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Single particle spectra, pairing correlations and spectroscopic properties of actinide and heavier nuclei

P. Quentin[1], **L. Bonneau**[1], **N. Minkov**[2], **D. Ivanova**[3], **J. Bartel**[4], **H. Molique**[4], **Meng-Hock Koh**[5]

[1]CENBG, UMR5797, Université de Bordeaux, CNRS, 33170 Gradignan, France
[2]Institute of Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences,Tzarigrad Road 72, BG-1784 Sofia, Bulgaria
[3]Military Medical Academy, Sofia, Bulgaria and University Hospital ”Saint Ekaterina”, Sofia, Bulgaria
[4]IPHC, UMR7178, Université de Strasbourg, CNRS, 67200 Strasbourg, France
[5]Physics Department, Faculty of Sciences, UTM, 81310 Johor Bahru, Malaysia

Abstract

We discuss the relevance of the single particle (sp) properties of the well seasoned Skyrme SIII interaction to describe within self-consistent Hartree-Fock plus BCS (with blocking when needed) calculations, some spectroscopic properties of heavy nuclei using a simple seniority pairing residual interaction (V_{res}). To fit V_{res} we took stock of the excellent consistency found in the rare-earth region between its adjustment from both moments of inertia (MoI) of well-deformed nuclei and odd-even mass differences. For simplicity reasons we thus made a fit on MoI. Our sample was defined by all even-even isotopes of actinide and heavier elements, with two criteria: i) be well and rigidly deformed in their ground states, as assessed by a ratio $E(4_1^+)/E(2_1^+) > 3.2$, ii) present some isomeric activity with suggested isomeric (E_{isom}) and spin/parity characterization. We have thus considered 14 actinide isotopes (from Uranium to Nobelium) plus ^{256}Rf. With a simple law of variation of the matrix elements according to N or Z, we get a fair reproduction of MoI excepted around the neutron number $N = 152$ where SIII exaggerates its well documented magicity (for normally deformed solutions). Such a study of MoI assesses thus also the sp spectra, of which a further evaluation of the quality is provided by the comparison of the corresponding experimental and theoretical E_{isom}. Our calculations were limited to single quasi-particle (uncoupled) configuration seniority 2 states because higher seniority states are likely to present coupling between various quasi-particle configurations and/or with collective degrees of freedom, which are beyond the current capacities of our calculations. Preliminary resuts on some of the considered isotopes will be discussed particularly by comparing them with a particle number conserving approach.