Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Quantum superconductor-to-insulator transition in 2D $Y_{1-x}Ca_xBa_2Cu_3O_{7-\delta}$ films IULIAN HETEL, THOMAS LEMBERGER, Department of Physics, The Ohio State University, Columbus, Ohio, 43210 — This study investigates the relationship between the critical temperature, T_C, and the zero temperature superfluid density, $n_s(0)$, close to the quantum superconductor-to-insulator transition in 2D cuprate films. We use a two-coil technique, at frequencies up to 50 kHz, to measure the temperature dependence of superfluid density in severely underdoped $Y_{1-x}Ca_xBa_2Cu_3O_{7-\delta}$ films, as thin as 1-2 unit cells and with transition temperatures as low as 3 K. Superconducting films are grown by pulsed laser deposition on $SrTiO_3$ substrates, with thin insulating $PrBa_2Cu_3O_{7-\delta}$ protecting the film above and below. The zero temperature superfluid density in these films is comparable to values measured in thicker $Y_{1-x}Ca_xBa_2Cu_3O_{7-\delta}$ films, which suggests continuous superconducting layers. In 1-2 unit cell thick films, we find $T_C \propto n_s(0)$, which is expected in 2D. This result is different from the approximate $T_c \propto n_s(0)^{1/2}$ dependence previously reported in $YBa_2Cu_3O_{7-\delta}$ films and crystals and confirmed by our measurements on thicker $Y_{1-x}Ca_xBa_2Cu_3O_{7-\delta}$ films.

Iulian Hetel
Department of Physics, The Ohio State University, Columbus, Ohio, 43210

Date submitted: 17 Nov 2006 Electronic form version 1.4