



Review

Nuclear magic numbers: New features far from stability

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ABSTRACT

The main purpose of the present manuscript is to review the structural evolution along the isotonic and isotopic chains around the “traditional” magic numbers 8, 20, 28, 50, 82 and 126. The exotic regions of the chart of nuclides have been explored during the last three decades. Then the postulate of permanent magic numbers was definitely abandoned and the reason for these structural mutations has been in turn searched for. General trends in the evolution of shell closures are discussed using complementary experimental information, such as the binding energies of the orbits bounding the shell gaps, the trends of the first collective states of the even–even semi-magic nuclei, and the behavior of certain single-nucleon states. Each section is devoted to a particular magic number. It describes the underlying physics of the shell evolution which is not yet fully understood and indicates future experimental and theoretical challenges. The nuclear mean field embodies various facets of the nucleon–nucleon interaction, among which the spin-orbit and tensor terms play decisive roles in the shell evolutions. The present review intends to provide experimental constraints to be used for the refinement of theoretical models aiming at a good description of the existing atomic nuclei and at more accurate predictions of hitherto unreachable systems.

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