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Imaging individual Landau Level wavefunctions on the surface of bismuth MALLIKA T. RANDERIA, BENJAMIN E. FELDMAN, ANDRAS GYENIS, HAO DING, Princeton University, FENGCHENG WU, University of Texas, Austin, HUIWEN JI, ROBERT J. CAVA, Princeton University, ALLAN H. MACDONALD, University of Texas, Austin, ALI YAZDANI, Princeton University — The scanning tunneling microscope (STM) is a powerful tool to image electronic wavefunctions with high energy and spatial resolution. We examine the quantum Hall states that arise in a high magnetic field from anisotropic hole pockets on the Bi(111) surface. Spectroscopic mapping performed with a STM at the energies of valley-polarized Landau levels show elliptical rings of suppressed conductance centered on atomic-scale surface defects. These rings correspond to individual cyclotron orbits whose energy has been shifted by the defect potential and the overall shape matches well to the expected Landau orbits. Our measurements also reveal finer features of the wavefunction, which point to physics not captured by this simple analysis. We will discuss this aspect of the data and a possible interpretation within the framework of a more comprehensive model. In addition to providing the first direct mapping of isolated cyclotron orbits, this technique has the potential to visualize other exotic quantum wavefunctions on the atomic scale.

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