First β-delayed neutron spectroscopy of 24O

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Located at the neutron drip-line, 24O is the heaviest doubly-magic isotope of the oxygen isotopic chain. As the QB value increases and the neutron separation energy in the daughter nucleus decreases for the neutron-rich nucleus, beta-delayed neutron emission becomes a dominant decay mode, and neutron energy measurement is vital in studying the beta decay to the neutron unbound states. Also, spectroscopy of such drip-line nuclei may provide important information regarding the effects of nuclear interactions and many-body correlations in determining the limits of nuclear stability [1-3]. The neutron energy spectrum measurement of the betadelayed neutron precursor 24O was performed for the first time at the National Superconducting Cyclotron Laboratory (NSCL) using a neutron time-of-flight array (VANDLE[2]) accompanied by gamma spectroscopy setup. New half-life and beta decay branching ratios are extracted. Following the decay of 24O, the betagamma and beta-delayed neutron measurements provided the excitation energies and the beta decay strength distribution to neutron-bound and unbound states in 24F . The decay of "doubly-magic"24O is an excellent case to test the quality of the state-of-the-art calculations of the beta-decay strength distribution near the neutron drip line. The present experimental results were compared with shell-model calculations using the standard, empirical USDB interaction, predictions by the shell model embedded in the continuum, and novel ab initio calculations using the valence-space in-medium similarity renormalization group and the coupledcluster method.

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