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Review text:

Barbanis' (= two-dimensional non-separable $\sqrt{g}xy^2$ plus harmonic) potential is numerically studied in the two contexts (viz., of classical and quantum theory) and in two regimes (viz., the real and PT-symmetric one, with $g > 0$ and $g < 0$, respectively).

In the former context, several samples of the Poincare surfaces of sections confirm the expected transition, with the growth of the energy, from the regular domain via mixed domain to the almost complete chaos at both the positive g (mind the misprint) and negative g. This opens the terrain for the Percival's prediction (applied usually to Hermitian Hamiltonians) that at the lowest energies many non-integrable systems possess almost solely regular trajectories in classical phase space (which means that these trajectories are confined to an N-dimensional torus where N is the number of degrees of freedom) while their quantized spectrum remains "regular". In contrast, the classical trajectories become chaotic [filling all the (2N-1)-dimensional fixed-energy subspace (called "shell")] at the high energies while, in parallel, the quantized spectrum becomes "irregular", exhibiting, typically, the large second derivatives (with respect to g) and level repulsion.

The main attention of the paper is paid to the quantum and PT-symmetric context. Empirically (using matrix diagonalization and Rayleigh-Schroedinger perturbation methods), the Percival's correspondence is claimed confirmed. In this frame, my doubts concern one of the key author's claims that the levels cannot cross in the PT-symmetric regime. In fact, even if they did (as they really do in many solvable PT-symmetric models, say, of ref. [7]), the phenomenon could not have been detected by the diagonalization method once the operator itself ceases to be diagonalizable at the points of the crossing.