. Sakaguchi,[d] N. Sakamoto,[c] Y. Sakemi,[c] Y. Shimizu,[c] H. Takeda,[f] M. Uchida,[e] Y. Yasuda,[e] H. Yoshida,[c] and M. Yosoi[e]

[a] *Department of Physics, Kyushu University, Higashi, Fukuoka 812-8581, Japan*
[b] *Kernfysisch Versneller Institute (KVI), Groningen, The Netherlands*
[b] *Research Center for Nuclear Physics (RCNP), Osaka University, Osaka 567-0047, Japan*
[d] *Center for Nuclear Study (CNS) The University of Tokyo, Tokyo 113-0033, Japan*
[e] *Department of Physics, Kyoto University, Kyoto 606-8502, Japan*
[f] *Institute of Physical and Chemical Research (RIKEN), Saitama 351-0198, Japan*

Isovector $J^\pi = 0^-$, $0^\pm \rightarrow 0^\mp$ excitations are of particular interest since they carry the simplest pion-like quantum number. Orihara *et al.* reported the angular distribution for the ^{16}O$(p,n)^{16}$N$(0^-, 0.12$ MeV) reaction at $T_p = 35$ MeV. The discrepancy between the DWBA calculation and their data in the large momentum transfer region of $q = 1.4$–2.0 fm^{-1} has been observed, which might be due to the effect of the enhancement of the pion probability in the nucleus. However, in the proton inelastic scattering to the 0^-, $T = 1$ state in ^{16}O at $T_p = 65$ MeV, such an enhancement was not observed The differences between (p,n) and (p,p') results might indicate the contribution from complicated reaction mechanisms in these low incident energies. At intermediate energies of $T_p > 100$ MeV, reaction mechanisms are expected to be simple. However, there is no published experimental data for the 0^-, $T = 1$ state at $E_x = 12.80$ MeV in this energy region.

We have succeeded to measure the isovector 0^- state in ^{16}O with the Grand Raiden spectrometer after employing the dispersion matching method. Figure 1 shows the excitation energy spectrum of the ^{16}O(p,p') scattering at $T_p = 295$ MeV and $\theta_{\rm lab} = 30°$. A thin ice (H_2O) target with a thickness of 10 mg/cm^2 was used. The isovector 0^- state of $E_x = 12.80$ MeV is clearly separated from the neighboring states with an energy resolution of $\Delta E = 35$ keV in FWHM. Figure 2 compares the preliminary result of the angular distribution for the isovector 0^- state with the DWIA+RPA calculation. The DWIA calculation reproduces the angular distribution fairly well at large momentum transfers of $q \geq 1.5$ rm^{-1}.

This experiment was performed under Program Number E155.

References

[1] H. Orihara *et al.*, Phys. Rev. Lett. **49**, 1318 (1982).
[2] K. Hosono *et al.*, Phys. Rev. C **30**, 746 (1984).

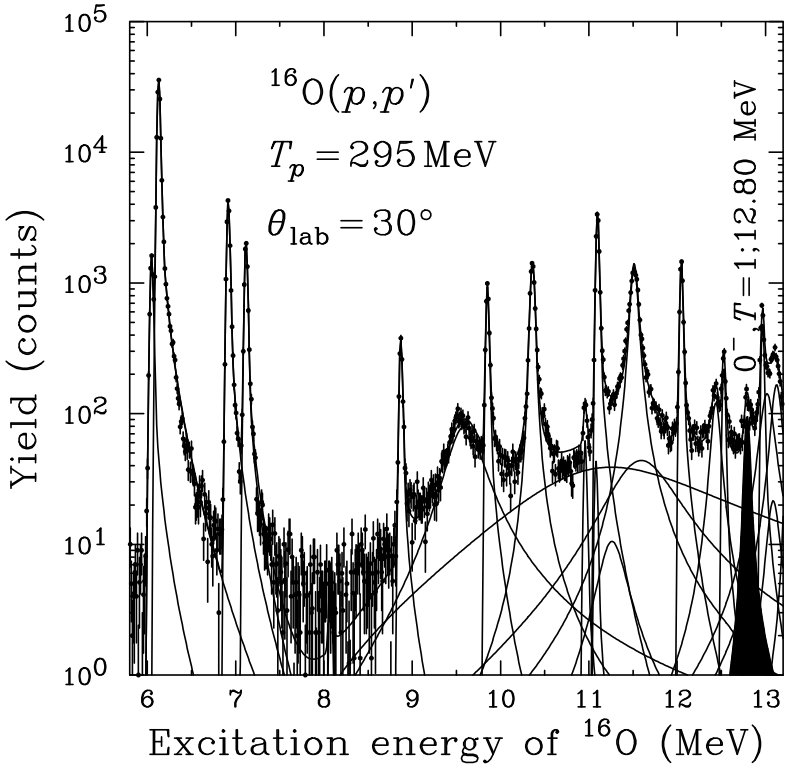

Figure 1: A typical excitation energy spectrum of the $^{16}\mathrm{O}(p, p')$ scattering at $T_p = 295$ MeV and $\theta_{\mathrm{lab}} = 30°$. Results of Hyper-Gaussian peak-fitting are also shown.

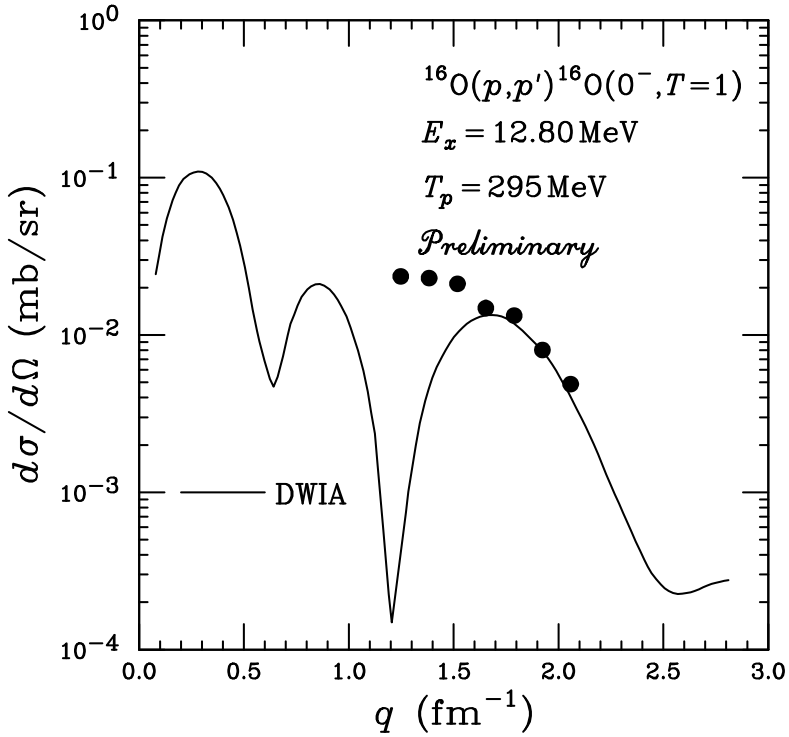

Figure 2: Measured angular distribution for the isovector 0^- state via the $^{16}\mathrm{O}(p, p')$ scattering at $T_p = 295$ MeV. The solid curve is the DWIA+RPA calculation.