Photometer detector temperatures derived from loadcurves during PFM2 Test Campaign

Data used for the analysis

Loadcurves were taken at regular intervals during the campaign to assess both the instrument performance and as a measurement of the temperatures of the detectors for the different thermal cases. Here I give the analysis of four loadcurves taken under nominally dark conditions – i.e with the CBB at 6.4 K – this only affects PLW significantly. Table 1 gives the details of when the loadcurves were taken, the bias frequency and whether all JFETs were on or not. The latter is significant as it was found that some JFETs did not self start due to too few channels being connected to the LIAs. This caused power to be dissipated on the focal planes raising the temperature of both the BDAs and the evaporator.

The data were analysed in the standard manner using the EIDP data provided by JPL in plw_eidp6a; pmw_eidp10 and psw_eidp9. The analysis now includes removal of the gain variation due to the bandpass filter on the LIA channels. The gains were checked by comparing the derived conductance with the JPL predicted "G" – this was in good agreement for all three arrays except where there was anomalous behaviour due to increased thermal capacitance (see next section). JPL have issued a caveat on the PSW and PMW EIDP data as there was some mix up in the analysis of the BDA level tests – when the EIDP's are re-issued I will recheck the temperatures quoted in this note.

Table 1: Details of the loadcurves used in the analysis.

OBSID	File Prefix	Description of measurement	Date/Time	Plot Colour	SubK Temp	PLW T2	PMW T1	PSW E7
0x3000C29D	lc_1909_0x3000C29D	70 Hz data with CBB off not all JFETs on	19th September 20:04	black	0.2886	0.2830	0.3037	0.2933
0x3000C2AC	lc_200905_0x3000C2AC	70 Hz data with CBB off not all JFETs on	20th September 08:33	green	0.2884	0.2829	0.3033	0.2931
0x3000C39F	lc_270905_0x3000c39f	70 Hz data with CBB off not all JFETs on	27th September 10:03	purple	0.2890	0.2841	0.3046	0.2943
0x3000C138	lc_0809_1356_1426_	70 Hz data with CBB off all JFETs on	8th September 13:56	red	0.2905	0.2881	0.3109	0.3018

"Helium" Problem

It has been noted that the detectors had a very slow speed of response. One probable cause for this is that Liquid Helium was present on the detector absorbers causing a change in the detector heat capacity. When the same problem occurred during CQM testing the diagnostic was that the V-I behaved strangely at the highest bias settings. Figure 1 shows examples of loadcurves (plotted as volts across the bolometer versus bias) for the three arrays for the four cases. Only in the very first loadcurve taken during the test campaign to we see nominal behaviour in all three arrays. It seems that the film grew in each period following a cooler recycle; affecting PSW worst (and first?) followed by PMW and PLW. There is evidence that following each recycle the situation recovered to certain extent. Note that even in the worst case (green) the high impedance (low bias) part of the loadcurve is unaffected giving confidence that the temperature measurement is also unaffected.

Temperatures

Figure 2 shows the temperatures for each of the operational pixels – representative temperatures are also reported in table 1. Note that for PLW the BDA temperature is apparently lower than the evaporator temperature. This is clearly wrong and there is either a calibration error in the JPL provided values for the BDAs or with the calibration of the SubK Cernox thermistor. Checking the calibration curve for the Cernox we find that only a few values cover the critical range – see table 2 – and, what's more, the SCU readout circuits are only calibrated to 150 kΩ whereas this thermistor is at around 160-170 kΩ. Given the large range of resistance values and few data points covering the critical part of the temperature curve and the lack of calibration for the SCU over this same range, however a temperature of around 288 mK is correct for the 48 Hr holdtime we saw during testing and is consistent with what Lionel found during the cooler testing in Grenoble.

As a check that something makes some sense I plot the reported BDA temperatures versus the reported evaporator temperatures in figure 3 – the trend appears consistent across the arrays and, except for PLW, the delta T also appears to be constant(ish). More investigation required…..

