Imaging the Vortex Liquid State in Bi$_2$Sr$_2$CuO$_{6+\delta}$.\textsuperscript{1} T.L. WILLIAMS, M. ZECH, YI YIN, Harvard University, T. KONDO, Ames Laboratory, Iowa State University, T. TAKEUCHI, H. IKUTA, Nagoya University, J.E. HOFFMAN, Harvard University — We use a low temperature scanning tunneling microscope (STM) to study the vortex state of the high-$T_c$ superconductor Bi$_2$Sr$_2$CuO$_{6+\delta}$ in magnetic fields up to 9 T. At a temperature of 6 Kelvin, we find no localized vortices down to $H = 0.25$ T. However, the gap depth from the spatially averaged d$I$/d$V$ spectrum decreases with increasing magnetic field, which indicates a vortex liquid state. By tracking atomically resolved locations at different magnetic fields, we apply a normalization technique to remove inhomogeneities in the underlying density of states, revealing a more homogeneous superconducting state.

\textsuperscript{1}We acknowledge support from NSF grant DMR-0508812 and AFOSR grant FA9550-05-1-0371.

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Date submitted: 22 Jan 2009