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The attached report, in DRAFT form, *Thermal Imaging and Current Emission Measurements On a Large Thermionic Dispenser Cathode* is made available with permission from:

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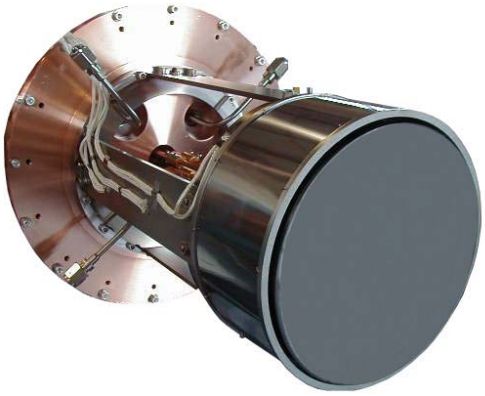


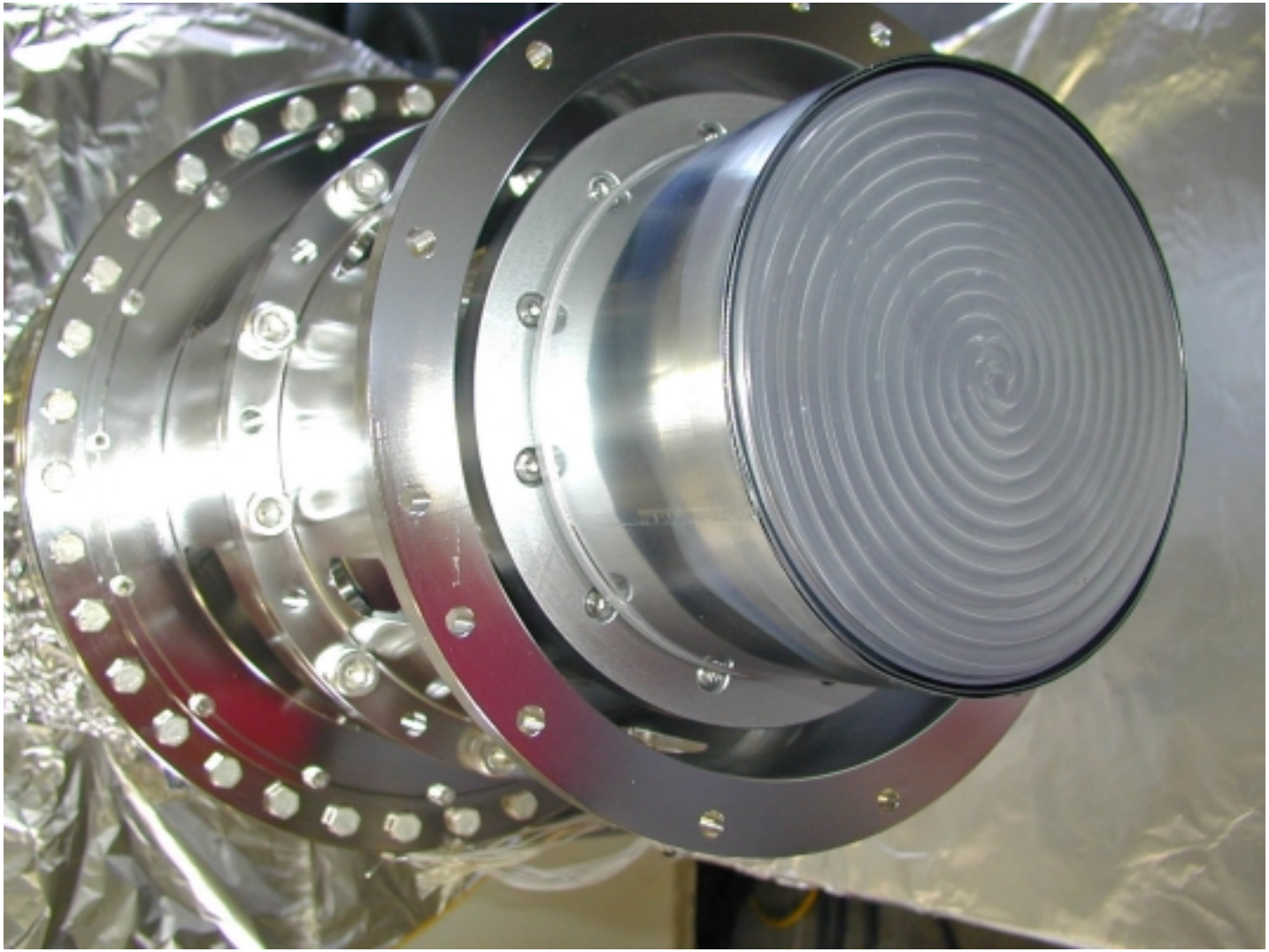
HeatWave Labs #101186 ∅8" Cathode only and mounted cathode with shielding

Thermal Imaging and Current Emission Measurements On a Large Thermionic Dispenser Cathode

Clifford M. Fortgang
Los Alamos National Lab
Lansce-9

Workshop on Cathodes for Relativistic Electron Beams
Naval Research Lab
May 10-11, 2001

Los Alamos
NATIONAL LABORATORY



Hardware identical to DARHT-2 is being tested on the CTS.

