Long, JA (Judy)

From: Swinyard, BM (Bruce)
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To: Long, JA (Judy)
Subject: Tech Note 002248 Temperature Drop during CQM Test2

SPIRE-RAL-NOT-002248 Temperature Drop during CQM Test2 13/12/04

Scope
This note reports the analysis of the detector loadcurve data taken during the CQM Test2 thermal balance test with various L0 temperature settings. The thermal test procedure is described in REFERENCE1 and the method of taking the detector loadcurves in REFERENCE2 (and in the text).

Data
Loadcurves were taken on the 15 September when the L0 temperature had been set to a given value using the GSE heater. The values of the heater power and consequent temperatures are given in table1. For all loadcurves the bias frequency was set to 70 Hz and the LIA phase zero'ed at a bias of 32 mV. The raw detector laodcurve data are stored in FITS format at:

http://scott1.bnsc.rl.ac.uk:8080/hcss/test_area/CQM2%20Data/Load%20Curves/AC/

The individual file prefixes are as given in Table 1.

Table 1: Basic case definitions and data files used for detector temperature analysis

Parameter	Case #1	Case #2	Case #3
Heater on L0 Photometer Enclosure	10 mW	5 mW	0 mW
L0 Photometer Temperature at PLW IF	2.345K	2.066K	1.740K
L0 photometer Enc at strap IF	2.101K	1.938K	1.764K
L0 Spectrometer Enclosure at A frame	1.867K	1.782K	1.695K
Loadcurve Data Prefix	cqm2_lc_1509_1836_1904	cqm2_lc_1509_2005_2033	cqm2_lc_1509_1642_1710

The detector data used for determination of the temperature consist of the recorded voltage across the detector from the LIA outputs (denoted "signal" from hereon) and the applied bias. The signal is a combination of the 16-bit ADC output and the 4 bit offset out; the bias is taken as the commanded value. Both bias and signal are read from the FITS files and converted to mV using the IDL programme COLDLOAD_GP. The gains for the signal conversions are taken as the conical LIA gains; the bias is converted assuming a full scale total output of 140 mV in 255 steps.

Loadcurve Analysis
The IDL function PLOAD was used to extract the power versus temperature and zero point temperature from the low current part of the loadcurve [1]. The analysis includes a first order correction for the bias and signal roll off due to the cable capacitance, this was always a small correction for the bolometer impedance and bias frequency used. In order to verify that the analysis gives reasonable numbers I plot dP/dT versus temperature and compare this to the prediction from the JPL Bodac calibration in figure 1. The temperature derivation is taken from the JPL values for R_0 and Δ. We can see there is reasonable agreement except at the low bias (i.e. low temperature and power) part of the curve. The reason for this and the deviation of some detectors from the JPL calibration requires further investigation, however we can have some confidence that the temperature values derived are correct.

The minimum temperature – i.e. the zero power temperature – is plotted by detector in figure 2. I have compared this to the temperature derived using the slope of the load curve over the first few bias settings - the values agree on average to within 0.6 mK.

