Fragmentation of single-particle strength around the doubly-magic nucleus ^{132}Sn and the position of the $0f_{5/2}$ proton-hole state in ^{131}In†

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The neutron-hole and proton-hole nuclei ^{131}Sn and ^{131}In were studied using one-nucleon removal reactions from doubly-magic ^{132}Sn at relativistic energies. In ^{131}In, a 2910(50)-keV γ ray was observed for the first time, see Fig. 1, mainly thanks to the good energy and time resolution of the eight $LaBr_3$ detectors employed in this experiment. This high-energy γ ray was tentatively assigned to the decay of the $0f_{5/2}$ proton-hole state to the known $1/2^-$ level at 365 keV. Thus, the excitation energy of the last so far unknown proton-hole state in ^{132}Sn was fixed to 3275(50) keV. From the absolute intensities of the observed γ rays, the spectroscopic factors for the $1d_{5/2}$ and $0g_{7/2}$ neutron-hole states in ^{131}Sn and the $1p_{3/2}$ and $0f_{5/2}$ proton-hole states in ^{131}In were determined. They nicely agree with those of the analog states with quantum numbers $n(\ell+1)_{j+1}$ in ^{207}Pb and ^{207}Tl indicating that the close resemblance between the shell structures around the doubly-magic nuclei ^{132}Sn and ^{208}Pb established since long also holds for the spectroscopic factors. To investigate the origin of the strong fragmentation of single-particle strength state-of-the-art calculations based on the relativistic particle-vibration coupling model were performed. While the coupling to the first excited 3^- states in the core nuclei ^{132}Sn and ^{208}Pb was identified as the main origin for the reduced spectroscopic factors measured for the $1d_{5/2}/1f_{7/2}$ single-particle states in ^{131}Sn/^{207}Pb and the $1p_{3/2}/1d_{5/2}$ levels in ^{131}In/^{207}Tl, clearly more complex coupling scenarios are responsible for the strong fragmentation and the small measured spectroscopic factors in the case of the $0g_{7/2}/0h_{9/2}$ states in ^{131}Sn/^{207}Pb and the $0f_{5/2}/0g_{7/2}$ levels in ^{131}In/^{207}Tl.

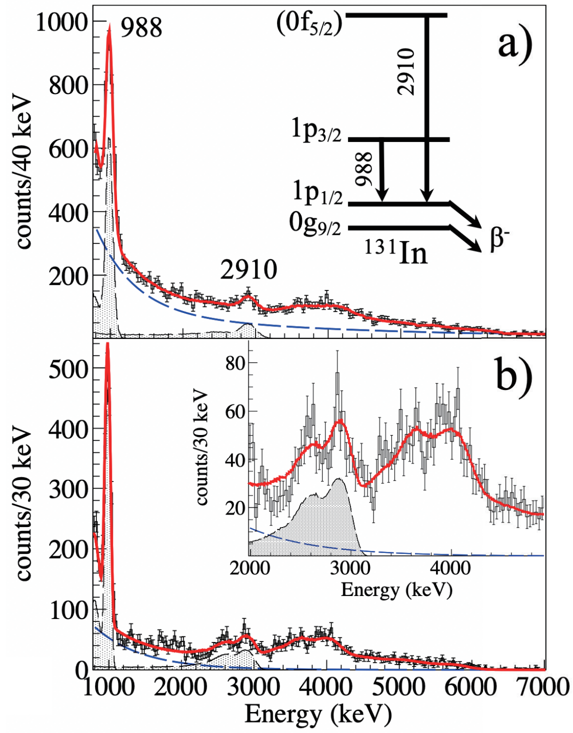

Fig. 1. Doppler-corrected γ-ray spectra of ^{131}In populated via one-proton removal from ^{132}Sn measured with a) 96 NaI crystals of DALI2 covering polar angles in the range $\theta = 50$–$150°$ and b) eight $LaBr_3$ detectors placed at $\theta = 30°$ (adopted from Fig. 1 of the original article).

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