Positive-energy and weakly-bound one-particle levels in quadrupole-deformed potentials

I.Hamamoto[1,2]

[1] *Division of Mathematical Physics, LTH, University of Lund, P.O.Box 118, S-22100 Lund, Sweden*
[2] *The Niels Bohr Institute, University of Copenhagen, Blegdamsvej 17, Copenhagen Ø, DK-2100, Denmark*

In order to understand the structure of deformed drip-line nuclei one-particle levels in deformed finite-well potentials must be first studied. Since the Fermi level of drip-line nuclei lies close to the continuum, both weakly-bound and positive-energy one-particle levels play a crucial role in the many-body correlation of those nuclei. One-particle resonant levels are well-defined in spherical potentials, while a systematic study of one-particle resonant levels in deformed potentials is hardly found in available literature. Though there are an infinite number of one-particle levels at a given positive-energy, only some selected levels related to one-particle resonant levels are important in bound states of drip-line nuclei.

The unique behavior of weakly-bound and positive-energy one-neutron levels are studied, solving the Schrödinger equation in coordinate space with the appropriate asymptotic boundary conditions. One-particle resonant levels are examined using the eigenphase representation. As an example, in the figure taken from [1] we show calculated one-particle energies in Y_{20} deformed Woods-Saxon potentials as a function of the potential strength, $(R/r_0)^3$. While weakly-bound $s_{1/2}$ levels play a unique role in spherical drip-line nuclei, weakly-bound $\Omega^\pi = 1/2^+$ levels, which always contain some amount of $s_{1/2}$ component, exhibit a unique and important role in deformed drip-line nuclei. Some weakly-bound $\Omega^\pi = 1/2^+$ levels continue to the positive-energy region as one-particle resonant levels, while others have no such continuation.

For positive energies not only one-particle resonant levels but also all solutions in the eigenphase representation within a model are studied, and the properties of eigenphase sum are examined. It is shown that a particular eigenphase solution with resonant structure (and not the eigenphase sum) plays a role in the many-body correlation of bound states.

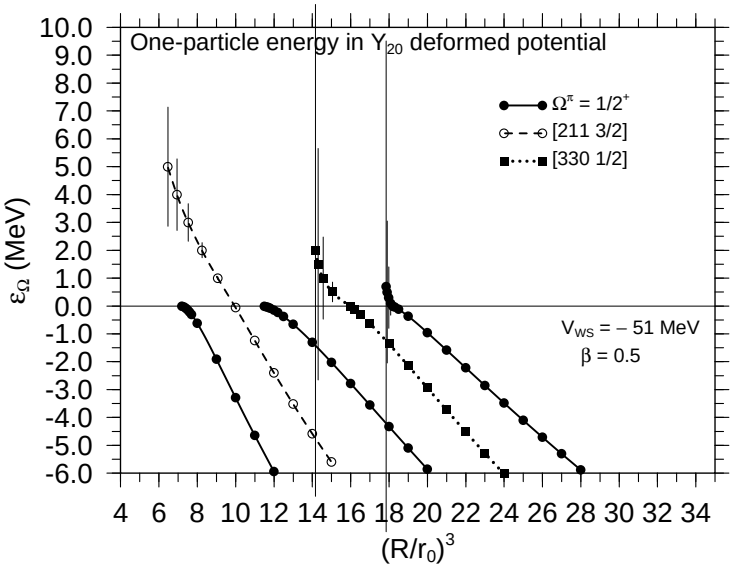

Figure 1: *Weakly-bound one-particle energy and one-particle resonant energy as a function of potential strength. The vertical thin line indicates the width of respective one-particle resonance.*

[1] I. Hamamoto, Phys. Rev. C 72, 024301 (2005);