Delivery test of the FIES camera with E2V CCD 231-41 Ser. no. 12234-07-04

1. Gain and linearity

All linearity tests are made with setup scripts “setup_teu” (updated March 7) and “speed_100”, with a detector temperature of -120C. Illumination is an incandescent lamp via an integrating sphere.

Output	**Gain**	**RON**	**Linearity deviation P-P**
A	0.155 e-/ADU +/- 0.003	3.98 e- +/- 0.22	1.5% 100e - 100ke
B	0.151 e-/ADU +/- 0.003	3.76 e- +/- 0.10	1 % 100e - 100ke
C	0.150 e-/ADU +/- 0.003	3.88 e- +/- 0.08	1 % 100e - 100ke
D	0.151 e-/ADU +/- 0.002	3.93 e- +/- 0.07	1 % 100e - 100ke

Figures showing count rates per second and gain for each channel are shown below. The main source of scatter in the count rates is likely to be drift in the lamp intensity.

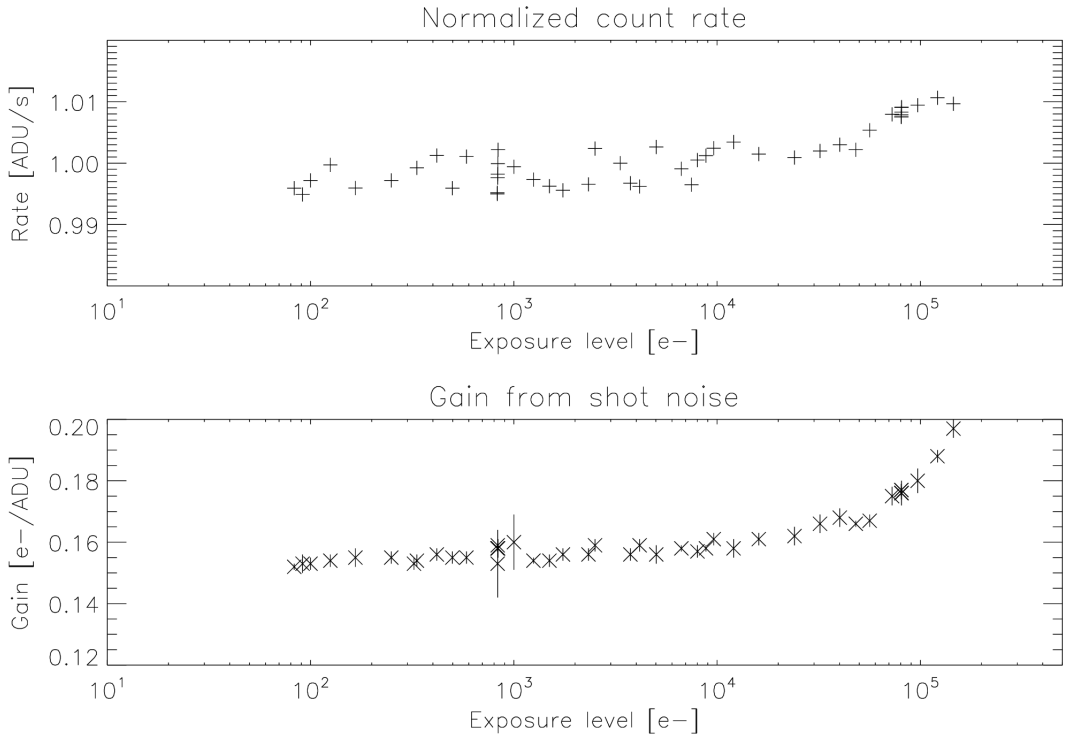


Illustration 1: Output A. Data merged from two sequences at different illumination levels.