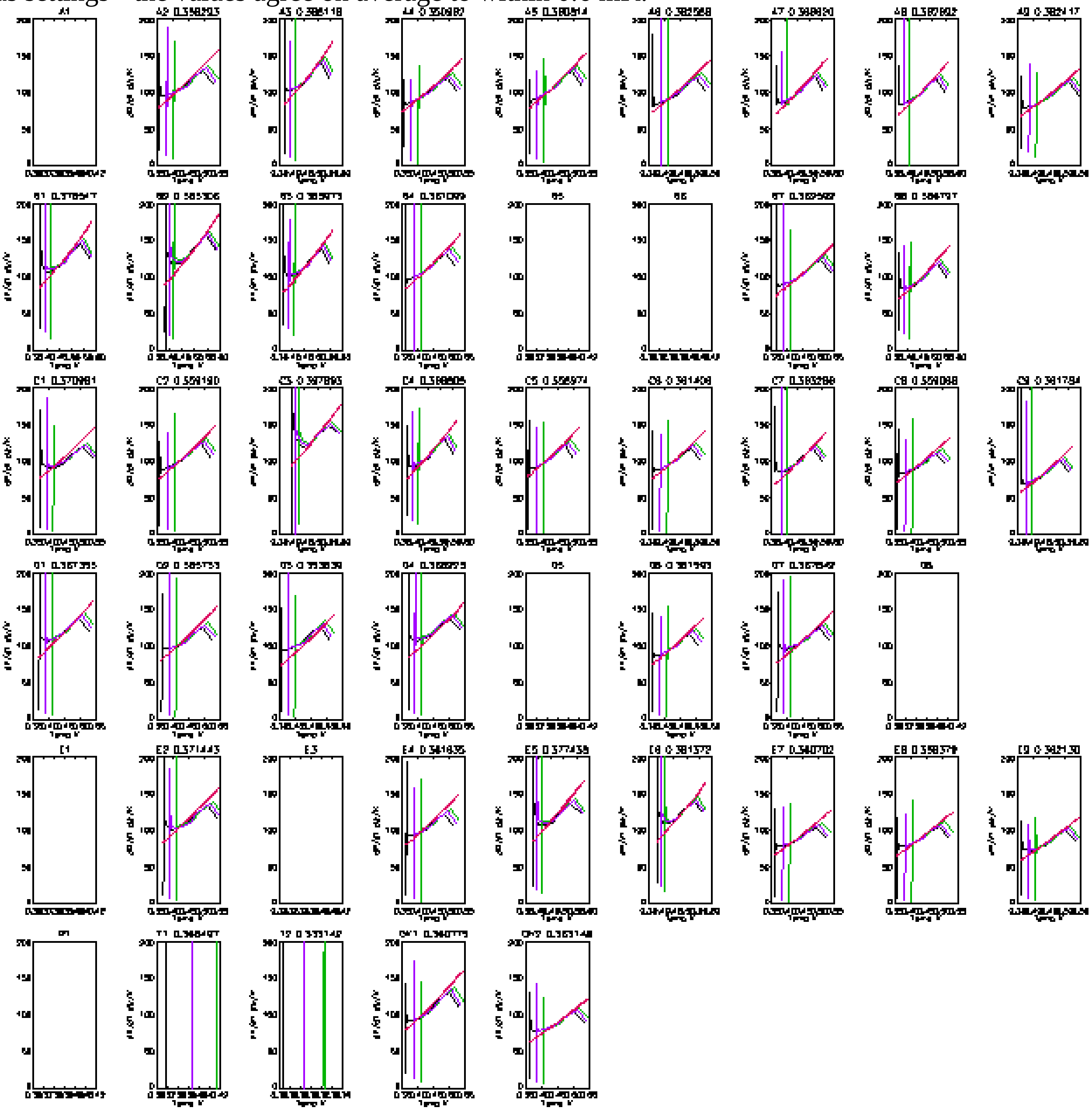

Figure 1: Conductivity of bolometers expressed as dP/dT versus temperature derived for the loadcurves taken during the three thermal test cases (black, purple and green) compared to the G value derived from the JPL BoDac calibration (red).

Evaporator Temperature

The temperature of the evaporator is recorded in the housekeeping (SubKTemp). The IDL procedure SUBKT was used to convert the raw values to temperature using the conversion curve provided by Dave Smith. The procedure fits a 4th order polynomial to the first 6 values in the conversion table and using the coefficients to calculate the temperature. This is a different method compared to the SCOS conversion and therefore the evaporator temperature reported here is slightly different to that reported in the thermal test report (see table 2). The conversion table values of interest are given in the appendix.

The temperature difference between the evaporator and the PLW detectors is shown graphically in figure 3. The dark pixels (TDK1 and TDK2) appear to show consistent values and, in particular, TDK1 gives a value for the temperature that is always close to the median for the array. The median array temperature and temperature difference between the array and the evaporator are given in Table 2 together with the estimated loads on the evaporator derived from the cooler parameters (see REFERENCE3).

Table 2: Temperatures and estimated cooler loads during the thermal test cases

Parameter	Case #1	Case #2	Case #3
OS value for evaporator ıperature [mK]	286.2	282.2	277.2
BKT value for evaporator ıperature (mK)	285.6	280.6	274.2
x Total Evaporator Load /]	40	33	26
ı Total Evaporator Load /]	36	29	24
dian Array temperature	407.3	385.0	361.6
imated Temperature ərence to detector nearest mK)	122	104	87