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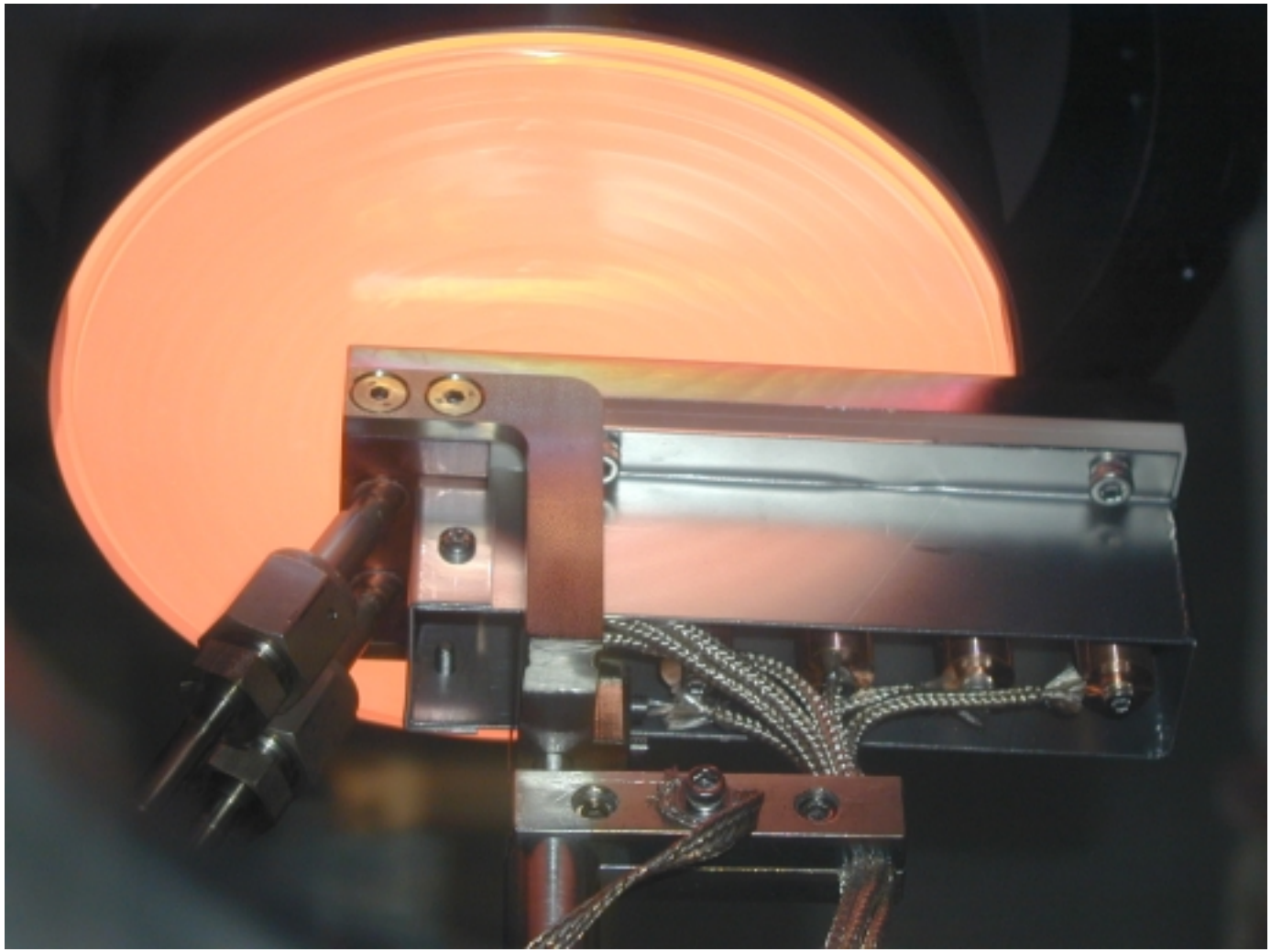
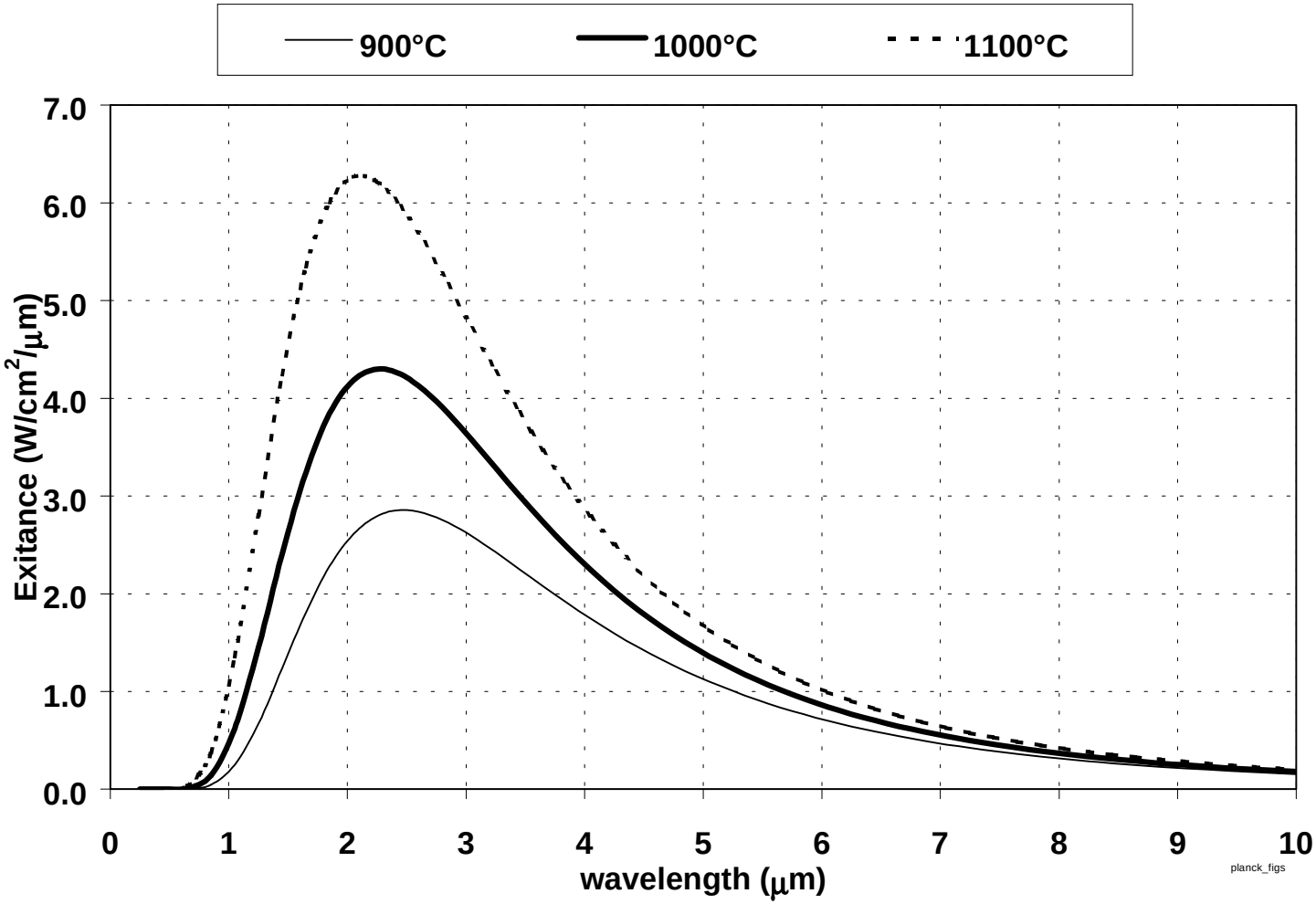
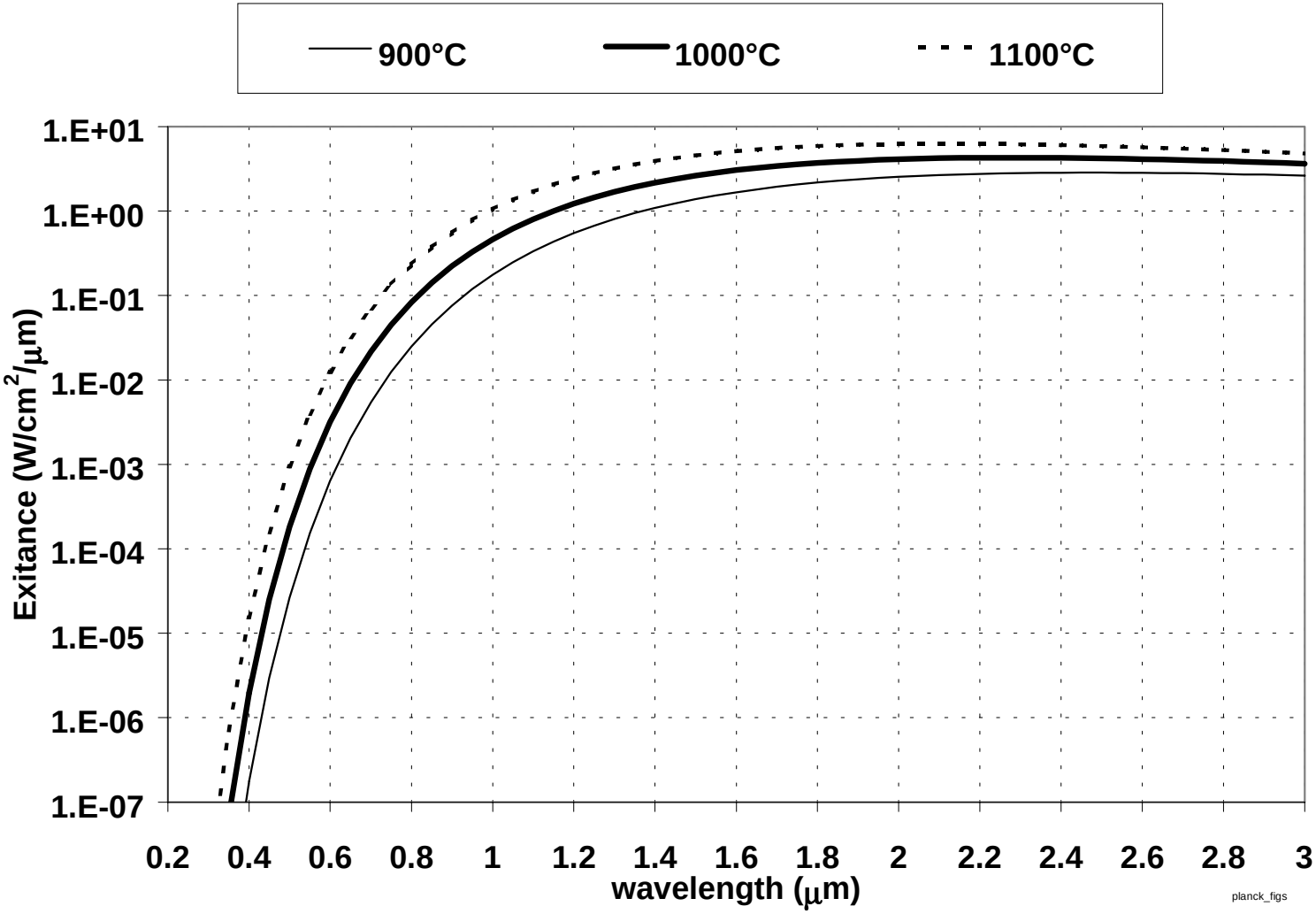


