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Production of 40Mg Following 2p Knockout from 42Si

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The experimentally observed collapse of the N=28 shell closure in 42Si has suggested a large oblate deformation at Z=14 and N=28. The isotonic nucleus 40Mg may be expected to have "mid-shell"character, and a similarly large deformation. Combined with the fact that it may lie at the edge of the predicted neutron drip-line for Z=12, 40Mg is a key nucleus both for understanding single-particle and shape evolution in the sd-fp shell, as well as the possible effects of weak binding. The last neutron in 40Mg is expected to occupy a low-l p3/2 state, which could lead to a neutron halo. The structure of 40Mg provides a benchmark for theory to predict the properties of the most exotic nuclei.
The inclusive two-proton knockout reaction cross-section for 42Si into 40Mg has been measured in an experiment performed at the RI Beam Factory, at RIKEN Nishina Center. A secondary radioactive ion beam of 42Si was produced following fragmentation of 48Ca on a Be target, and identified through the BigRIPS fragment separator. Following reactions on a thick (~4g/cm2) 12C target, five 40Mg were uniquely identified in the ZeroDegree spectrometer, providing the first measurement of the inclusive two-proton knockout cross-section into 40Mg. Comparison with theoretical shell-model predictions suggests that the observed cross-section is consistent with a drastic change in nuclear shape between the 42Si and the 40Mg ground states.
We will describe the results and interpretation of our first measurement in 40Mg, and discuss the planned follow-up experiment, focusing on the measurement of the energy of the first 2+ excited in this most exotic N=28 isotone.

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