Progress in Particle and Nuclear Physics 61 (2008) 602–673

Contents lists available at ScienceDirect

Progress in Particle and Nuclear Physics

journal homepage: www.elsevier.com/locate/ppnp

Review

Nuclear magic numbers: New features far from stability

O. Sorlin [a], M.-G. Porquet [b,*]

[a] Grand Accélérateur National d'Ions Lours (GANIL), CEA/DSM - CNRS/IN2P3, B.P. 55027, F-14076 Caen Cedex 5, France

[b] Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse (CSNSM), CNRS/IN2P3 - Université Paris-Sud, Bât 104-108, F-91405 Orsay, France

ARTICLE INFO

Keywords:
Nuclear structure
Magic numbers
Shell closures
Exotic nuclei
Single-particle states
Nuclear spectroscopy

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.

Contents

* Corresponding author.
E-mail addresses: sorlin@ganil.fr (O. Sorlin), porquet@csnsm.in2p3.fr (M.-G. Porquet).

0146-6410/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.ppnp.2008.05.001