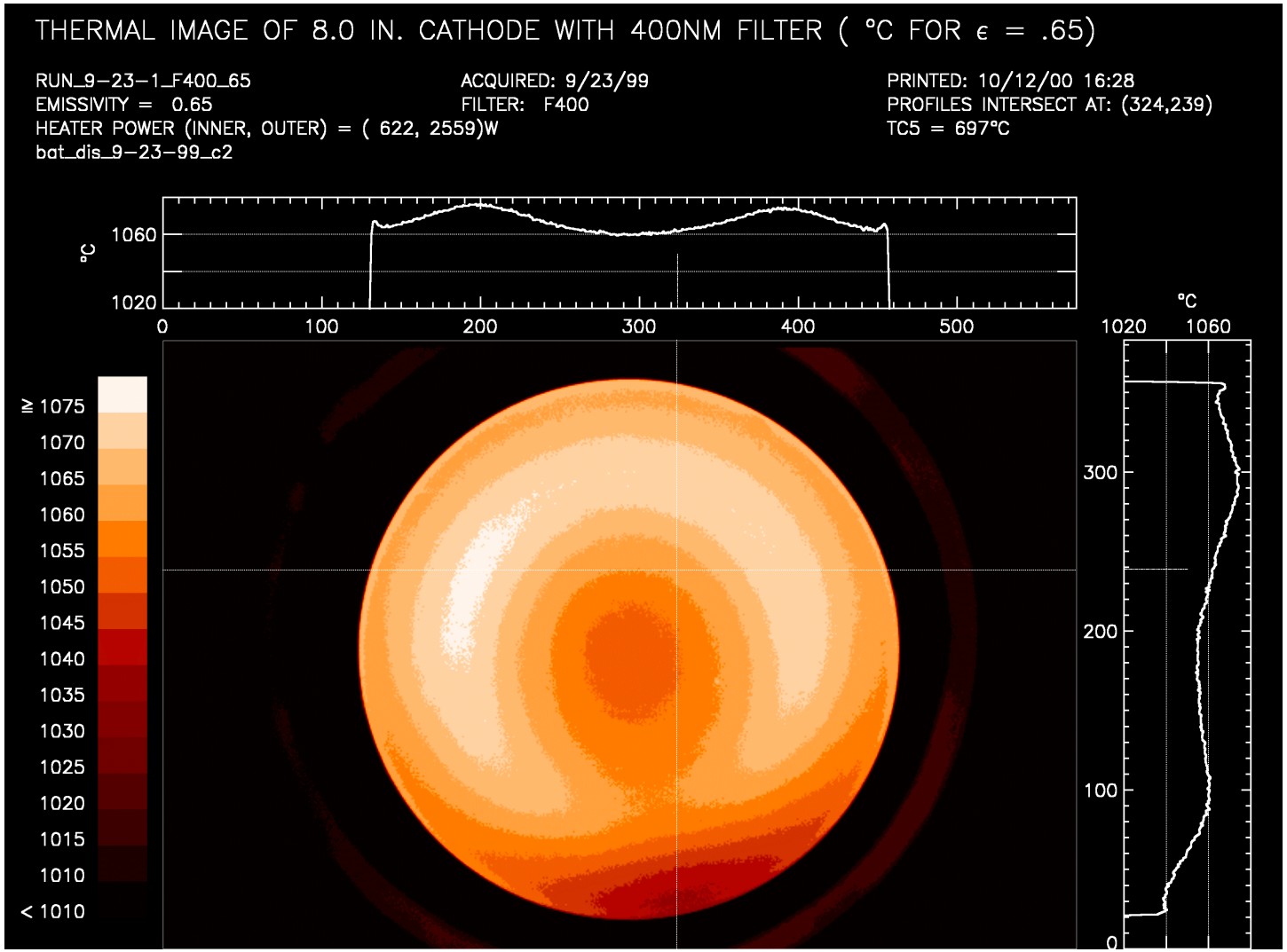
On the CTS, a unique current emission diagnostic is being used to characterize cathode quality.