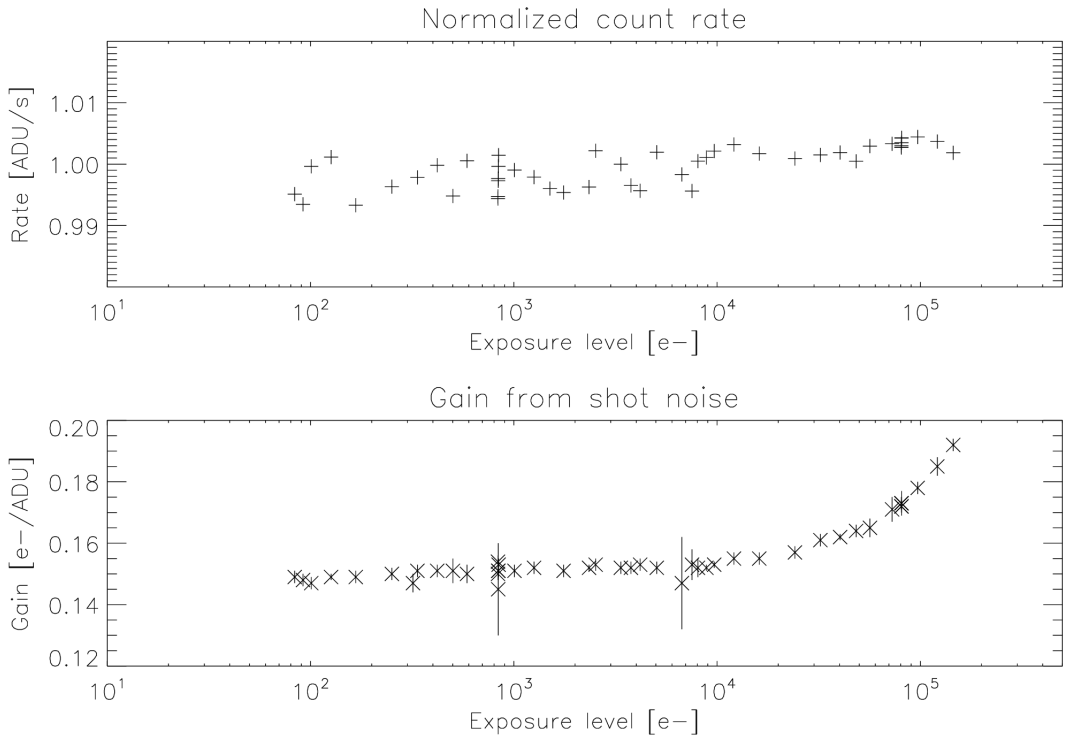


Illustration 2: Output B. Data merged from two sequences at different illumination levels.

