Contribution ID: **425** Type: **Poster**

Effect of neutron excess on the single-particle structure of silicon and sulfur isotopes

Tuesday, 16 April 2019 17:00 (2 hours)

Characteristics of nuclei far from the stability line are of particular interest. The predictions of regular nuclear models that give similar results for stable isotopes can vary greatly with an increase of neutron excess. Therefore, experimental data for neutron-rich nuclei and the chains to which they belong are extremely important. In this paper, we consider chains of silicon and sulfur isotopes with even values of A = 24÷42 and A = 28÷46, respectively. These isotopes hold great interest for astrophysics research.

For stable even isotopes 28,30Si and 32,34S the position of single-particle states can be estimated from the experimental data of one-nucleon transfer reactions. The data about pick-up and stripping reactions are often gained from different experiments. Therefore, we used complementary analysis to find the best agreed pairs of experiments. The calculations of the energy levels are based on the known nucleon separation energies and the excitation energy centroids. To describe single-particle states in unstable neutron-rich isotopes, instead of energy centroids, the energies of the first excited states in the neighboring odd isotopes were used. But still the information about shell occupancy of stable isotopes helps to describe characteristics of unstable nuclei. This calculation scheme was used earlier to determine the single-particle structure of the 2s1d shell in silicon isotopes.

The position of the proton levels varies greatly due to a significant change in the central potential. At the same time the energy of the neutron states remains almost unchanged. It seems that the excess of external neutrons balances the effect of the potential change with an increase in the total number of nucleons. The results of experimental data evaluation were compared with a model data.

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Session Classification: Poster session