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Shell evolution in neutron-rich Al isotopes around N=20

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The structure of nuclei in the region commonly referred as island of inversion has been extensively studied because of the anomalous breakdown of the N = 20 shell closure. Differently than in Ne, Na and Mg isotopes, the experimental two-neutron separation energy of the Al isotopes do not show anomalies and are well reproduced by large scale shell model calculations involving the full sd proton shell and the pf neutron shell as valence space [1]. Recent magnetic moment measurements performed on the 33,34Al isotopes [2] have shown large discrepancies with shell model predictions, in the sd and sdpf model spaces, implying a possible extension of a deformed region beyond Z = 12.
In order to study the evolution of the single particle occupancy in the Al isotopes we have measured the longitudinal momentum distributions of the 33,34,35Al from one-neutron removal reactions and the corresponding cross sections at the Fragment Separator at GSI [3]. The beam energy was around 900 MeV/u. The momentum distribution analysis has been performed in the eikonal framework. Comparing our results with shell model predictions, the inferred 2s1/2 neutron occupancy in the 33Al ground state wave function is 20-40% lower than the predicted one. The inclusive data do not exclude the presence of intruder states. Large l=1 occupancy is found in 34Al although it is smaller than in 33Mg [4].
[1] PRC58(1998)2033; [2] PLB643(2006)257and PLB658(2008)203; [3] NIMB70(1992)286; [4] PLB685(2010)253.

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