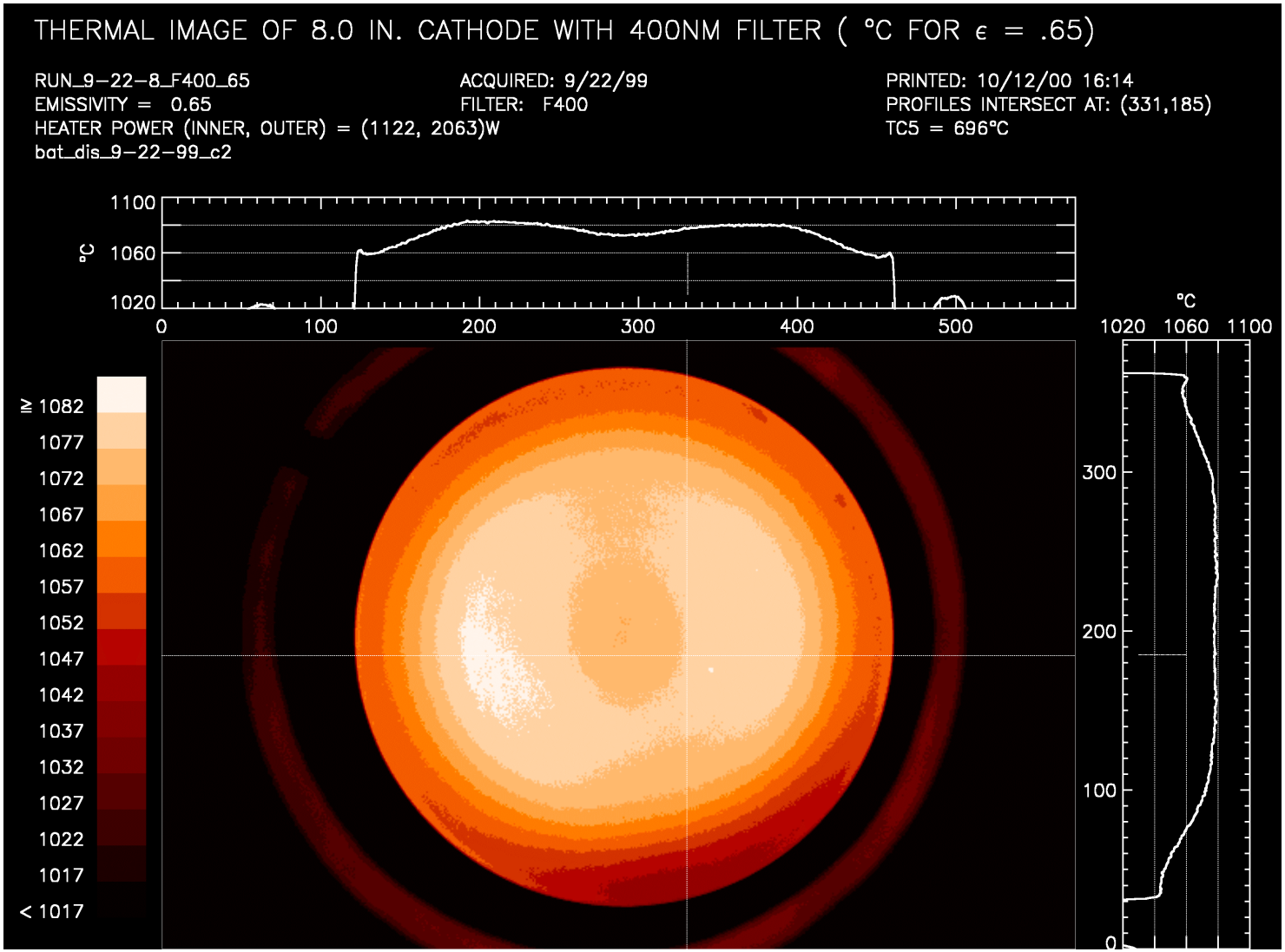
At temperatures of interest blackbody radiation peaks at about 2 microns.



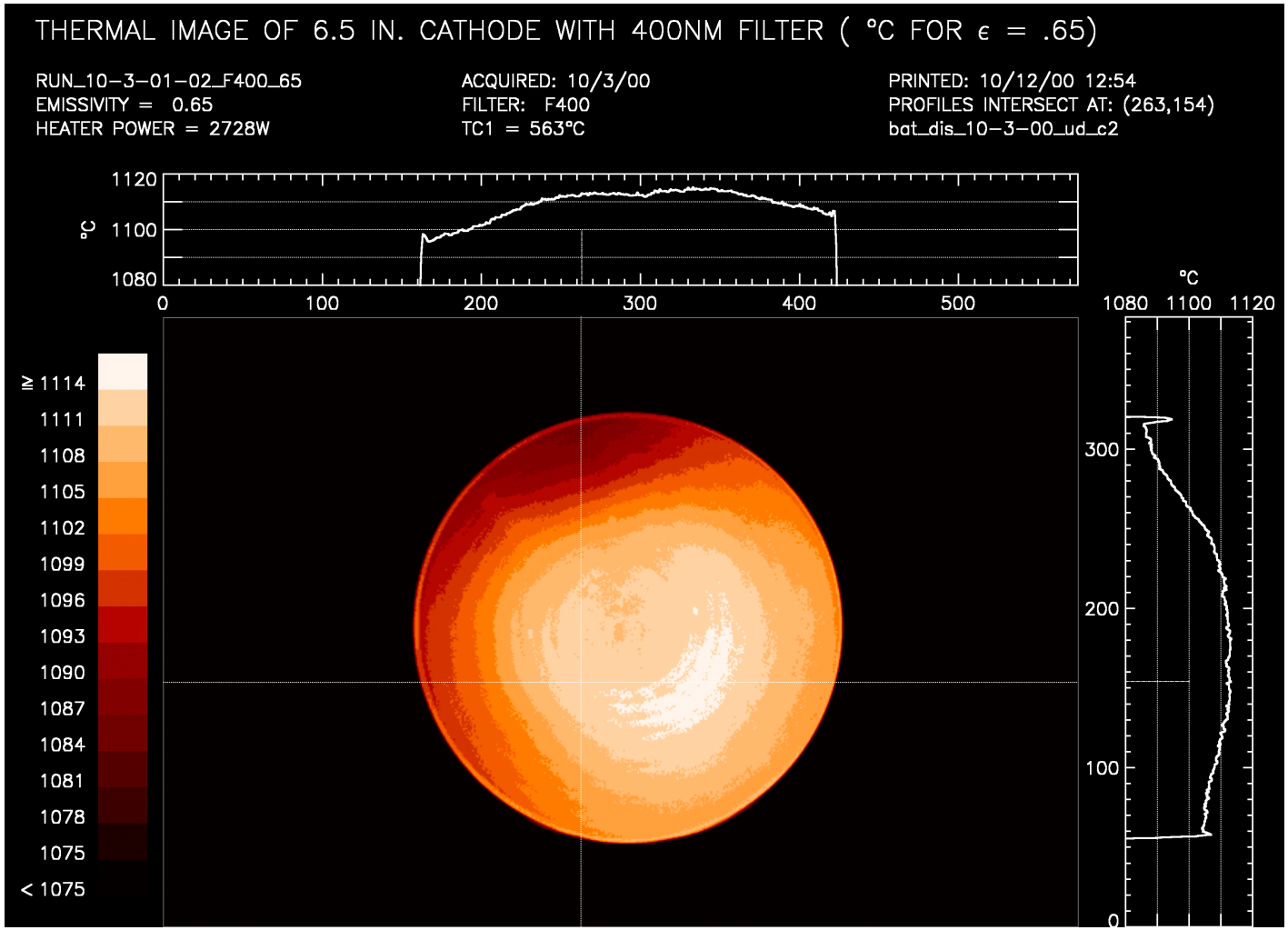
However photon flux is most sensitive to temperature on the short wavelength side of the peak.



