Softness of doubly-magic ^{78}Ni and related topics [4]

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Neutron-rich nickel isotopes in the vicinity of $^{78}_{28}Ni_{50}$ are currently in the focus of modern nuclear physics and astrophysics studies. The interest in this region is motivated by the doubly magic nature of $^{78}_{28}$Ni and understanding the way in which the neutron excess will affect the properties of nearby nuclei and nucleon-nucleon interaction. The astrophysical importance is related to the understanding of the nuclear mechanism of the rapid capture of neutrons by seed nuclei through the r-process. The path of this reaction network is expected in neutron-rich nuclei for which there is little experimental data, and the precise trajectory is dictated by the details of the shell structure far from stability.

The shell-model orbitals for neutrons in nuclei with $Z = 28$ and N=28-50 (^{56}Ni-^{78}Ni) are the same as those for protons in nuclei with N=50 and Z=28-50 (^{78}Ni-^{100}Sn). However the comparison of the properties of the N=50 isotones near ^{100}Sn and Ni-isotopes near ^{78}Ni with a structure dominated by the $g_{9/2}$-orbital configurations indicate a considerable difference in the corresponding spectra. New effective shell model interactions [1] links the difference to the unusual enhancement of the two-body interaction in $J^\pi = 2^+$and $J^\pi = 4^+$ channels for neutron $g_{9/2}$ orbital near ^{78}Ni [2]. This is well illustrated by experimental data for essentially two-nucleon hole states in ^{76}Ni and ^{98}Cd nuclei.

In present contribution we discuss the possibility to understand the observed differences and unusual properties of the interaction by breaking the ^{56}Ni core. An issue of ^{56}Ni core breaking effects for the structure and beta decay of neutron rich nickel isotopes will be addressed.

[1] A.F. Lisetskiy, B. A. Brown, M. Horoi, H. Grawe, *Phys. Rev. C.***70**,044314,(2004).
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