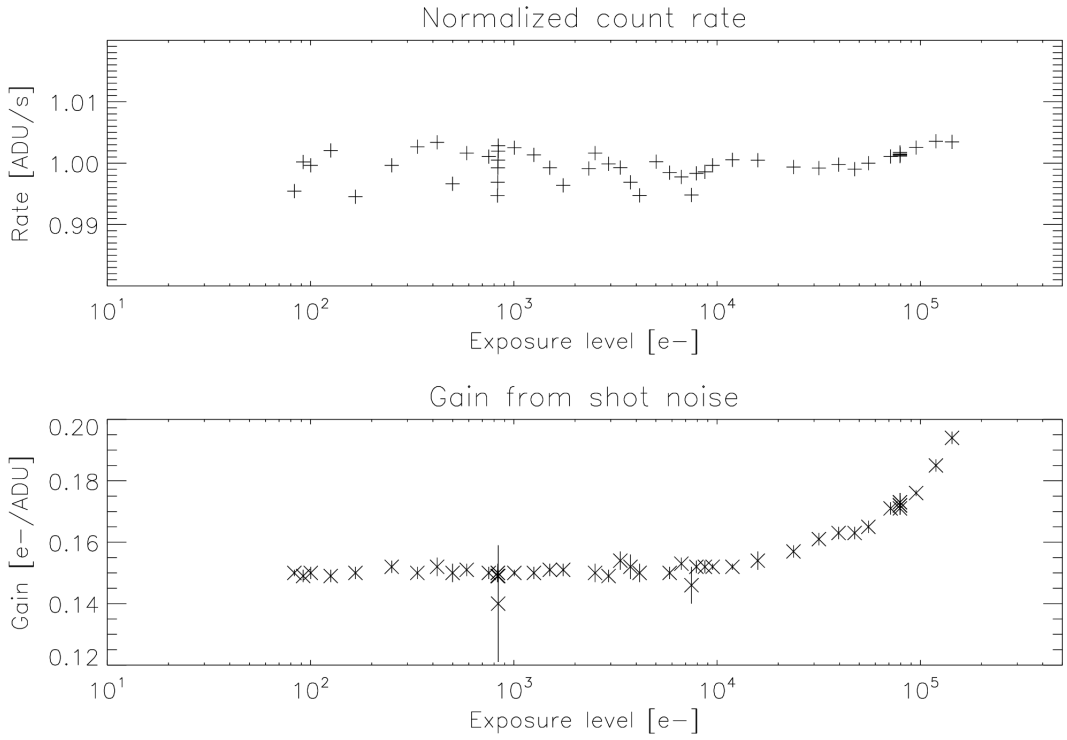


Illustration 3: Output C. Data merged from two sequences at different illumination levels.

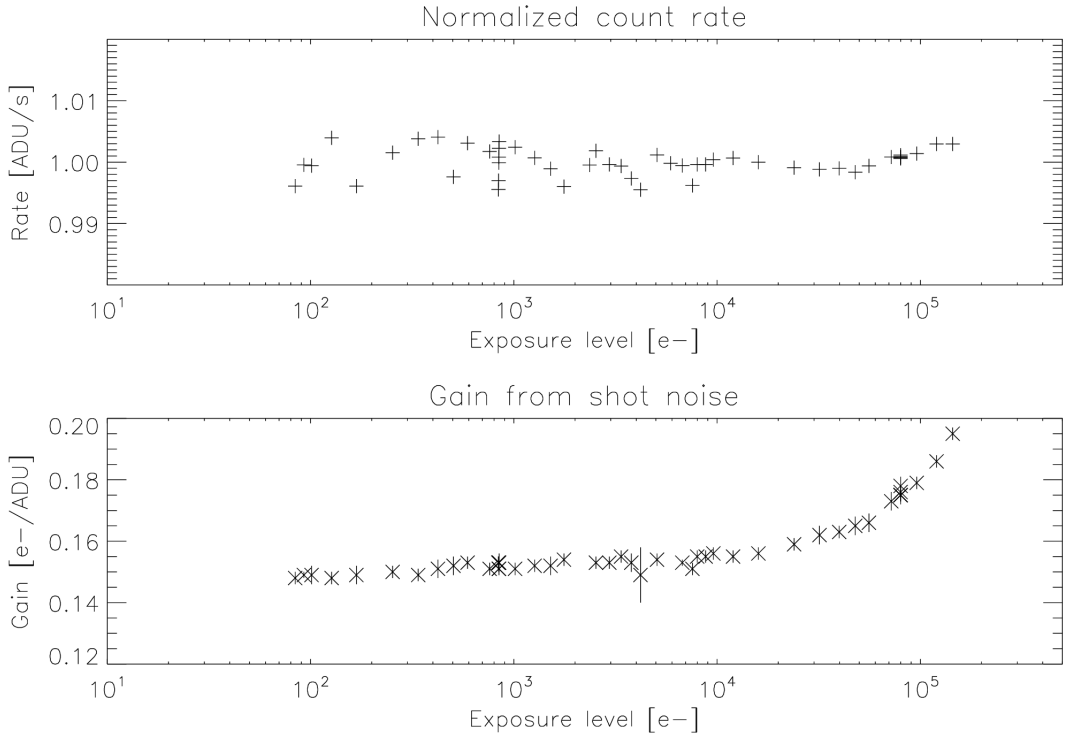


Illustration 4: Output D. Data merged from two sequences at different illumination levels.

2. Flat fields

Flat fields made through 550 and 334nm filters are displayed below. They are compared to similar flats made 10 months earlier.
Some differences are visible:
Due to a slightly off-center position on the test-setup May 2016, some vignetting appears in one corner.
Dust has changed position on the windows.
Stray light reflected off the window edge is not equally suppressed, causing an X-like structure on the 2015 flats and a central blob on the 2016 flats.
Small white points in the ratio image show where dust specks on the detector have been removed since 2015.

