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Gap spectroscopy in underdoped $YBa_2Cu_3O_{6+x}$ from superfluid spectral weight and intrinsic pair tunneling WENDELL HUTTEMA, PATRICK TURNER, Simon Fraser University, RUIXING LIANG, WALTER HARDY, DOUG BONN, University of British Columbia, DAVID BROUN, Simon Fraser University — Numerous experiments on cuprate high temperature superconductors reveal evidence for two different energy gaps: a normal state pseudogap that grows on underdoping, and a superconducting gap connected to the transition temperature T_c [1]. Here we use two different experiments to probe the superconducting energy gap scale in highly underdoped $YBa_2Cu_3O_{6+x}$: intrinsic pair tunneling perpendicular to the CuO_2 planes; and measurements of in-plane superfluid spectral weight. The measurements have been carried out on special samples in which doping can be tuned continuously using controlled oxygen annealing at room temperature [2]. We present data for T_c in the range of 3 K to 17 K, and show that the superconducting energy gap is indeed linked to T_c ($2\Delta \sim 4k_BT_c$), vanishing as $T_c \to 0$.

[1] Hüfner *et al.* Rep. Prog. Phys. 71, 062501 (2008)
[2] Broun *et al.* Phys. Rev. Lett. 99, 237003 (2007)

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