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Recent studies of exotic nuclei near the self-conjugate doubly-magic ^{100}Sn nucleus[1]

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The exotic proton-rich self-conjugate doubly-magic nucleus ^{100}Sn is one of the corner stones of nuclear structure. The ^{100}Sn region provides a stringent test for the shell model far away from the line of stability. The ^{100}Sn nucleus is the fastest known Gamow-Teller β emitter. Its large binding energy is signaled by the existence of an island of proton and α emitters decaying towards the N=Z=50 closed shells. Also, the astrophysical rp-process was proposed to terminate with α decays of light Te isotopes. Despite prohibitively small production cross sections, several exotic nuclei near ^{100}Sn have been studied recently using various probes at the ATLAS facility at the Argonne National Laboratory. 1) First evidence for the α-decay chain ^{108}Xe-^{104}Te into ^{100}Sn was observed. This is only the second case of α decay into a doubly-magic nucleus besides ^{212}Po, which has been a benchmark of microscopic models of α decay. The reduced α-decay widths deduced for ^{108}Xe and ^{104}Te are larger than that for ^{212}Po supporting the expectation that the enhanced interaction between protons and neutrons, which occupy the same orbitals, leads to a larger α-particle preformation, which results in the so-called superallowed α decay. 2) A small proton-decay branch was found in ^{108}I. The proton separation energy in ^{104}Sb, deduced using the measured ^{108}I proton energies, indicates that the rp-process does not form a Sn-Sb-Te cycle at ^{103}Sn which is delayed until heavier Sn isotopes. 3) Excited states in the fast ^{105}Te α emitter were studied for the first time using in-beam γ-ray spectroscopy to shed light on the long standing issue of the ordering of the $d_{5/2}$ and $g_{7/2}$ single-neutron orbitals in ^{101}Sn.

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