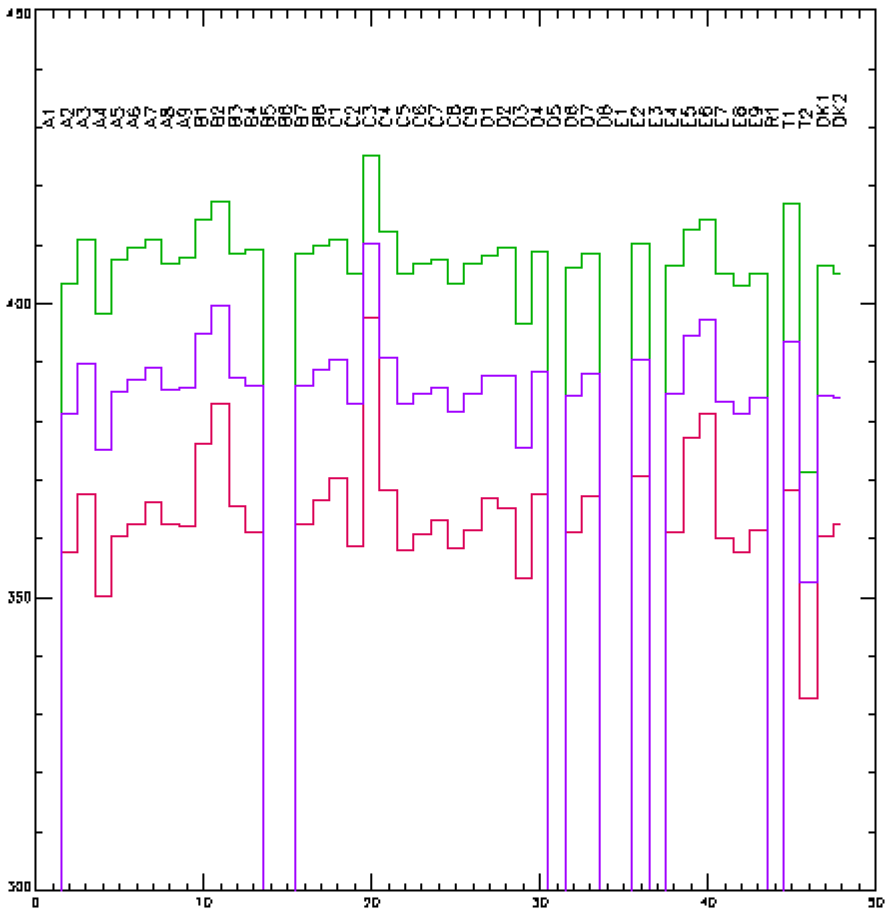

Figure 2: Calculated zero power temperature for each detector for the three cases. Case #1 green; Case #2 purple; Case #3 red.

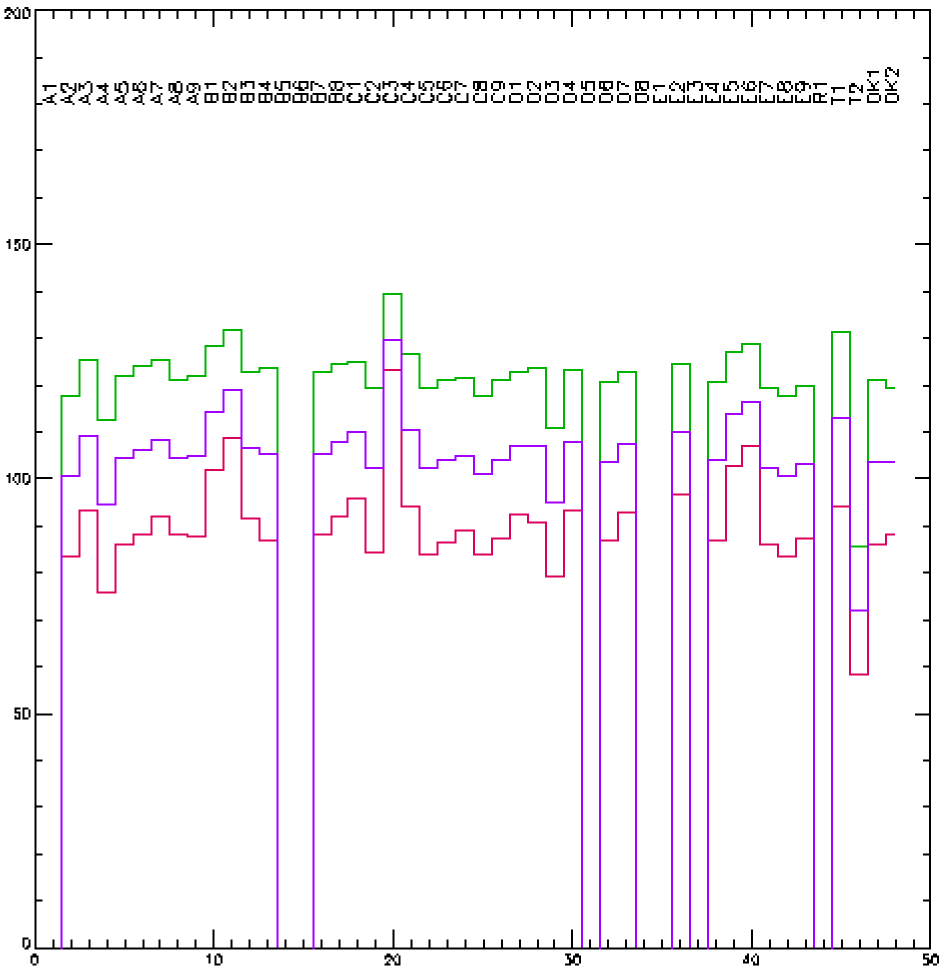

Figure 3: Calculated temperature difference between evaporator and array for each detector for the three cases. Case #1 green; Case #2 purple; Case #3 red.

Appendix

Conversion curve values from raw data to temperature for the CQM evaporator Cernox thermistor

16139	0.260373
21061	0.290862
23241	0.310719
24680	0.329311
26680	0.368686
28221	0.415666

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[1] The full algorithm used for loadcurve reduction will be described in a separate note TBW.