Resonance Zones in Action Space

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The classical and quantum mechanics of isolated, nonlinear resonances in integrable systems with $N \geq 2$ degrees of freedom is discussed in terms of geometry in the space of action variables. Energy surfaces and frequencies are calculated and graphically presented for invariant tori inside and outside the resonance zone. The quantum mechanical eigenvalues, computed in the semiclassical WKB approximation, show a regular pattern when transformed into the action space of the associated symmetry reduced system: eigenvalues inside the resonance zone are arranged on N-dimensional cubic lattices, whereas those outside are, in general, non-periodically distributed. However, N-dimensional triclinic (skewed) lattices exist locally. Both kinds of lattices are joined smoothly across the classical separatrix surface. The statements are illustrated with the help of two and three coupled rotors. The energy-level statistics of this system are found numerically to be in very good agreement with the Poisson distribution, despite of the complex lattice structure.
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