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Low-spin excitations in the ^{206}Tl and ^{205}Pb nuclei studied by thermal neutron capture reactions

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Nuclei from the regions of doubly-closed shells may be considered an excellent ground for studying both a) the couplings between valence nucleons - this provides information on the effective nucleon-nucleon interaction and, b) couplings of the valence nucleons with core excitations, what may be used as a unique test of various effective interactions (Skyrme, Gogny, etc.) employed in mean-field based models.

^{206}Tl , having only one-proton-hole and one-neutron-hole with respect to the ^{208}Pb core, was populated in a thermal neutron capture reaction $^{205}\text{Tl}(n,\gamma)^{206}\text{Tl}$ at Institut Laue-Langevin in Grenoble (France). To reach the low-spin structure of this nucleus, the gamma decay from the capture state was studied using the HPGe multidetector FIPPS facility. Gamma rays from the capture state, which in ^{206}Tl is placed at 6.5 MeV, were detected by an array of 8 Ge clovers. The results of the double and triple gamma-coincidence analysis will be presented: 21 low-spin excited states were observed in ^{206}Tl , 8 of them were newly established. As the detectors of FIPPS were placed in one ring in octagonal geometry, double-coincidence data could be sorted into the matrices corresponding to different average angles between the crystals. The analysis of gamma-ray angular correlations provided information about transitions multipolarities, which significantly helped with spin-parity assignments.

After extracting the information about spin and parity of the excited states in ^{206}Tl , the level structure of this nucleus was compared to the results of shell-model calculations. The large number of low-spin states populated in neutron capture reactions on ^{205}Tl , arising from one proton-hole and one neutron-hole excitations, can be used as a very good testing ground for the old and newly developed shell-model interactions in the south-west quadrant of the nuclear chart with respect to ^{208}Pb . It will allow to benchmark the two-body matrix elements of the residual interaction in this important region of the nuclear chart.

In turn, the ^{205}Pb nucleus has three neutron-holes with respect to the ^{208}Pb core, which makes it even more demanding testing field for the shell-model calculations. In longer perspective the studies of its structure would also stimulate the works on the shell-model description with a term coming from three-body forces in the region of heavier masses nuclei.

The decay of the capture state in ^{205}Pb populated at ILL in $^{204}\text{Pb}(n,\gamma)^{205}\text{Pb}$ reaction was investigated using FIPPS array coupled to the 7 HPGe clovers from IFIN Bucharest. The preliminary results of double and triple gamma-coincidence analysis will be presented: the new findings on the ^{205}Pb low-spin structure include 7 excited states and 85 gamma transitions.

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