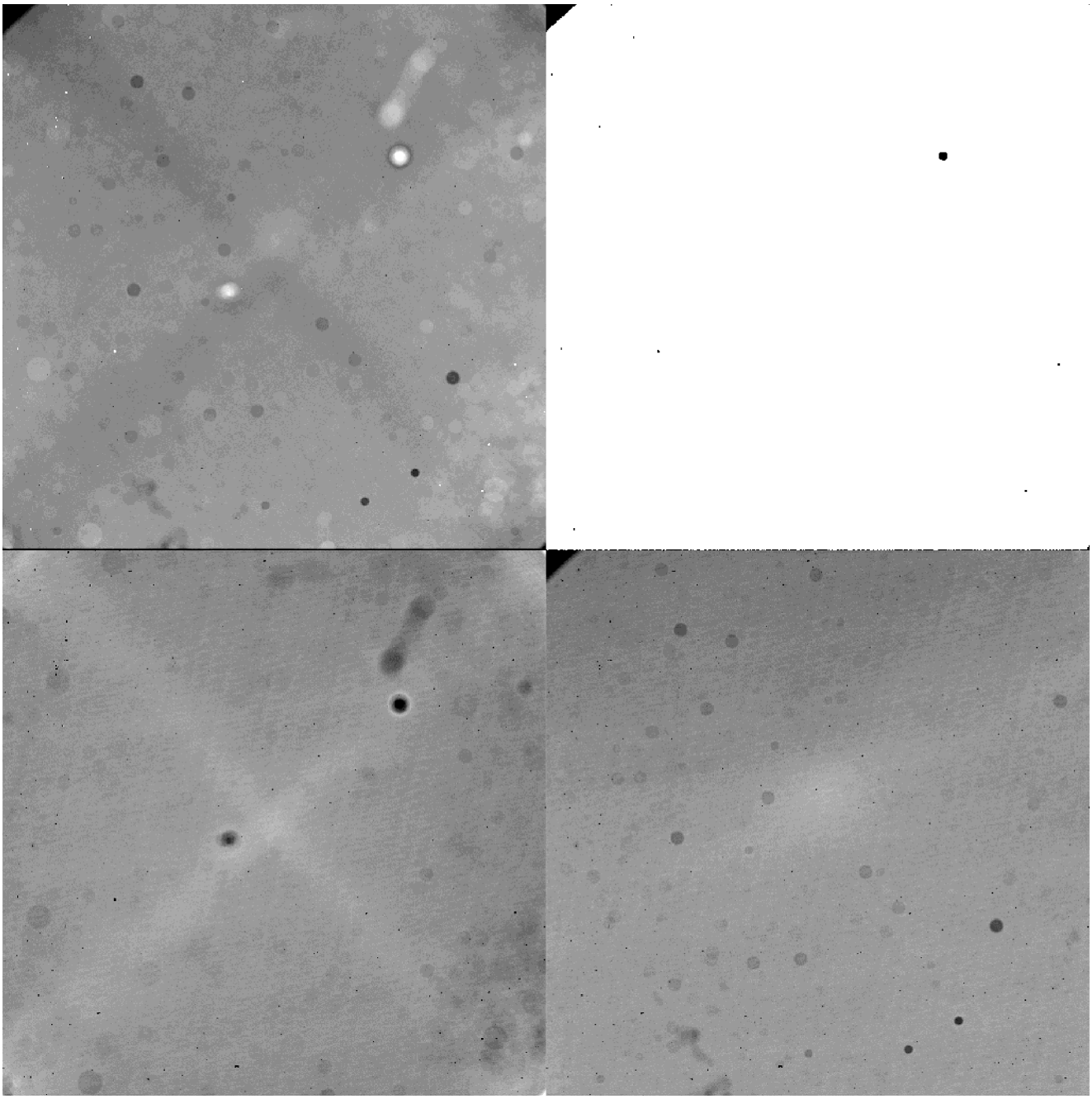


Illustration 5: 550nm flat fields. Lower left: May 2015. Lower right: March 2016. Upper left: Ratio of the two flats. All three displayed with +/- 5% grey-scale cuts.