Table 2: Evaporator Cernox Calibration data

Temp (K)	Resistance (Ω)
0.260627	270457
0.289219	157819
0.309679	115822
0.330457	89836
0.367734	59116.2
0.418493	37414.4
0.47655	24824.8
0.534421	17949.2
0.608538	12838.4
0.684954	9743.5
0.765752	7704.6
0.854438	6177.2
0.950501	5075.94
1.04994	4266.7

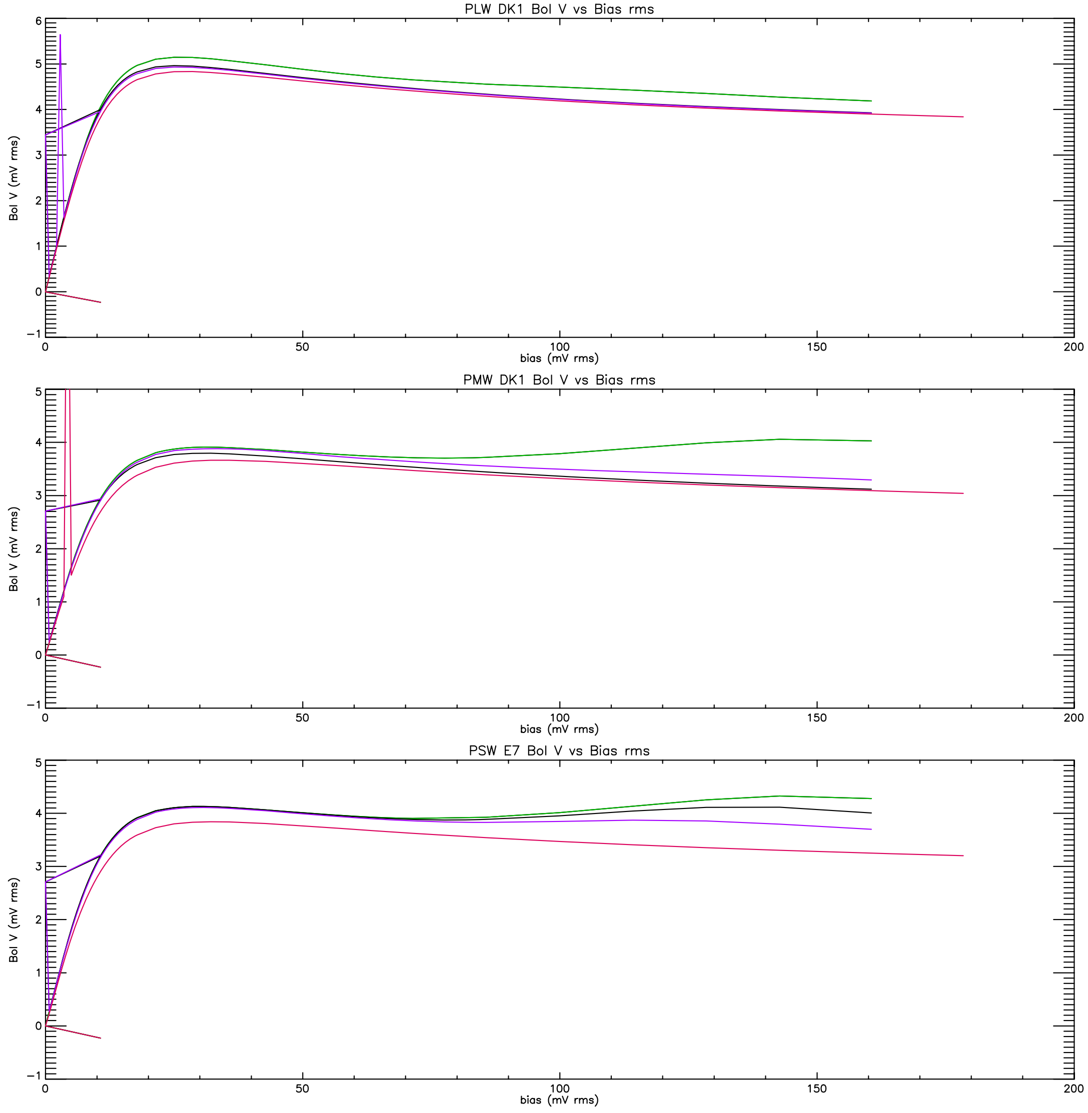

Figure 1: Examples of loadcurves for each of the three arrays (PLW; PMW and PSW in order down the page). For PLW and PMW dark pixels are shown, for PSW there is no optical load so one of the central pixels is shown. The red curve is the first loadcurve taken during the campaign and can be taken to represent nominal behaviour. The other curves appear to be affected by liquid Helium deposited on the absorbers.

