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Mapping Dimensionality and Directionality of Electronic Behavior in $CeCoIn_5$: the Superconducting State BENJAMIN E. FELDMAN, ANDRAS GYENIS, MALLIKA T. RANDERIA, GABRIEL A. PETERSON, Princeton University, PEGOR AYNAJIAN, Binghamton University, ERIC D. BAUER, Los Alamos National Laboratory, ALI YAZDANI, Princeton University — Unconventional superconductors often exhibit anisotropic physical properties that arise from the directional dependence of their order parameters. A prime example is $CeCoIn_5$, a heavy fermion d-wave superconductor with a rich low-temperature phase diagram consisting of competing and coexisting magnetic and superconducting orders. Here we present dilution refrigerator scanning tunneling microscopy of $CeCoIn_5$ cleaved perpendicular to its basal plane. We study superconductivity on the (100) surface, whose normal vector points along the antinode of the superconducting energy gap. The gap magnitude is similar to that observed in the basal plane, with a key difference: it does not exhibit any suppression near step edges. Application of a magnetic field along the [100] direction leads to the formation of anisotropic vortices, and the vortex lattice undergoes a transition at high field before the superconducting state gives way to a pseudogap phase. Our measurements illustrate the directional dependence of the superconducting properties in $CeCoIn_5$, and more generally, demonstrate the utility of imaging d-wave superconductors along their nodal and antinodal directions.

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