Complex Nuclear Spectra in a New Large Scale Shell Model Approach

D. Bianco

Dipartimento di Scienze Fisiche, Università di Napoli Federico II,
and Istituto Nazionale di Fisica Nucleare,
Complesso Universitario di Monte S. Angelo, Via Cintia, I-80126 Napoli, Italy

Contact e-mail: bianco@na.infn.it

An importance sampling iterative algorithm, developed few years ago [1] for diagonalizing large matrices, has been upgraded so as to allow large scale nuclear shell model calculations in the uncoupled m-scheme [2]. This new version can generate a large number of eigenstates for each angular momentum and, therefore, is able to provide a complete description of the low energy properties of complex nuclei.

The method has been implemented numerically for investigating the low-lying spectroscopic properties of the $^{130-134}$Xe isotopes. We used a single set of single particle states and a realistic two-body potential. To our knowledge, this is the first large scale shell model study of these nuclei. In order to perform this calculation we had to deal with Hamiltonian matrices of very large dimensions (about one billion). The sampling algorithm, however, allowed us to select only the relevant basis states, which came out to be about 10% of the total.

The calculation produces quite rich spectra together with the strengths of the transitions among all low-lying states. The spectra, the $E2$ and $M1$ transition strengths are generally in good agreement with the experiments. The shell model analysis allows to determine the collectivity of the states as well as their proton-neutron symmetry and their multiphonon nature. It allows also to follow the evolution of their collectivity and symmetry properties as we move toward the transitional ^{130}Xe.

1. F. Andreozzi, N. Lo Iudice, and A. Porrino, J. Phys. : Nucl. Part. Phys. **29**, 2319 (2003)
2. D. Bianco, F. Andreozzi, N. Lo Iudice, A. Porrino, and F. Knapp, J. Phys. G: Nucl. Part. Phys. **38**, 025103 (2011).