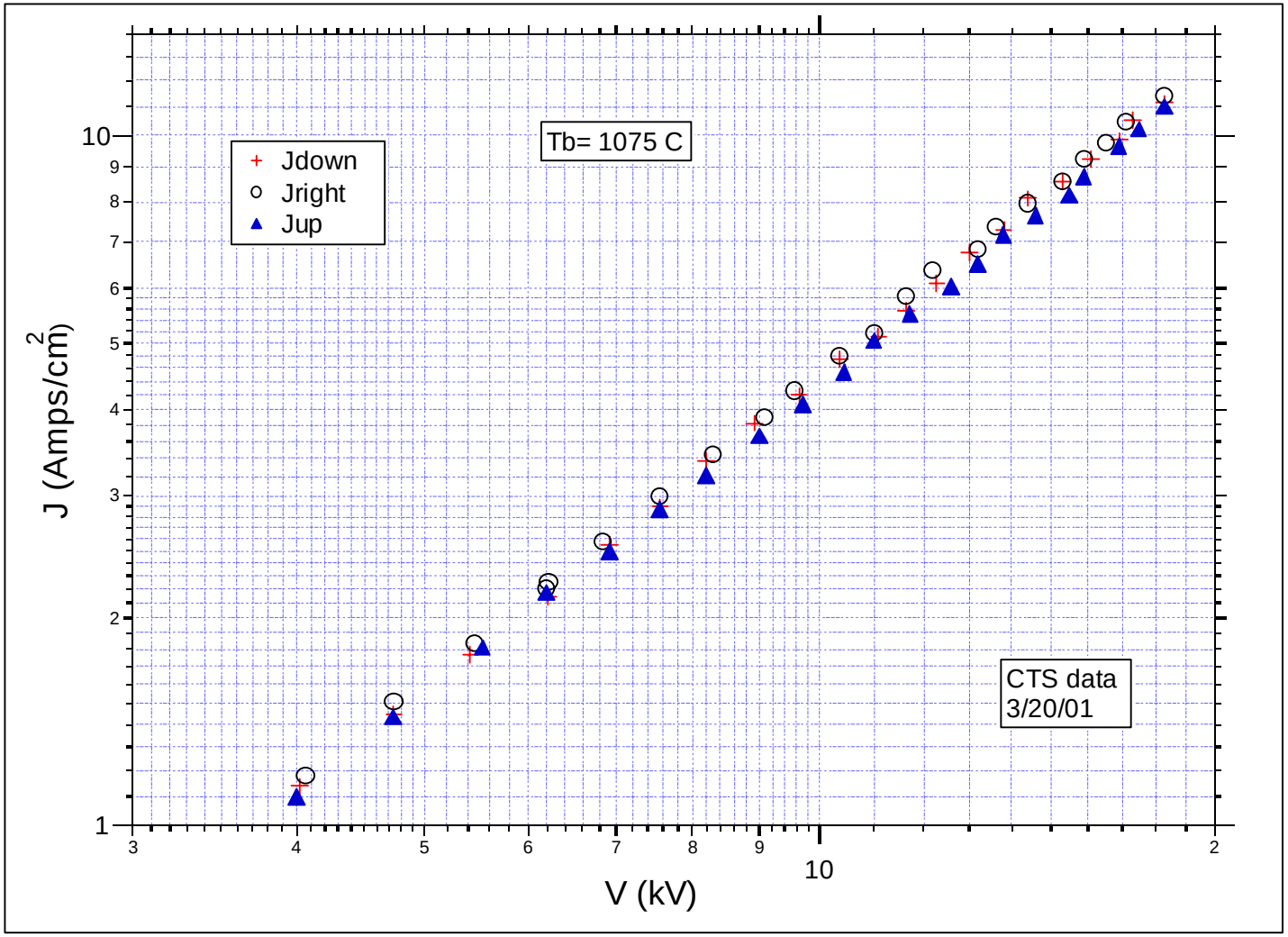
Radial profile was adjustable but not optimal with a dual heater design



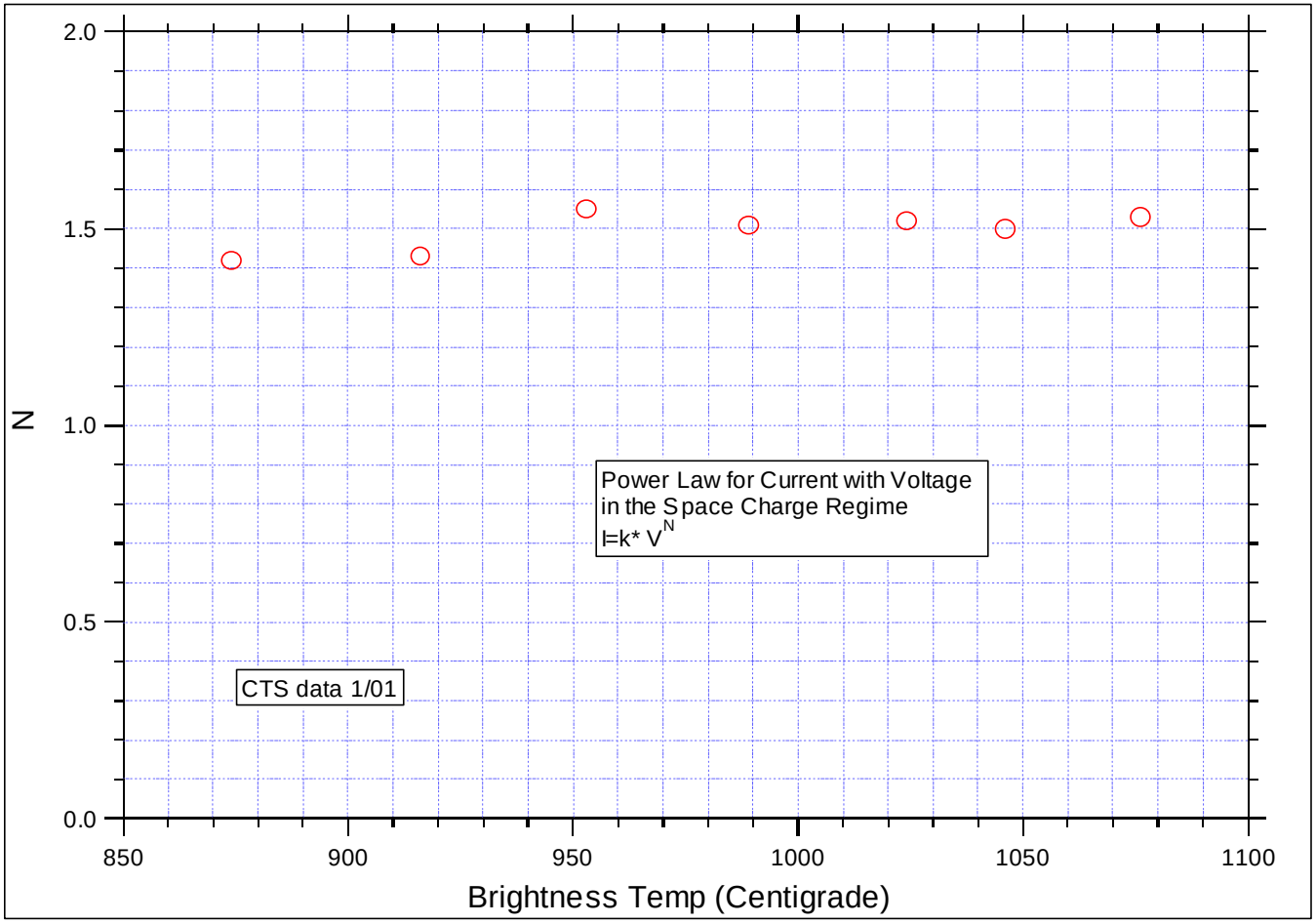
Best case temperature uniformity with dual heater design



