Nonlocal transport in superconducting oxide nanostructures

JOSHUA VEAZEY, GUANGLEI CHENG, SHICHENG LU, MICHELLE TOMCZYK, PATRICK IRVIN, MENGCHEN HUANG, University of Pittsburgh, CHUNG WUNG BARK, SANGWOOU RYU, CHANG-BEOM EOM, University of Wisconsin-Madison, JEREMY LEVY, University of Pittsburgh — We report nonlocal transport signatures in the superconducting state of nanostructures formed at the LaAlO$_3$/SrTiO$_3$ interface using conductive AFM lithography. Nonlocal resistances (nonlocal voltage divided by current) are as large as 200 $\Omega$ when 2-10 $\mu$m separate the current-carrying segments from the voltage-sensing leads. The nonlocal resistance reverses sign at the local critical current of the superconducting state. Features observed in the nonlocal $V$-$I$ curves evolve with back gate voltage and magnetic field, and are correlated with the local four-terminal $V$-$I$ curves. We discuss how nonlocal and local transport effects in LaAlO$_3$/SrTiO$_3$ nanostructures may result from the electronic phase separation and superconducting inhomogeneity reported by others in planar structures.

1This work is supported by AFOSR (FA9550-10-1-0524) and NSF DMR-0906443