Gamma-spectroscopy studies around the ^{208}Pb core: the ^{210}Bi, ^{206}Tl, ^{205}Pb, ^{207}Pb nuclei investigated in neutron capture reactions

N. Cieplicka-Oryńczak[1], C. Michelagnoli[2], B. Fornal[1], S. Leoni[3], G. Benzoni[3], A. Blanc[2], S. Bottoni[3], A. Bracco[3], G. Colombi[2], F. C. L. Crespi[3], A. Gargano[4], Ł. W. Iskra[1], M. Jentschel[2], U. Köster[2], N. Marginean[5], R. Marginean[5], C. Mihai[5], A. Negret[5], P. Mutti[2], J. Pacyna[6], S. Pascu[5], N. Pietralla[7], E. Ruiz-Martinez[2], J. Sieber[7], and V. Werner[7]

[1]*Institute of Nuclear Physics PAN, Kraków, Poland*

[2]*Institut Laue-Langevin, Grenoble, France*

[3]*INFN Sezione di Milano and Università di Milano, Milano, Italy*

[4]*INFN Sezione di Napoli, Napoli, Italy*

[5]*IFIN-HH, Bucharest, Romania*

[6]*AGH University of Science and Technology, Kraków, Poland and*

[7]*Technische Universität Darmstadt, Darmstadt, Germany*

Nuclei surrounding doubly-closed cores provide an excellent ground for studying two types of couplings: a) between valence nucleons and b) couplings of the valence nucleons with core excitations. The former are the source of information on the effective nucleon-nucleon interaction while the latter may be used as a unique test of various effective interactions (Skyrme, Gogny, etc.) employed in mean-field based models.

We have performed γ-spectroscopic studies of low-spin structures in ^{210}Bi, ^{206}Tl, ^{205}Pb, and ^{207}Pb lying in the close neighborhood of the ^{208}Pb nucleus which is one of the best known doubly-magic cores in nature. The experiments were carried out at Institut Laue-Langevin in Grenoble (France) employing the thermal neutron capture reactions, which are expected to populate the majority of the excited low-spin states up to the neutron binding energy. Gamma rays from the capture states decays were detected by HPGe arrays: FIPPS or EXILL. The double and triple γ-coincidence analysis allowed to significantly extend the experimental information on the low-spin structures in the ^{210}Bi, ^{206}Tl, ^{205}Pb, and ^{207}Pb nuclei, while the analysis of γ-ray angular correlations provided information about transitions multipolarities, which significantly helped with spin-parity assignments.

The ^{210}Bi and ^{206}Tl isotopes are only one-proton-one-neutron and one-proton-hole-one-neutron-hole nuclei relative to the ^{208}Pb core, respectively. We would like to present the comparison between the experimentally established excited structures in ^{210}Bi and ^{206}Tl and the results of recently performed shell-model realistic calculations [1]. The large number of low-spin states populated in (n,γ) reactions on ^{209}Bi and ^{205}Tl, arising from valence particles/holes excitations, can be used as a very good testing ground for the old and newly developed shell-model interactions on odd-odd spherical nuclei near ^{208}Pb core. 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. We would like to present the new findings on the ^{205}Pb low-spin structure including 7 excited states and 85 γ transitions. Furthermore, the ^{207}Pb nucleus, having only one-neutron-hole relative to the ^{208}Pb core, was for the first time studied in a thermal neutron capture reaction, employing a multidetector HPGe coincidence setup (FIPPS). We would like to present the preliminary results of the γ-coincidence analysis which on the later stage will provide valuable information on the low-spin excited states in this nucleus and allow for instructive comparisons with the theoretical approaches taking into account couplings between the valence hole of ^{207}Pb and the ^{208}Pb core excitations [2].

[1] N. Cieplicka-Oryńczak *et al.*, Phys. Lett. B **802** (2020) 135222.

[2] G. Colò, P.F. Bortignon, and G. Bocchi, Phys. Rev. C **95** (2017) 034303.