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**Evidence for Competing Order in Underdoped $Bi_2Sr_2CaCu_2O_{8+\delta}$ from Break Junction Tunneling Spectroscopy** JOHN ZASADZINSKI, Illinois Inst of Tech, NICHOLAS GROLL, Materials Science Division Argonne National Laboratory, CHAOYUE CAO, Physics Department Illinois Inst of Tech, MIKE HINTON, Physics Department Ohio State University, THOMAS PROSLIER, Materials Science Division Argonne National Laboratory, THOMAS LEMBERGER, Physics Department Ohio State University — Superconductor-insulator-superconductor (SIS) break junction tunneling measurements of the low-temperature, single-electron gap parameter, $\Delta$, are reported on heavily underdoped thin films of $Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi2212). This extends previous, doping-dependent studies on bulk single crystals and the combined data reveal that for hole concentrations, $p$ $<$0.11 there is an abrupt change in slope of $\Delta(p)$ along with the observation of extraordinarily large single-electron energy gaps ($\Delta \sim$ 115 meV-135 meV). This underdoped region displays a corresponding drop in the superfluid density and distinctive changes in the shape of the electronic density of states (DOS). The shape of $\Delta$(T) near Tc (as measured by the loss of Josephson current) is inconsistent with single gap scenarios. The combined results signal that a competing order has emerged. The underdoped $\Delta$ values are close to the antiferromagnetic exchange energy, J, and the overall trends indicate that the quasiparticle gap in the DOS has evolved from primarily superconducting to primarily magnetic character. These results may be relevant for pseudogap phenomena in underdoped cuprates.

John Zasadzinski
Physics Department Illinois Inst of Tech

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