

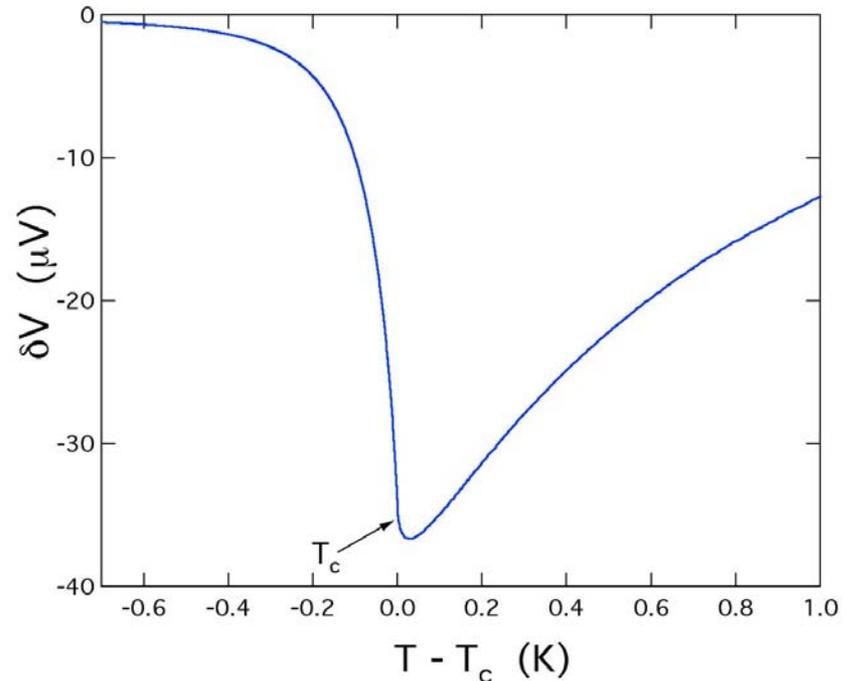
Prediction of a New Effect in High- T_c Superconducting Films: Critical Casimir Voltage

Gary Williams, UCLA, DMR 01-31111

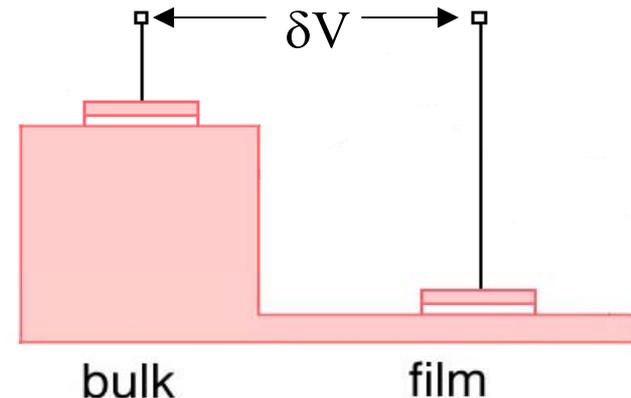
We have carried out the first calculation of the critical Casimir force in thin high- T_c superconducting films, using our vortex-loop renormalization theory of the phase transition.

In the superconducting case this takes the form of a voltage difference which will appear at the junction between the thin film and the bulk superconductor. Estimates for a BSCCO film of thickness 600 Å (figure at right) show that this voltage may be readily measurable, with a maximum voltage drop near T_c of order tens of microvolts over a temperature range of about 1 K near $T_c = 85$ K.

Reference: G. A. Williams, Physca B **329-333**, 204 (2003),
cond-mat/0307125



This figure shows the experimental setup that we propose for measuring the Casimir voltage. Two Josephson junctions make contacts to the film and bulk, and then the Casimir voltage across them can be measured with a low- T_c SQUID voltmeter. If it can be observed, this would be a sensitive new probe of the high- T_c phase transition.



Bubbles, Drops, and Vortices in Cryogenic Liquids

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Research activities:

Measurements of the superfluid density of thin helium films adsorbed in the 1D pores of MCM-41 porous ceramic (40 Å pore size).

Study of the dynamics of superfluid and normal fogs using a laser-scattering technique (diffusing-wave spectroscopy) for the first time.

Measurements of the pulse width and spectrum of luminescence from laser-induced bubbles in water pressurized up to 10 atmospheres.

Further development of a vortex-loop theory of the superfluid phase transition, including predictions for the critical Casimir effect in superfluid and superconducting films.

Educational activities:

3 graduate students, Han-Ching Chu, David Hecht, and Heetae Kim (received Ph.D. degree Dec. 2002, now a postdoc at Harvard)

1 undergraduate student, Frank Lee

Outreach activity:

Summer lab experience for 1 high school student, Eyal Dechter