1. Using 3-eV photons from a Blu-ray diode

C and G Measurements

- 405 nm (3.06 eV) photons from a Blu-ray diode outside the crystal
- Photon pulse width: 0.7 ns, repetition rate: 70 Hz
- 10,000 triggered records at each T

2. Noise spectra measurement

- Measured C and G using 3-eV photon data only (left) and together with noise spectrum data (right)
- The two methods share the same dI/dV and r values

MPT operation

- A persistent current is trapped in the bias circuit above the Tc of aluminum wirebonds that connect each sensor to its associated SQUID.
- As we cool or warm through the MoAu sensor’s superconducting transition, the inductance of the meander changes as the MoAu film is trapped or allows entry of flux, and we measure a current proportional to the sensor’s magnetic response.
- MPTs give us a unique avenue to probe superconducting effects in MoAu films.

M vs T

- Four different bias currents (806 uA, 903 uA, 952 uA, 1001 uA)

Theory

1. Free-energy difference between superconducting and normal states of MPT

- f = fraction of meander length for which MoAu enters a partly-normal intermediate state
- g = fractional width of normal stripes in intermediate state region
- ζ = superconducting energy gap reduction in Ginzburg-Landau equation

2. Heat capacity from second derivative of free energy

3. Thermal conductance: quasiparticle recombination & electron-phonon cooling

Conclusions

- We measured the variation in heat capacity and thermal conductance of a molybdenum-gold Magnetic Penetration Thermometer (MPT) near its field dependent Meissner transition temperature.
- We did this by two methods: detection of pulses in response to absorption of one or more 3 eV photons, and equilibrium noise measurements.
- Observed C & G show peaks in approximate agreement with a Ginzburg-Landau model of the superconducting intermediate state of an MPT.

References