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Microwave spectroscopy of d-wave quasiparticles in highly underdoped YBCO WENDELL HUTTEMA, PATRICK TURNER, Simon Fraser University, RUIXING LIANG, WALTER HARDY, DOUG BONN, University of British Columbia, DAVID BROUN, Simon Fraser University — In the underdoped cuprates, photoemission and scanning-tunneling spectroscopies reveal that low energy quasiparticle excitations are confined to "Fermi arcs" on the Brillouin zone diagonals. We have used microwave spectroscopy to probe these excitations with high resolution in high purity $YBa_2Cu_3O_{6+y}$. We have carried out detailed measurements of the superfluid density and conductivity as a function of doping, using a novel in-situ oxygen-ordering technique to tune doping in a single sample, in the range $T_c = 20$ K to $T_c = 0$ K. These measurements complement and extend the other spectroscopic measurements and show that nodal d-wave quasiparticles continue to exist as superconductivity is suppressed. We show that as the superconducting transition temperature T_c is tuned to zero: the zero temperature superfluid density goes to zero; the maximum superconducting gap goes to zero; the gap slope softens; and Fermi liquid corrections cause the electrical current carried by the quasiparticles to decrease smoothly to zero.

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