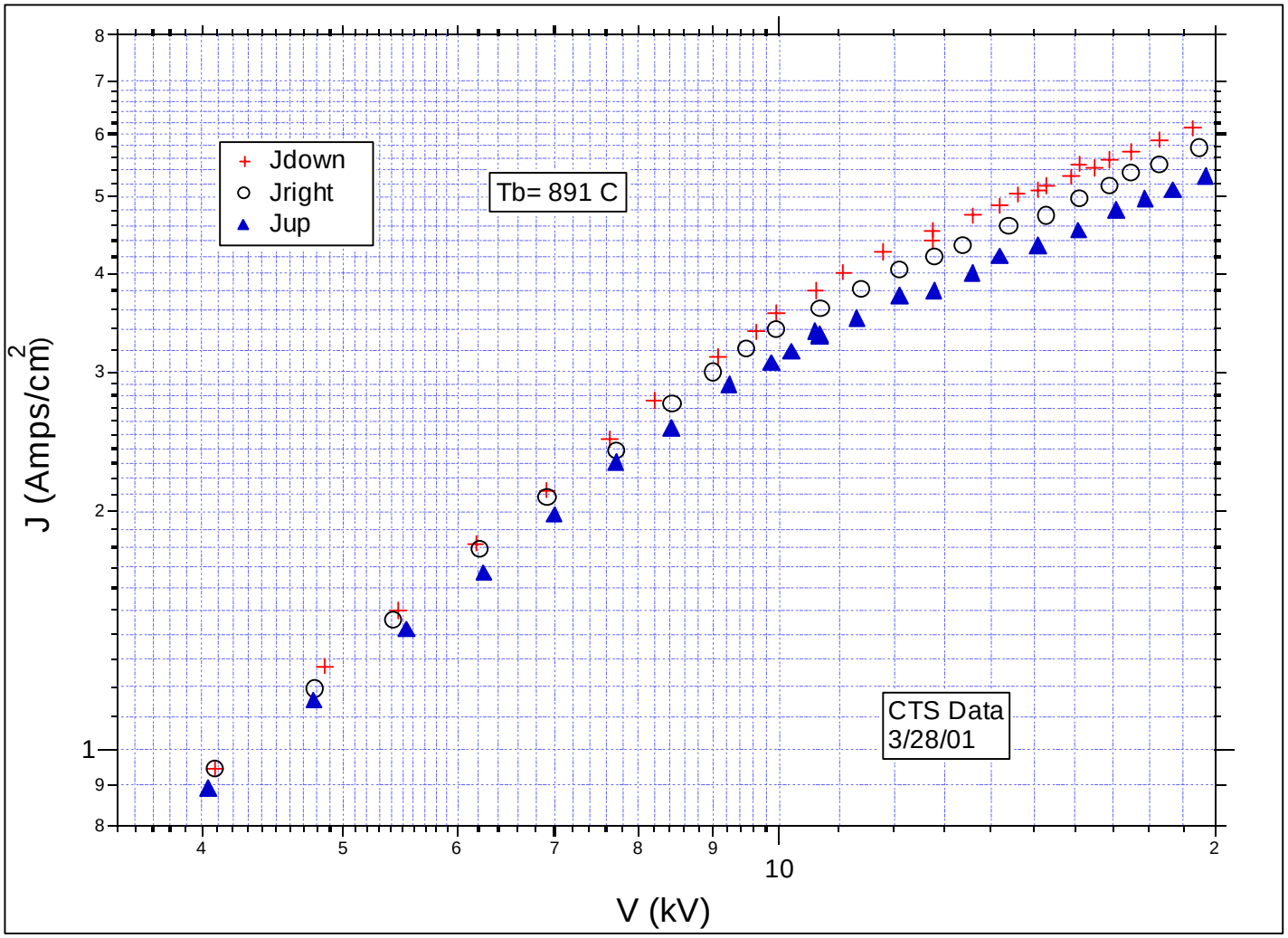
CTS Data- Thermal imaging has revealed a –25°C cold spot where the filament leads enter and exit the cathode.



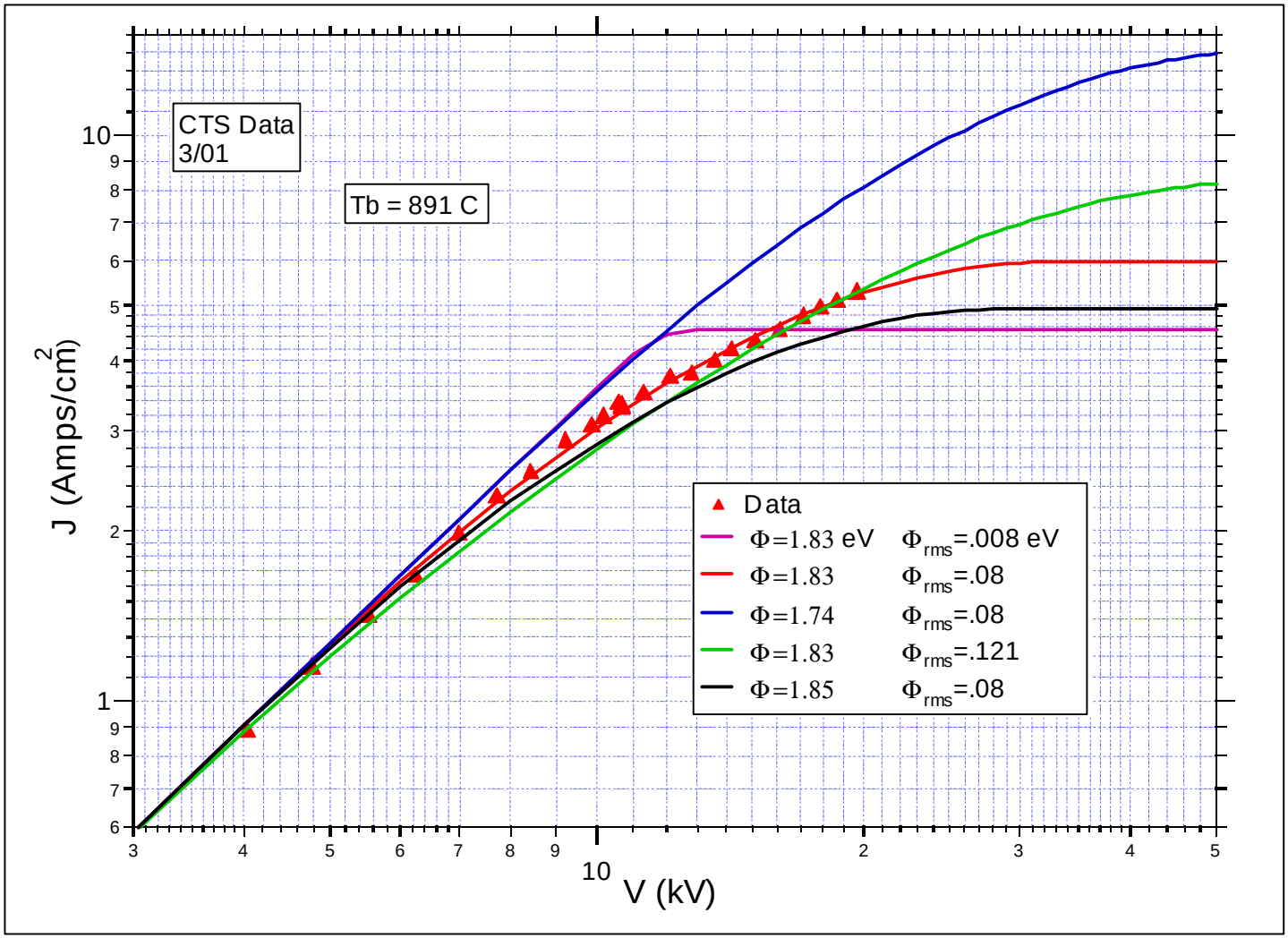
Emission is uniform when the cathode operates in the fully space-charge limited regime.



