Parity-transfer (^{16}O, ^{16}F(0^-)) reaction to study spin-dipole 0^- states

M. Dozono,[*1] T. Uesaka,[*2] N. Fukuda,[*2] M. Ichimura,[*2] N. Inabe,[*2] S. Kawase,[*1] K. Kisamori,[*1] Y. Kiyokawa,[*1] K. Kobayashi,[*3] M. Kobayashi,[*1] T. Kubo,[*2] Y. Kubota,[*1] C. S. Lee,[*1] M. Matsushita,[*1] S. Michimasa,[*1] H. Miya,[*1] A. Ohkura,[*4] S. Ota,[*1] H. Sagawa,[*2,*5] S. Sakaguchi,[*4] H. Sakai,[*2] M. Sasano,[*2] S. Shimoura,[*1] Y. Shindo,[*4] L. Stuhl,[*2] H. Suzuki,[*2] H. Tabata,[*4] M. Takaki,[*1] H. Takeda,[*2] H. Tokieda,[*1] T. Wakasa,[*4] K. Yako,[*1] Y. Yanagisawa,[*2] J. Yasuda,[*4] R. Yokoyama,[*1] K. Yoshida,[*2] and J. Zenihiro[*2]

We proposed a new reaction probe, *parity-transfer* (^{16}O, ^{16}F(0^-, g.s.)) reaction, as a powerful tool to study spin-dipole (SD) 0^- states in nuclei[1)]. This reaction has a unique selectivity to unnatural-parity states, which is an advantage over the other reactions used thus far. As the first measurement, the ^{12}C(^{16}O, ^{16}F(0^-)) reaction at 247 MeV/u was studied in the SHARAQ08 experiment at RIBF. A known 0^- state at $E_x = 9.3$ MeV in ^{12}B[2)] serves as a benchmark to verify the effectiveness of this reaction. The details of the experimental setup and method can be found in Ref.[3)].

The results of the present study are currently being prepared for publication. In this report, we discuss the selectivity of the parity-transfer reaction to 0^- states by comparing our data with that previously obtained by the ^{12}C(d, ^{2}He) reaction at 270 MeV[4)]. Figures 1(a) and 1(b) show excitation energy (E_x) spectra for the ^{12}C(^{16}O, ^{16}F(0^-)) reaction at $\theta_{\text{lab}} = 0° - 0.25°$ and $0.25° - 0.45°$, respectively. The energy resolution is 2.6 MeV in FWHM. Note that the events at $E_x \sim -10$ MeV are due to hydrogens in the target. The ^{12}C(d, ^{2}He) spectra at $\theta_{\text{cm}} = 0° - 1°$ and $6° - 8°$ are shown as dashed curves in Figs. 1(a) and 1(b), respectively. Here, the momentum transfer is comparable to that of our data in each figure. (Their values are $q \sim 0.3$ and 0.5 fm^{-1} in Figs. 1(a) and 1(b), respectively). Solid curves represent the (d, ^{2}He) cross sections after smearing with an energy resolution of the present experiment. The (d, ^{2}He) spectra have been arbitrarily normalized to the (^{16}O, ^{16}F(0^-)) cross sections for the 1^+ g.s.

The excitation of the 1^+ g.s. and the 2^- state at $E_x = 4.4$ MeV can be seen in both reaction data, while the structures at $E_x \gtrsim 6$ MeV are largely different. A bump structure at $E_x = 7.5$ MeV ("A" in Fig. 1(b)) seen in the (d, ^{2}He) reaction is missing in the (^{16}O, ^{16}F(0^-)) spectra. This is because natural-parity states are not populated with the parity transfer reaction. Another striking difference is a peak at $E_x \sim 9$ MeV observed in Fig. 1(a); a clear enhancement appears in the (^{16}O, ^{16}F(0^-)) data but vanishes in the (d, ^{2}He) data. This enhancement is due to the known 0^- state at $E_x = 9.3$ MeV. These differences in Fig. 1 indicate that the parity-transfer reaction has a high selectivity to 0^- states. The feature will be confirmed by further discussions including angular distributions and DWBA calculations in our future publication.

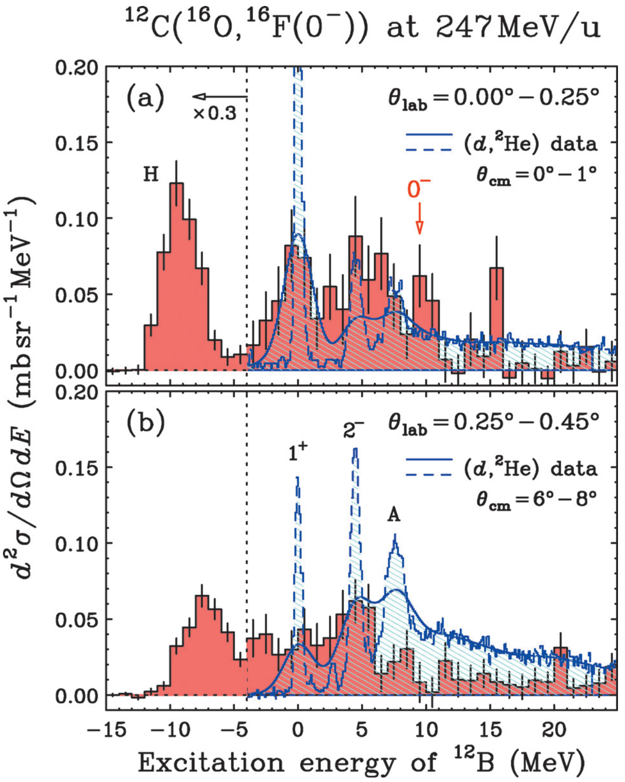

Fig. 1. Excitation energy spectra for the ^{12}C(^{16}O, ^{16}F(0^-)) reaction. The dashed and solid curves represent the experimental data for the ^{12}C(d, ^{2}He) reaction[4)].

References

1) M. Dozono et al., RIKEN Accel. Prog. Rep. **45**, 10 (2012).
2) H. Okamura et al., Phys. Rev. C **66**, 054602 (2002).
3) M. Dozono et al., Nucl. Instrum. Meth. A **830**, 233 (2016).
4) H. Okamura et al., Phys. Lett. B **345**, 1 (1995).

*1 Center for Nuclear Study, University of Tokyo
*2 RIKEN Nishina Center
*3 Department of Physics, Rikkyo University
*4 Department of Physics, Kyushu University
*5 Center for Mathematics and Physics, University of Aizu