Summary of Dark Measurements on VISTA During Final Testing

Observations:

1. A series of dark-current measurements was taken overnight on 11th September 2006 as the Camera was cooling down. The longest (1 hour) exposures showed that the ongoing cool-down was still affecting the measurements, so these were rejected and repeated the following night.
2. A cross section through detector #42 (readout position 4C, detector with two chips on top edge), now shows a typical count of ~125ADUs in a 1-hour exposure. This corresponds to an instrument background that is well within specification. This compares to the equivalent count rate seen in just 1 minute during AIT4d compared to 1 hour now, so the excess background issue appears to have been resolved by the new fence. There is no clear preferred orientation to the residual signal, unlike the AIT4d images which showed a clear gradient from top to bottom (i.e. brighter towards the filter wheel hub) in less than 1 minute of exposure time.
3. Looking at the sequence of dark current exposures, it appears that single integrations are not optimal for determining the true dark current/internal background levels due to possible bias level drifts during very long exposures. A series of 1-hour dark frames was taken using the img_cal_dark template, rather than the img_cal_darkcurrent template, with DIT set to 60s and NDIT set to 60 co-adds. In these frames, the typical count rate seen in detector #42 is indistinguishable from zero. This might imply that if dark-current calibrations are to be made up to long exposures, then co-adding data is likely to give a much more robust result than single DCS stares.
4. Looking across the top row of detectors, the observed image pattern is completely dominated by the known dark current structures in detectors #30 and #43. There is no evidence for any global gradient. The worst signal is from Module 30 which is around 1700 ADUs in 1 hour, or roughly 2.5 photons/pix/s
5. Looking at the rest of the array, a feature was noticed which appeared to be in common among a number of the detectors. This takes the form of a bright arc at x=1500,y=500 (local pixel coordinates) on each detector, as shown in the image opposite from detector #42. On the initial images this was only found to affect detectors 1, 3, 6, 8, 9, 11, 14 and 16. These are the 8 detectors whose temperatures are being measured by default. It was decided to continue the cold run over the week-end and repeat the measurements with the sensors swapped to the alternate set; this demonstrated that the arcs moved to the other 8 detectors as expected. The conclusion is that this emission is generated by the on-chip temperature diodes when they are in use. The peak signal level is around 500 ADU in 1 hour, or ~0.7 photons/pixel/s.

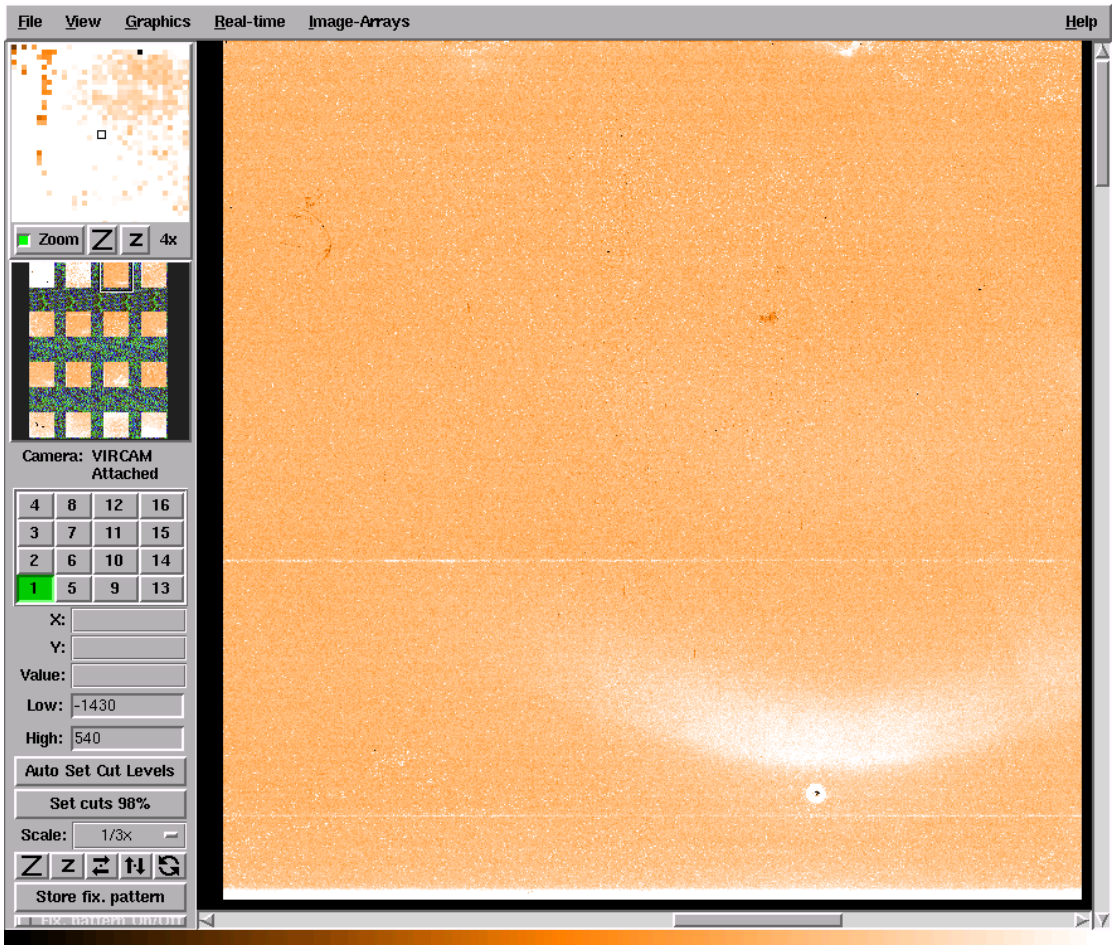
Conclusions:

1. There is no significant residual background from the region of the camera behind the filter wheel.
2. Long dark calibration images should be taken as a series of co-adds of short integrations, NOT as long single DITs.
3. The main residual source of stray emission seen by the camera other than detector dark current is due to the temperature sensors built into the detectors themselves. This is at a low level, and would require substantial intervention to remove. Possible options are:

a. Ignore the effect as it is well within specification;
b. Invite RVS to visit and modify each module underneath the PCB cover;
c. Modify each module underneath the PCB cover without RVS;
d. Abandon the on-chip diodes and install other diodes with suitable covers and additional wiring out through the FPA to the cryostat feed-through.

Optionsl b, c, and d should be considered risky and expensive.

4. Modules 30 and 43 show the highest overall dark current. A final test will be to take further images with the detector temperatures reduced from 72K to 65K to see if there is any room for compromise (there will be a trade-off with quantum efficiency). Further tests will be needed on this trade-off at Paranal, as on-sky measurements will be required to assess the q.e. effects in detail.



Residual image of Detector #42 showing the glow of the temperature diode. Peak count level is around 600 counts with a background of around 0.

G.B Dalton 18.09.06