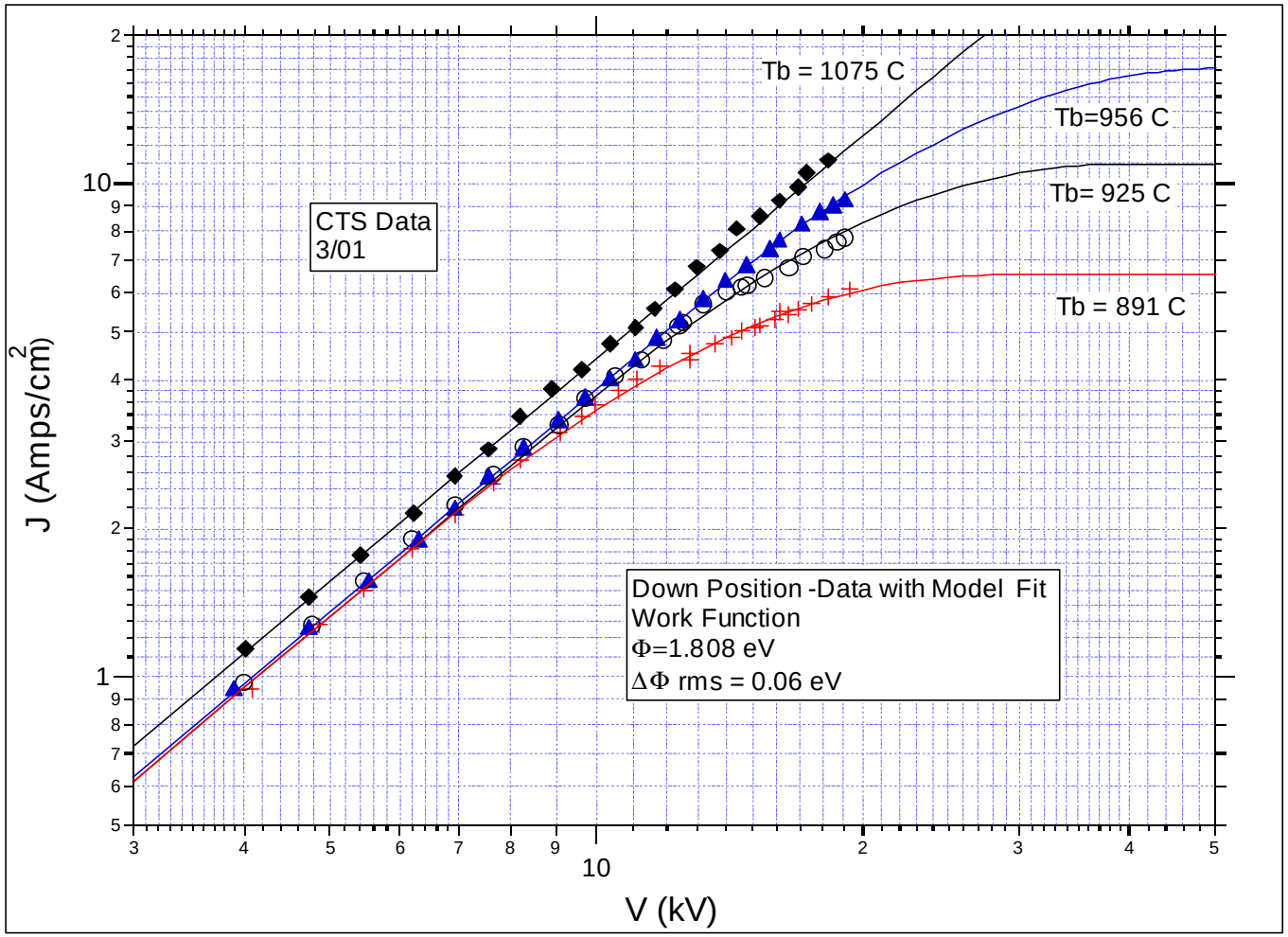
Data in the FSCL regime scales as $V^{3/2}$ to within a few %. At lower temperature emission is not fully SCL so scaling is slightly less than 3/2.



