Contribution ID: **43** Type: **Oral contribution**

Experimental study of the single-particle strength in 22F and 11Be using transfer reactions

A single-nucleon transfer reaction is a powerful experimental tool to probe the energies of shell-model orbitals and to study the changes in the energies of these orbitals away from the stable nuclei. In this light, 21F (d,p) 22F and 12B(d,3He)11Be measurements were carried out at the Argonne National Laboratory ATLAS In-Flight Facility. The HELIcal Orbit Spectrometer (HELIOS) was used to analyze outgoing protons and 3He particles.

Neutron configurations of the low-lying states in 22F have been determined using the neutron adding (d, p) reaction on a radioactive beam of 21F at 10A MeV. Five previously observed states in 22F were populated, showing a 0d5/2 or 1s1/2 neutron coupled to the 21F ground state. A large amount of strength with a configuration of 0d3/2 neutron coupled to 21F ground state was also observed. Spectroscopic factors and strengths determined from a DWBA analysis using a reasonable normalization, are reasonably well reproduced by shell-model calculations using the USDA/USDB interactions while calculation using USD interaction underestimates the 0d3/2 single particle energy. This reinforces the need to increase 0d3/2 single-particle energy in the USD interaction in order to reproduce the Z = 8 drip line. Estimates of the N = 14 shell gap and a lower limit of the N = 16 shell gap could also be deduced in 22F. Diagonal (0d5/2)2 two-body matrix elements were obtained using Pandya transformation and the particle-hole excitation energies from the present work. Furthermore, the monopole component of the (0d5/2)2 two body interaction was deduced and comparison was made with previous work.

The proton-removal reaction on a radioactive beam of 12B at 12A MeV has been carried out to determine the 0p-orbital strength in 11Be, a one-neutron-halo nucleus. Considering the very pure p-wave ground state of 12B, the 12B(d,3He) 11Be reaction is a highly selective for the p-wave strength. This strength is inverted with respect to the sd-shell strength predicted by the conventional independent particle model. Resulting spectroscopic factors and strengths determined using a DWBA analysis will be discussed.

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