Spherical and Superdeformed Structures Near Doubly-Magic Nuclei ^{40}Ca, ^{56}Ni, and ^{100}Sn

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For more than thirty years, shell model calculations have predicted that multiparticle-multihole excitations across magic numbers 8, 20 and 28 would lead to very deformed and superdeformed states in the vicinity of doubly-magic nuclei ^{16}O, ^{40}Ca, and ^{56}Ni. These expectations were later confirmed in various cluster and mean field calculations that predicted the existence of new islands of superdeformation centered around ^{32}S and ^{60}Zn. However, it was only recently that advances in detector technology have allowed exploration of these weakly-populated structures. In this talk, I will present results of our recent experiments that have succeeded in identifying these long-sought states and their exotic decay modes. These data have provided a unique testing ground to confront, compare, and relate state-of-the-art calculations in the framework of microscopic (large-scale shell models, Quantum Monte Carlo Diagonalization), and mean field theories. Highlights of these results, including a discussion of the importance of neutron-proton pairing correlations in these nearly N=Z nuclei will be discussed.

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