Structure of light neutron-rich nuclei using separation energies

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In the past twenty years our understanding of the structure of light neutron-rich nuclei has developed very dramatically. The nuclear shell model has been successful in the description of various aspects of the nuclear structure for nuclei near the valley of stability, and has enabled to involve the magic numbers that has become very important quantities reflecting the nuclear structure. Basic nuclear properties - binding energies and nuclear shapes - depend strongly on the underlying shell structure. Thus these properties studied in nuclei beyond the valley of stability could help us to understand the changes in the shell structure on the way from stable nuclei to the drip line. The breaking of magicity has already been observed at the N=20 shell closure where an "island of inversion" in shell ordering has been established. As well at N=8 the doubly magic ^{10}He nucleus has been confirmed to be unbound. Though some theoretical calculations [1,2] predict the existence of new neutron magic numbers N=6, 16 and 34, until lately, no experimental evidence about new magic numbers has been found.

Recently, two experimental surveys [3,4] resulting in an appearance of a new neutron magic number N=16 have been published. We have surveyed [3] experiments performed at GANIL from the point of view of two-neutron separation energies for determination of neutron shells in this region. On the other hand, Ozawa et al. [4] have inspected the information on one neutron separation energies. Kanungo et al. [5] have published systematics of the beta decay Q-values indicating new regions of shell closures at N=6, 16 and also near 32. The magicity at N=16 was also confirmed from the analysis of a derivate of the two neutron separation energy [6] and the magicity at both N=14 and 16 from the analysis of energies of first excited states in heavy oxygen isotopes [7].

In this contribution we have continued in the search for deviations in different separation energies in the frame of mass measurement of neutron-rich nuclei at GANIL [8], and we have performed an analysis of triton separation energies S_t of light neutron-rich nuclei. The deduced triton separation energies S_t show the tendency to form the neutron halo in ^{11}Li and ^{27}F nuclei adding a triton to new doubly magic even-Z nuclei ^{8}He and ^{24}O, respectively. Possible appearance of other neutron-halo odd-Z nuclei in this region, and the connection between doubly magic nuclei and neutron halo odd-Z nuclei is discussed.

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