Nuclear Structure in the neutron excess region and the quest for a new Shell Model interaction.

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The study of sd shell nuclei has been valuable to the understanding of nuclear structure. Their intruder states are very informative to understand the shell gap evolution as well as to refine the existing theoretical models. With the tremendous improvement of the experimental instrumentations and the analytical techniques in recent years, it has become possible not only to populate more exotic isotopes with higher N/Z ratio but also to re-examine some previously known isotopes and improve their structural information. In that direction, the excited states of ^{33}P have been populated in a ^{18}O+^{18}O fusion evaporation reaction with a beam energy of 24.0 MeV. The experiment conducted at Argonne National Laboratory used Gammasphere as the γ detection system and Microball for particle identification. In a different experiment, the excited states of ^{38}Cl were populated by the ^{26}Mg(^{14}C, pn)^{38}Cl fusion evaporation reaction with beam energies of 30.0, 37.0 MeV at John. D. Fox laboratory in Florida State University. Six clover and three single crystal HPGe detectors along with an $E - \Delta E$ charged particle telescope were used to detect the γ rays emitted in coincidence with the charged particles. The experimental observations have been interpreted in light of shell model calculations using an interaction, named FSU, developed by our group [1]. The interaction built by using the data fitting method has covered a wide range of isotopes and intends to clarify the N= 20 shell gap evolution by adjusting different parameters sensitive to the shell gap. The interaction well accounts for the $1\hbar\omega$ intruder states of ^{33}P. The $0\hbar\omega$ and $1\hbar\omega$ states of ^{38}Cl can also be reproduced by using the new interaction. These results will be presented along with the discussion on some other properties.

[1] R. S. Lubna, K. Kravvaris, A. Volya, S.L. Tabor, V. Tripathi