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**First excited state of doubly-magic $^{24}$O**[1] N. FRANK, Michigan State Univ./Natl. Superconducting Cyclotron Laboratory, A. SCHILLER, T. BAUMANN, NSCL, J. BROWN, Wabash College, P. DEYOUNG, Hope College, J. HINNEFELD, Indiana Univ. at South Bend, R. HOWES, Marquette Univ., J.-L. LECOUEY, Laboratoire de Physique Corpusculaire, B. LUTHER, Concordia College, W.A. PETERS, M. THOENNESSEN, Michigan State Univ./NSCL — Neutron separation energy systematics indicate the formation of a new magic number $N = 16$ close to the dripline. The energy of the first $2^+$ state may indicate or invalidate the existence of a shell closure. The search for excited states in $^{23.24}$O using in beam $\gamma$ ray spectroscopy has yielded no results, which could indicate that the $2^+$ state is neutron unbound. In order to unambiguously identify $^{24}$O as a doubly magic nucleus, we therefore have resorted to neutron decay spectroscopy. Experimentally, the two-proton-knockout reaction of a 86 MeV/u $^{26}$Ne beam on a Be target at the fast- fragmentation radioactive beam facility of the National Superconducting Cyclotron Laboratory was investigated and $\sim$ 500 neutron-$^{23}$O coincidences were recorded using the Sweeper/MoNA setup. From these events, a decay-energy spectrum was reconstructed which combined with the neutron separation energy of $^{24}$O yields an excitation energy of the first excited state of $^{24}$O in the order of 3.6 MeV, in agreement with new shell-model calculations.

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