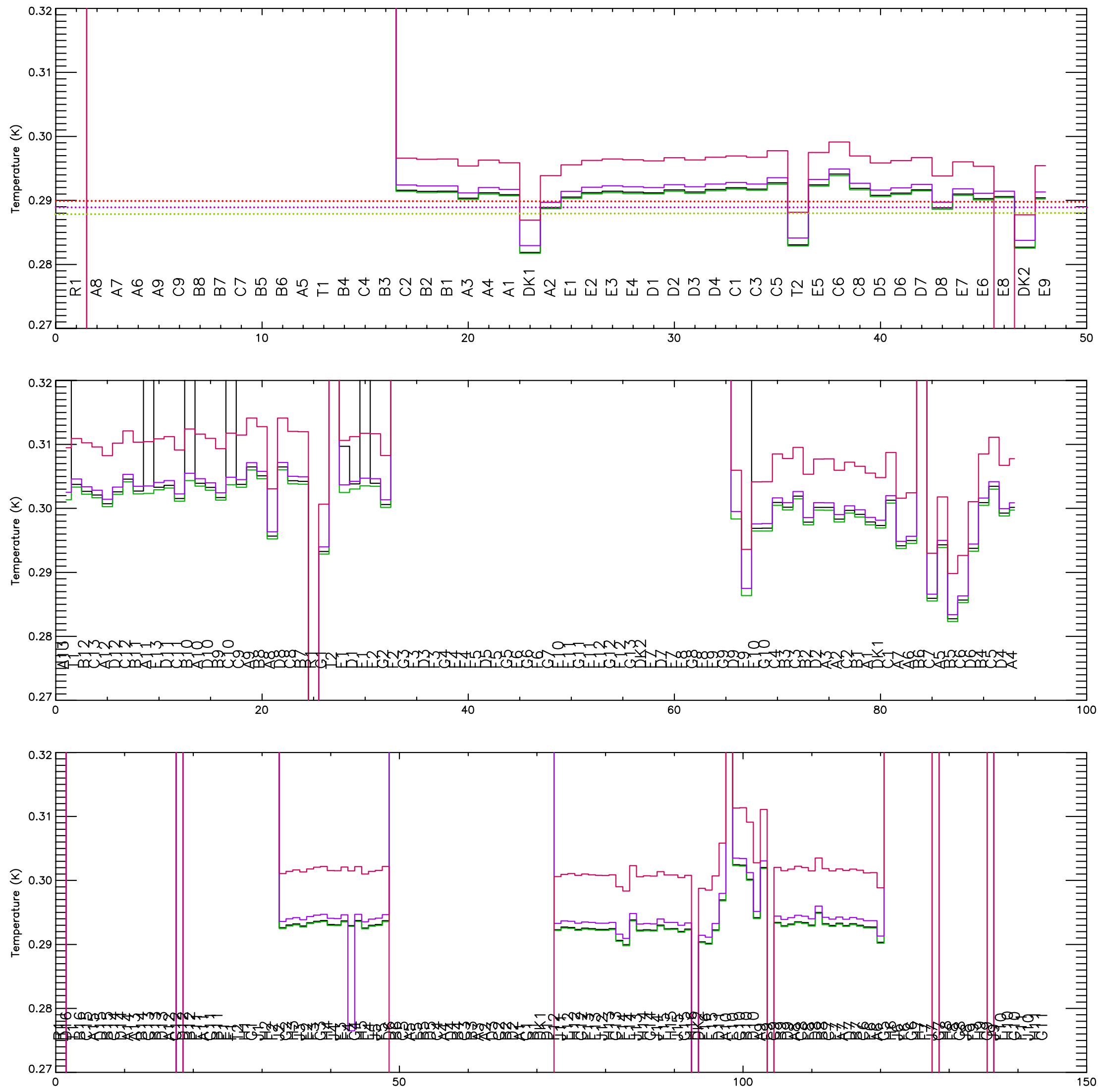

Figure 2: Temperature of each of the working pixels in each BDA (PLW, PMW and PSW down the page) derived from loadcurves on 8/9/05 (red); 19/09/05 (black); 20/09/05 (green) and 27/09/05 (purple). The three horizontal lines on the PLW plot are indicative of the reported evaporator temperature during three cases – colour coding the same.

