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Studying pinning on the nanoscale by vortex dragging in a $YBa_2Cu_3O_{6.991}$ single crystal O. M. AUSLAENDER, LAN LUAN, Stanford University, E. ZELDOV, Weizmann Institute of Science, K. A. MOLER, Stanford University, D. A. BONN, RUIXING LIANG, W. N. HARDY, University of British Columbia — We have used a magnetic force microscope to drag individual, well isolated vortices in a detwinned $YBa_2Cu_3O_{6.991}$ single crystal. At this slight degree of overdoping, a vortex can be described as a one-dimensional elastic string. We find an angle dependent dragging distance, implying that it is easier to drag a vortex along the Cu-O chains than across them. We understand this as a manifestation of single vortex weak collective pinning (WCP) by oxygen vacancies along the Cu-O chains, the dominant source of pinning in our sample. Single vortex WCP arises when individual pinning sites are too weak individually, but are able to compete with elasticity by cumulative effect. Using the usual single vortex WCP assumption of isotropic point pinning sites at uncorrelated positions we find that the anisotropy of superconductivity in $YBa_2Cu_3O_{6.991}$ only partially accounts for the angle dependence. Relaxing that assumption to account for the known tendency of the vacancies to cluster along the Cu-O chains, we find that single vortex WCP describes the dragging anisotropy quantitatively. This picture is further supported by the observation that vortex motion is more erratic along the chains than across them.

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