Decay of Quantum Accelerator Modes.

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Unexpected accelerator modes were observed experimentally for cold cesium atoms when driven in the presence of gravity [1]. The theory of this purely quantum effect relies on a pseudoclassical limit, which relates the observed modes to stable periodic orbits of a classical map [2], and thus allows classification of the modes based on the arithmetical organization of the periodic orbits [3]. Trapping of wavefunctions inside islands of stability associated with such orbits gives rise to metastable states, which eventually decay due to tunneling. These metastable states are shown to correspond to the observed accelerator modes, and a relation to the Wannier-Stark resonances is exposed. They provide an excellent test case for the study of tunneling out of stable islands immersed in a chaotic sea, which is a central problem of present-day Quantum Chaology. Different regimes of quantum tunneling, marked by different quantitative dependence of decay rates on the effective Planck's constant, are identified, depending on the degree of resolution of KAM substructures that is afforded by the value of $\hbar$ [4].

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