

Preface

This monograph on high spin physics is geared towards the beginners in research or the young researchers, in the exciting field of high spin nuclear structure physics. New and interesting phenomena have and are being discovered in this field which is providing a microscopic insight into the behaviour of nuclei under the extreme conditions of high excitation energy, highest spins and abnormal neutron-to-proton ratios. The quest for achieving the highest spin states has resulted in remarkable success in this direction. An attempt has been made in this monograph to provide the reader an up-to-date knowledge of some of the recent exotic phenomena at high spins in a collective and consolidated manner. The topics covered are the rotational alignment and bandcrossings, magnetic rotation, triaxial strong deformation and wobbling motion and chirality in nuclei. The earliest discovered is the phenomenon of bandcrossings which is generally known as backbending in nuclei. This discovery led to great excitement and interest in high spin nuclear spectroscopy and has been responsible for the present development so that a very large volume of useful information is available now. Magnetic rotation is a relatively newly discovered phenomenon in which the generation of angular momentum in nuclei is caused by the ‘shears mechanism’. It gives rise to rotation-like magnetic dipole bands in nearly spherical nuclei. Axially symmetric shapes in nuclei are known for the last several decades. Recently, success was achieved in finding the occurrence of stable triaxial shapes in odd- Z Lu nuclei at high spins through the observation of wobbling motion at high quadrupole deformation. Although chirality is known in other fields like chemistry, the search for the observation of chirality is being extensively pursued presently in particle physics—in nuclei at moderate spins. Chirality can also provide evidence for the existence of stable triaxial shapes in nuclei.

Due to the monograph nature of this volume, I have purposely left out a number of other very interesting phenomena. These are identical bands, superdeformation and energy correlation in superdeformed states known as C_4 symmetry, hyperdeformation, smooth band termination, enhanced and highly deformed bands, particle–hole excitations, tetrahedral symmetry, isomers at high spins, research area in neutron-rich nuclei providing new physics concepts in nuclear physics in nuclei away from the line of beta stability, etc., to name some of these observations.

The key contributors to this field of research activity are the parallel development of heavy-ion accelerators providing a large variety of heavy-ion beams and gamma detector arrays with large photopeak detection efficiencies. A new avenue in high spin nuclear spectroscopy is now emerging with the development of gamma-ray tracking arrays which are likely to enhance the gamma-ray detection efficiency by several folds.

The emphasis throughout the book has been on a simple and up-to-date treatment of the topics covered. The pre-requisites for a proper appreciation are basic and advanced courses in nuclear physics and nuclear models as well as measurement techniques of observables like gamma-ray energies, intensities, multi-fold coincidences, angular correlations or distributions, linear polarisation, internal conversion coefficients, short lifetime (picosecond range) of excited states, etc. and instrumentation and data analysis methods.

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