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Beyond Planck-Einstein quanta: Crossover from frequency driven to amplitude driven excitation in a nonequilibrium many-body system[1] JAMES FREERICKS, WEN SHEN, Georgetown Univ, TOM DEVEREAUX, Stanford University and SLAC — Planck introduced the idea of light quanta to calculate the spectrum for black body radiation, which was employed by Einstein to explain the photoelectric effect. Later, Kubo and Greenwood derived the linear response of a quantum system to an applied external field, and found that the energy available for excitation was determined by the frequency of the driving field as given by the Planck-Einstein relation. As the magnitude of the driving field is further increased into the nonlinear regime, one expects to see multiphoton processes and then for there to be a crossover from frequency-driven excitation of the quantum system to amplitude-driven excitation. Here we use the exact quantum solution of ultracold spinless fermions in a double-well optical lattice driven by an artificial pulsed electric field to show generically how such a crossover occurs. We find that the behavior is quite complex due to excitation and de-excitation processes, so that it is no longer true that tunneling is optimized when the field amplitude is the highest. When the field amplitude becomes very large, there is a novel quantum oscillatory behavior in the excitation spectroscopy that appears to describe a new regime for quantum phenomena.

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