

# SEMICLASSICAL SHELL STRUCTURE AND NUCLEAR DOUBLE-HUMPED FISSION BARRIERS

*To the memory of V. M. Strutinsky*

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We derived the semiclassical trace formulas for the level density as sums over periodic-orbit families and isolated orbits within the improved stationary phase method. Averaged level-density shell corrections and shell-structure energies are continuous through all symmetry-breaking (bifurcation) points with the correct asymptotics of the standard stationary phase approach accounting for continuous symmetries. We found enhancement of the nuclear shell structure near bifurcations in the superdeformed region. Our semiclassical results for the averaged level densities with the gross-shell and more thin-shell structures and the energy shell corrections for critical deformations are in good agreement with the quantum calculations for several single-particle Hamiltonians, in particular for the potentials with a sharp spheroidal shape. Enhancement of the shell structure owing to bifurcations of the shortest 3-dimensional orbits from equatorial orbits is responsible for the second well of fission barrier in a superdeformation region.

*Keywords:* nuclear shell structure, fission barriers, nuclear deformations, energy shell corrections, semiclassical periodic orbit theory, quantum and classical chaos.