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First Spectroscopy of 40Mg

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The study of nuclei far from stability is one of the most active and challenging areas of nuclear structure physics. One of the most exotic neutron-rich nuclei currently accessible to experiment is 40Mg [1], which lies at the intersection of the nucleon magic number N=28 and the dripline, and is expected to have a large prolate deformation similar to that observed in the neighboring lighter isotopes 32-38Mg [2]. In addition, the occupation of the weakly bound p3/2 state may lead to the appearance of an extended neutron halo[3]. Thus 40Mg offers an exciting possibility and a rare opportunity to investigate the coupling of weakly bound valence particles to a deformed core, and the influence of near threshold effects on collective rotational motion.

We will discuss the results of an experiment carried out at RIBF RIKEN to study low-lying states in 40Mg produced by a 1-proton removal reaction from a ~240 MeV/u 41Al secondary beam. 40Mg and other final products were separated and identified using the Zero Degree Spectrometer, and prompt gamma rays detected using the DALI2 array. The observed excitation spectrum is shown to reveal unexpected properties as compared to both neighboring (more bound) Mg isotopes and theoretical model predictions.

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