Exploring the changing of shell structure of nuclei around N=50

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Properties inconsistent with shell closure have been found in several neutron-rich systems around shell-model magic numbers-(see reference [1] and references therein). They may be interpreted as a modification of the nucleon-nucleon interaction leading to shell-structure changes in neutron-rich nuclei. Different scenarii are proposed, i) a softening of the Woods-Saxon shape of the neutron potential which is expected to cause a reduction of the spin-orbit interaction and ii) the action of the tensor part of the nucleon-nucleon interaction [2] which is responsible for the strong attraction between a proton and a neutron in the spin-flip partner orbits as well as between orbitals with non identical orbital angular momenta.
The shell-structure changes in neutron-rich nuclei close to shell gaps enable, when compared with the shell-model prediction, to search for anomalies into the shell structure. It is predicted, for example, that the Z=28 gap for protons in the pf-shell becomes smaller moving from ^{68}Ni to ^{78}Ni as consequence of the attraction between the proton $f_{5/2}$ and neutron $g_{9/2}$ orbits and the repulsion between the proton $f_{7/2}$ and the neutron $g_{9/2}$ configurations. The same argument also predicts a weakening of the N=50 shell gap when approaching the ^{78}Ni nucleus due to the attraction between the neutron $g_{9/2}$ and $d_{5/2}$ configurations with the proton $f_{5/2}$ state and the repulsion between the neutron $g_{7/2}$ with the proton $f_{5/2}$ state.

Here we report on an experimental study performed at LNL, Italy on the excited structures of the neutron-rich nuclei produced by means of multi-nucleon transfer and deep-inelastic collisions using the ^{82}Se (@505 MeV) + ^{238}U reaction. Previously unknown isotopes have been identified using the CLARA γ-detector array [3] in coincidence with the PRISMA spectrometer [4]. Systematic structure studies are performed along isotopic chains from Se to Ni nuclei as well as around the N=50 shell closure (see figure 1). Preliminary results are compared with shell-model calculations.

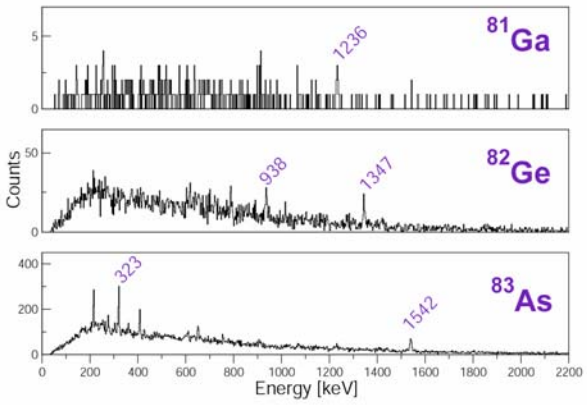

Figure 1: *Gamma-ray spectra of the N=50 ^{81}Ga, ^{82}Ge and ^{83}As nuclei after mass and charge identification through the PRISMA spectrometer.*

[1] Y.H. Zhang et al., PRC 70, 024301 (2004)
[2] T. Otsuka et al., PRL 11, 145 (1964)
[3] A. Gadea et al., EPJA 20, 193 (2004)
[4] A.M. Stefanini et al., NPA 701, 217c (2002)