Spectroscopy of single-particle states in oxygen isotopes via the ^{A}O$(p, 2p)$ reaction

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^{14,22,24}O$(\vec{p}, 2p)$ reaction measurements (SHARAQ04 experiment) were carried out with a polarized proton target at the RIBF to measure single-particle spectra and determine spin-orbit splitting of proton single-particle orbits in ^{14,22,24}O as a function of their neutron number. Beams that included oxygen unstable isotopes bombarded the solid polarized proton target[1)] and two scattered protons were detected with the drift chambers and plastic scintillators, which were located on both left and right sides of the beamline. The residual nuclei were momentum-analyzed by using the first doublet quadrupole magnets (SDQ) and the first dipole magnet (D1) of the SHARAQ spectrometer. For further details about the experimental setup and conditions see Ref. 2.

The $(p, 2p)$ events were tagged by identifying two scattered protons and reaction residues. The particle identification of the reaction residues was performed by using the position information both before and after the D1 magnet, TOF from the target to the S1 focal plane, which is located at the downstream of the D1 magnet, and the energy loss in plastic scintillators at the downstream of the target. Figure 1 shows the correlation between the proton number Z and the mass-to-charge ratio A/Q at the focal plane S1 for the ^{22}O secondary beam. The reaction residues were successfully identified.

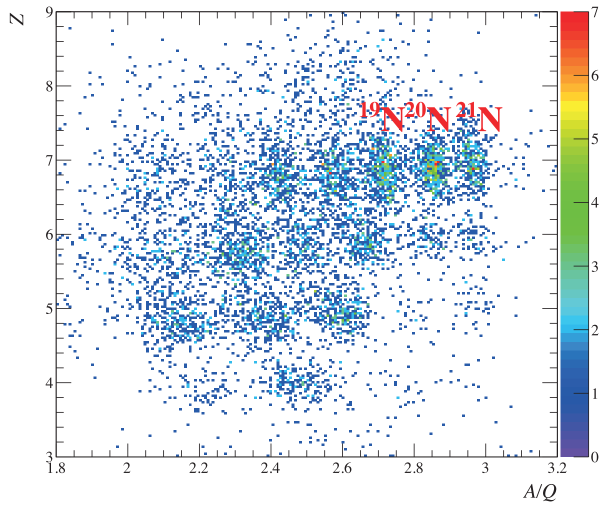

Fig. 1. Correlation between Z and A/Q at the focal plane S1.

After the identification of the reaction, spectroscopic factors for the ground states of ^{13}N, ^{21}N, and ^{23}N were deduced by comparing the experimental cross sections and DWIA calculations with computer code THREEDEE.[3)] In the calculation, global Dirac optical model potentials[4)] were used. For the NN interaction, the observables calculated from the phase-shift analysis of the NN elastic scattering by Arndt[5)] were used.

Both experimental and calculated cross sections of ^{22,24}O$(p, 2p)$ were dropped by a factor of 3 compared to that of ^{14}O$(p, 2p)$. This can be understood partially by the effect of stronger binding energy of protons. The preliminary values of the spectroscopic factors are 1.06±0.05 (^{14}O$(p, 2p)^{13}$N$_{\mathrm{g.s.}}$), 1.01±0.08 (^{22}O$(p, 2p)^{21}$N$_{\mathrm{g.s.}}$), and 1.0±0.3 (^{24}O$(p, 2p)^{23}$N$_{\mathrm{g.s.}}$). Here, only the statistical errors are indicated. No significant difference in the spectroscopic factors was observed among these ground-state transitions.

In the near future, the spectroscopic factors will be compared to the shell model calculations and their reductions will be discussed. The deduction of the vector analyzing power of the reaction will also be done.

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