Dense Regular Sub-Spectra of Nonintegrable Systems for Generic Quasimomentum

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Abstract

The quasienergy (QE) spectrum of general nonintegrable kicked systems is studied as a function of the quasimomentum β. The latter quantity is most significant in experimental realizations of kicked systems using atom-optics techniques due to the unavoidable finite width in β of cold-atom clouds or Bose-Einstein condensates. It is rigorously shown that for generic (irrational) values of β the QE spectrum always exhibits a completely regular component of equally-spaced levels covering densely the entire QE range. This causes the blurring of the rest of the spectrum which may consist of nontrivial structures such as the interesting "Hofstadter's butterfly" recently shown to occur for the double kicked particle at $\beta = 0$ (double kicked "rotor"). Thus, $\beta = 0$ turns out now to be a nongeneric value. For rational values of β and a scaled Planck constant, "quantum resonances" arise, with the QE spectrum consisting of a finite number of bands. In this case, the regular sub-spectrum is shown to lead to a unique quantum-dynamical phenomenon, "travelling wave-trains". It is also found that the bands are generically "flat", implying "quantum antiresonance" (bounded quantum motion), replacing the usual unbounded quantum-resonance motion.