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A direct measurement of Zitterbewegung in a BEC LINDSAY LEBLANC, MATTHEW BEELER, JQI, NIST and University of Maryland, KARINA JIMENEZ-GARCIA, James Frank Institute, Department of Physics, University of Chicago, ABIGAIL PERRY, SEIJI SUGAWA, ROSS WILLIAMS, IAN SPIELMAN, JQI, NIST and University of Maryland — The Dirac Hamiltonian was originally formulated to describe the dynamics of relativistic electrons within the framework of quantum mechanics. One of the phenomena to emerge from this description is "zitterbewegung," a trembling motion whose frequency is related to the particles' rest energy. To study this equation through quantum simulation, we used a ^{87}Rb Bose-Einstein condensate with two internal levels coupled by Raman lasers. The characteristic energy, frequency and length scales of this system fall within an experimentally accessible range. Using direct measurements, both insitu and time-of-flight, we measured the oscillatory motion of neutral BECs upon application of the Dirac Hamiltonian. Through this quantum simulation, we can relate zitterbewegung to a more familiar phenomenon ubiquitous in atomic physics: Rabi flopping in a two-level system.

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