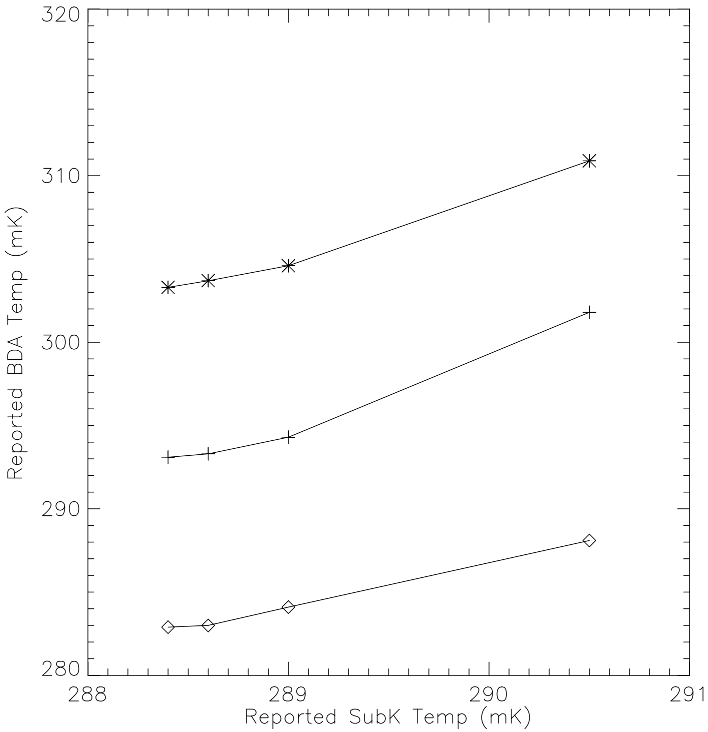

Figure 3: Reported BDA temperature versus reported evaporator temperature for the three BDAs for each of the four cases. PLW is diamonds; PMW is stars and PSW is crosses.

Spectrometer Detector Temperatures during PFM

Data used for the analysis

The spectrometer detectors were turned on for short periods at the end of the PFM2 test to allow their functionality and the operation of the SMEC to be verified. I have taken two loadcurves from 22/9 and 23/9 as detailed in Table 2. These loadcurves both exhibit the same anomalous "helium" problem as seen in the photometer data with the data taken on the 23rd being somewhat more affected that that on the 22nd.

The data were analysed in the standard manner using the EIDP data provided by JPL in ssw_eidp9 and slw_eidp14. The analysis now includes removal of the gain variation due to the bandpass filter on the LIA channels. The gains were checked by comparing the derived conductance with the JPL predicted "G" – this was in good agreement for both arrays except where there was anomalous behaviour due to increased thermal capacitance as was seen in the photometer (see previous section).

Table 2: Details of the loadcurves used in the analysis.

OBSID	File Prefix	Description of measurement	Date/Time	Plot Colour	SubK Temp	SLW T1/T2	SSW T2
0x3000C365	lc_220905_0x3000c365	70 Hz data with CBB off	22nd Sept 19:28	black	0.2884	0.2986 0.2999	0.2995
0x3000C386	lc_230905_0x3000c386	70 Hz data with CBB off	23rd Sept 18:08	green	0.3019	0.3395 0.3415	0.3414

The temperature for each of the live bolometers (only half of SSW was seen to be working) are plotted with the evaporator temperature in figure 4 below.

