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Multi-photon Transitions in a near-millimeter-sized superconducting device ROBERTO RAMOS, Indiana Wesleyan University, STEVEN CARABELLO, JOSEPH LAMBERT, Drexel University, DANIEL CUNNANE, Temple University, WENQING DAI, Penn State University, KE CHEN, Temple University, QI LI, Penn State University, XIAOXING XI, Temple University — The washboard potential well of a current-biased Josephson junction is a natural testbed for studying the quantum dynamics of trapped particles. At sufficiently low temperatures, the dynamics of the device is similar to that of a quantum "phase particle" that can access quantized states within the well. When photons are strongly coupled to such a quantum system such as by weak microwave irradiation, multi-photon transitions can be observed between two energy levels. This occurs when the quantum energy of the radiation, multiplied by an integer, matches the spacing between levels. These quantum-behaving devices are typically tens of microns across and are current-biased so that the well is shallow enough to accommodate few energy levels. In contrast, we have observed single- and multi-photon transitions in junctions with areas 600 times bigger than conventional junctions previously shown to display multi-photon transitions. These relatively large devices are MgB2 junctions, measuring up to 0.3 mm across. The data fits consistently with theoretical models of junctions behaving in the quantum limit. On the other hand, the data and the use of large capacitance junctions suggests observation of such transitions even in a deep well with many quantum levels.

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