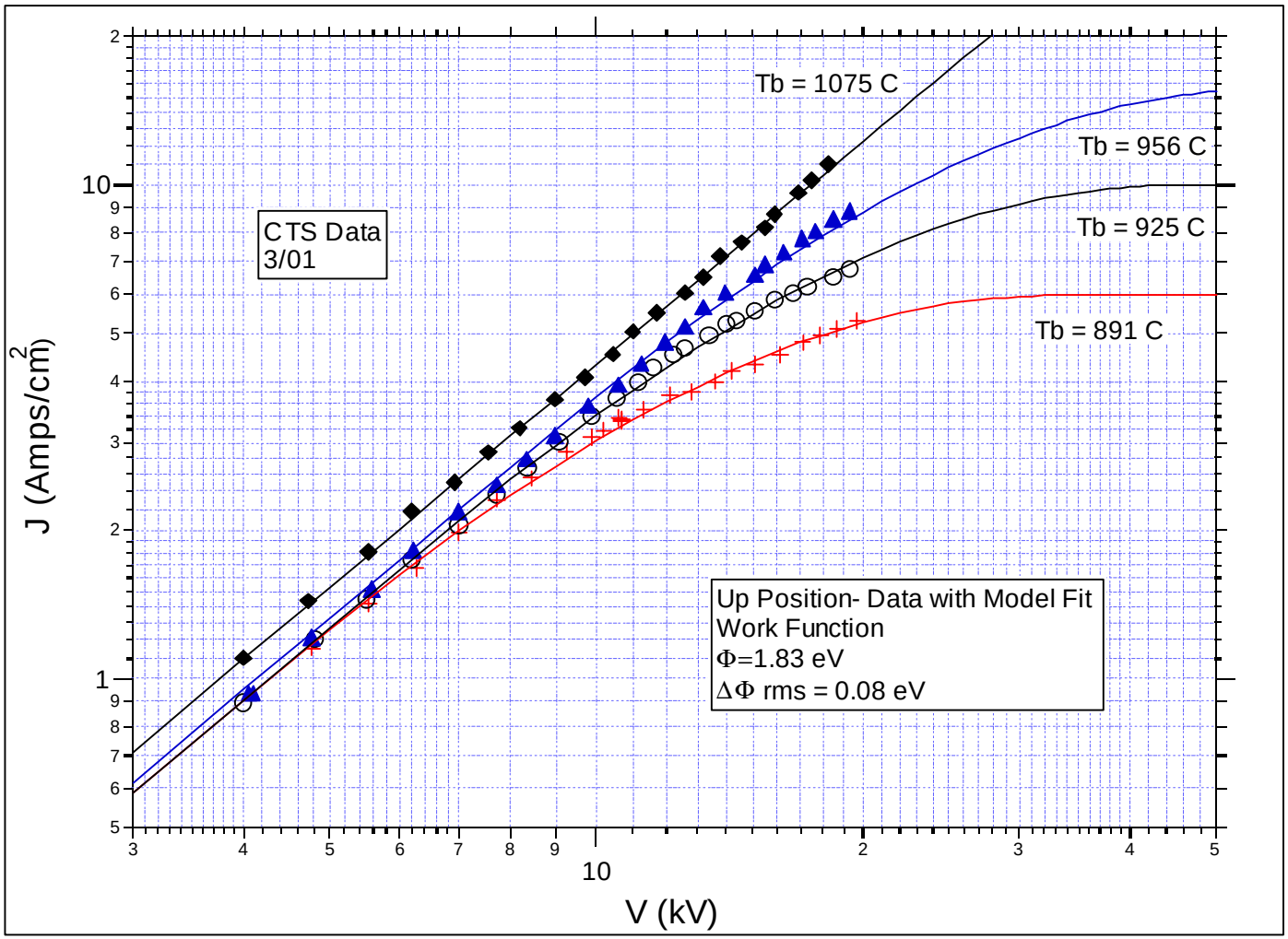
Emission becomes non-uniform at lower temperature.



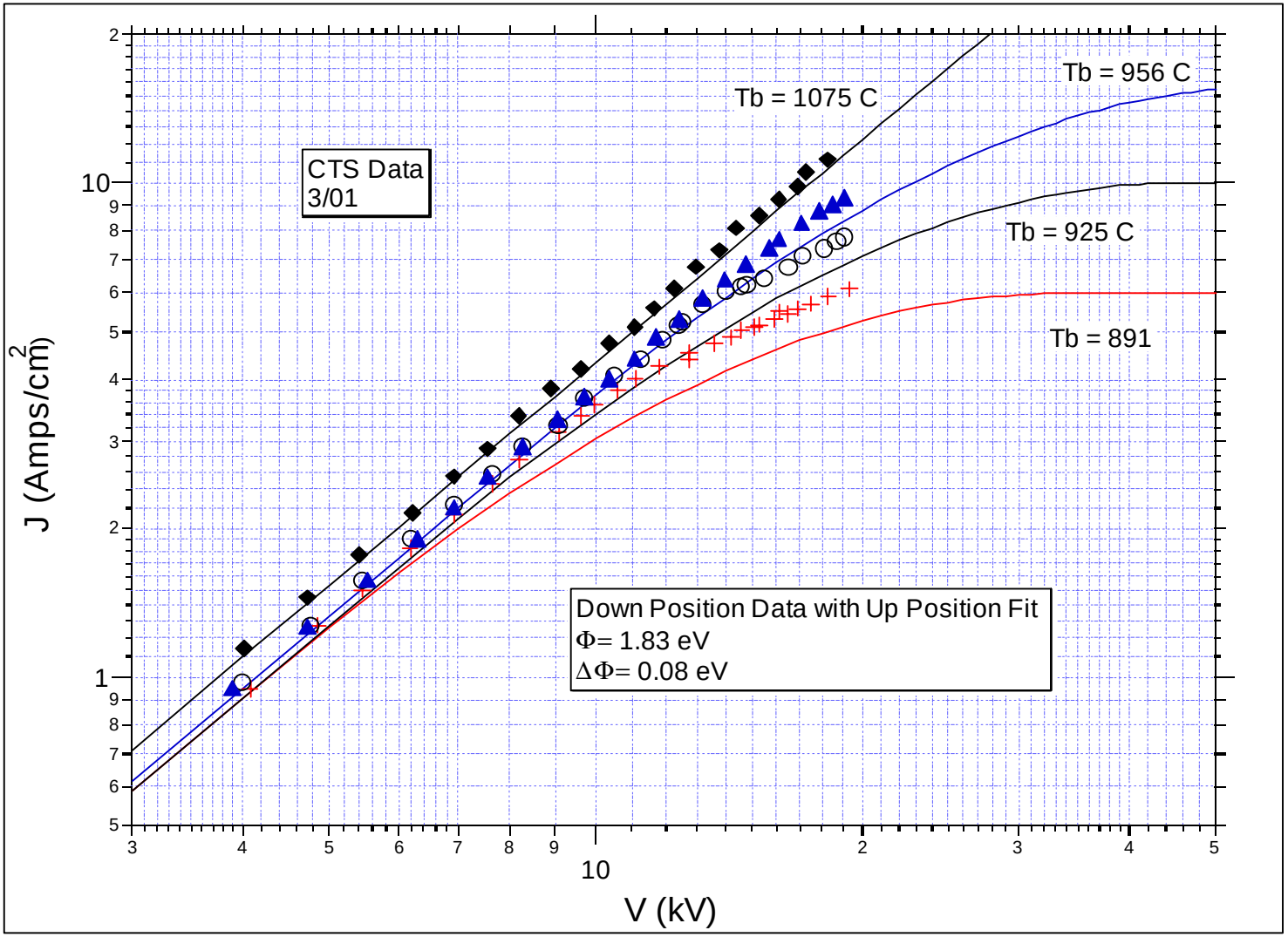
The model predictions are sensitive to both the average value of the work function and the rms width of the distribution.



A single work function distribution fits all the I-V curve data taken at various temperatures.



A slightly higher work function with a larger rms spread fits the up position data where the cathode is cooler and has a larger temperature variation.



The work function parameters from the up-position produces a poor fit for the down-position data.

SUMMARY

- Thermal imaging of an 8” and 6.5” cathode has been performed.
- A dual heater design was only moderately successful in making a uniform temperature profile.
- A non-axisymmetric cold spot is created where the filament enters and exits the cathode.
- A unique diagnostic has been developed to study the current emission uniformity of large thermionic cathodes.
- Emission has been studied from the FSCL regime to the TL regime over a range of cathode temperatures.
- A model that uses a work function distribution function fits the data very well. A work function of about 1.8 eV produces the best fit to the measurements. The rms spread of the work function is correlated with the measured temperature gradients.