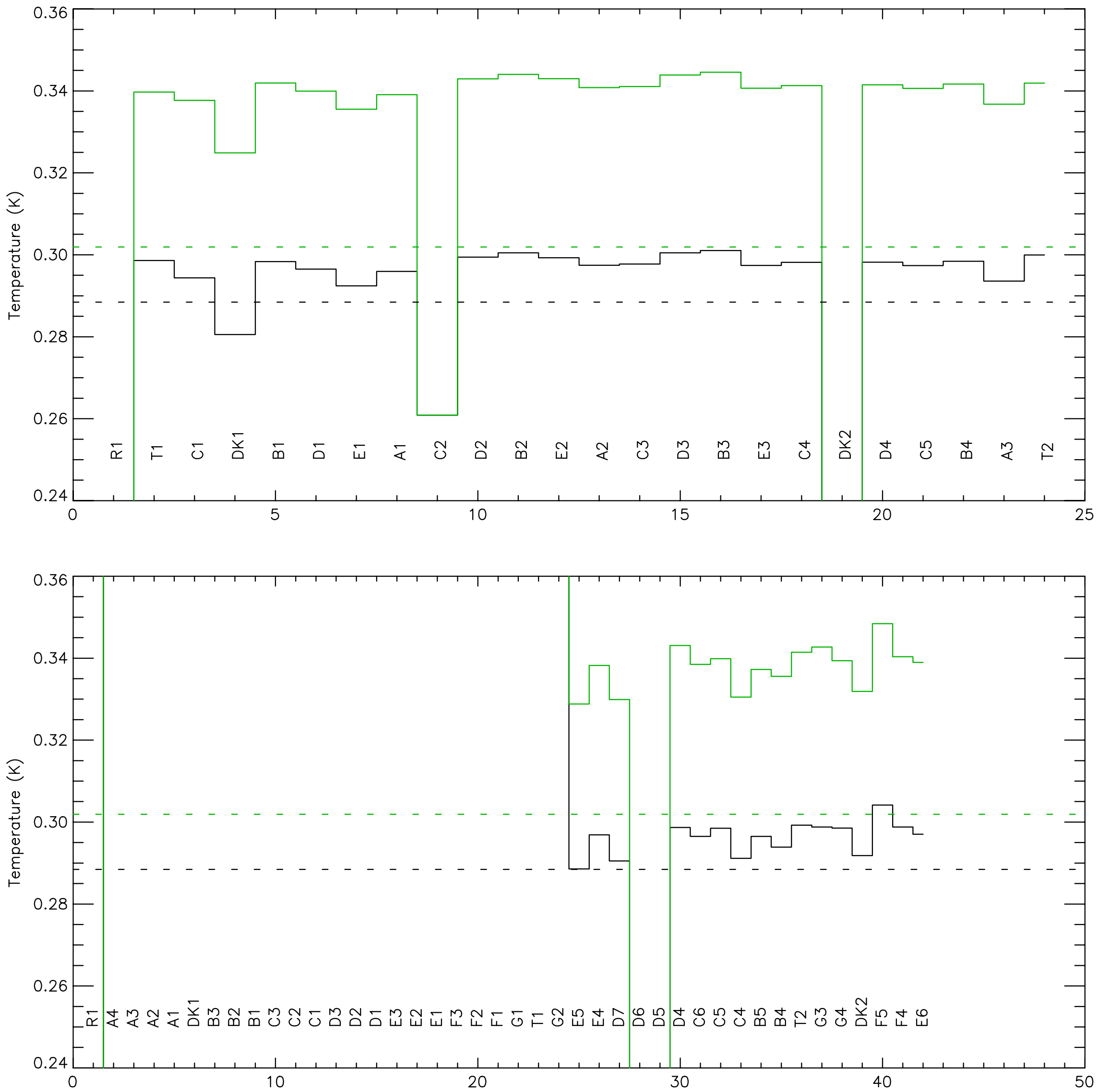

Figure 4: Spectrometer detector temperatures taken on the 22/9 (black) and 23/9 (green) plotted together with the recorded cooler evaporator temperature (dotted line). In SLW pixel C2 was not operational during this test; this is to be investigated. In SSW pixel D5 was recorded as non operational on delivery. Pixels SLW-DK2 and SSW-D6 have no parameters entered into the EIDP and therefore appear as 0 in this plot.