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Abstract

Vortices occur naturally in a wide range of gases and fluids, from macroscopic to microscopic scales. In Bose–Einstein condensates of dilute atomic gases1, superfluid helium2 and superconductors, the existence of vortices is a consequence of the quantum nature of the system. Quantized vortices of supercurrent3 are generated by magnetic flux penetrating the material, and play a key role in determining the material properties4 and the performance of superconductor-based devices5,6. At high temperatures the dynamics of such vortices are essentially classical, while at low temperatures previous experiments have suggested collective quantum dynamics7,8. However, the question of whether vortex tunnelling occurs at low temperatures has been addressed only for large collections of vortices. Here we study the quantum dynamics of an individual vortex in a superconducting Josephson junction. By measuring the statistics of the vortex escape from a controllable pinning potential, we demonstrate the existence of quantized levels of the vortex energy within the trapping potential well and quantum tunnelling of the vortex through the pinning barrier.