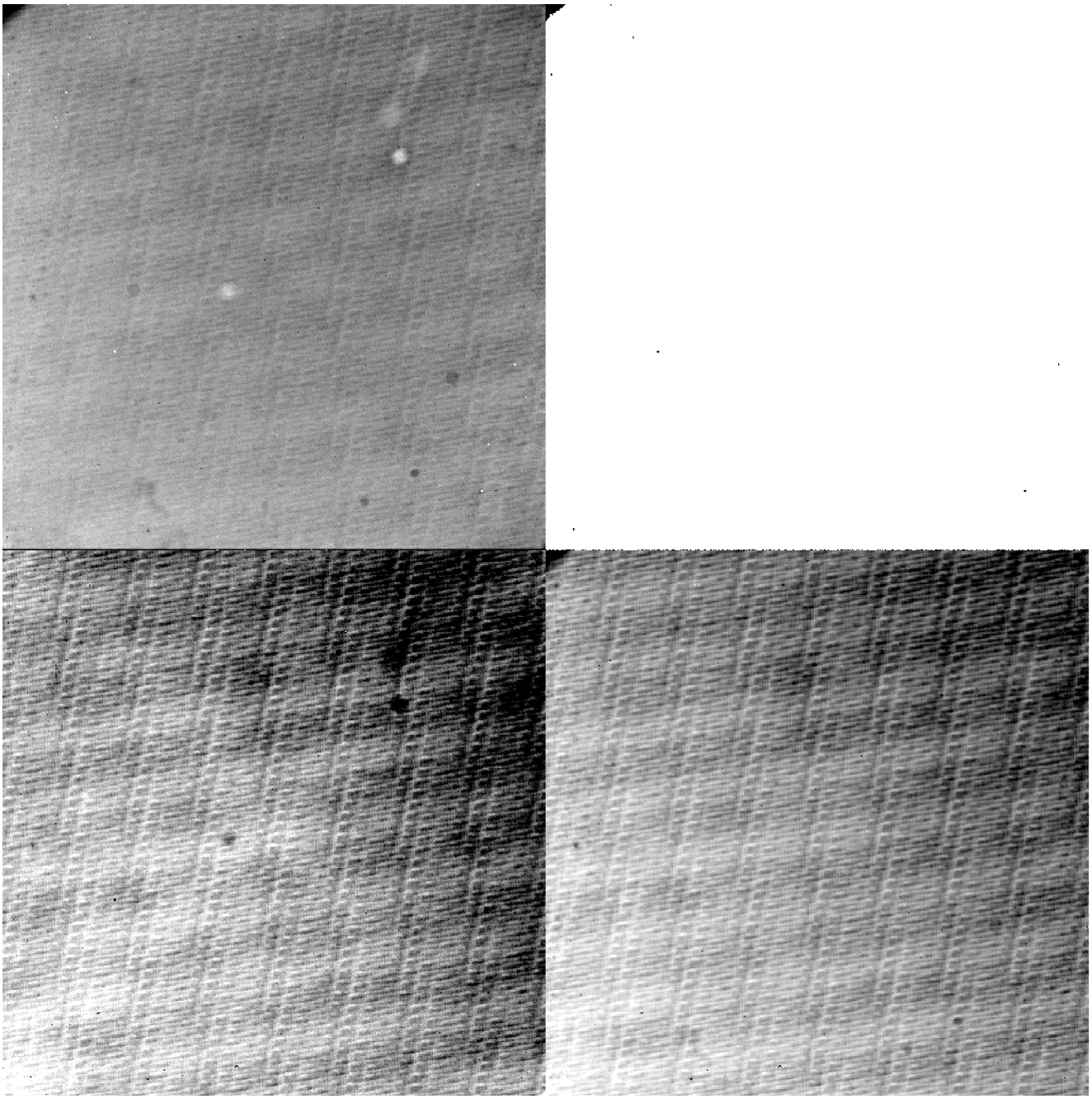


Illustration 6: 334nm flat fields. Lower left: May 2015. Lower right: March 2016. Both displayed with +/- 10% grey-scale cuts. Upper left: Ratio of the two flats, displayed with +/- 5% grey-scale cuts.

A considerable number of small dark spots are visible in the flat field from 2015, and only a few are changed in the 2016 flat field. Inspection from the front suggest that this is particle contamination.

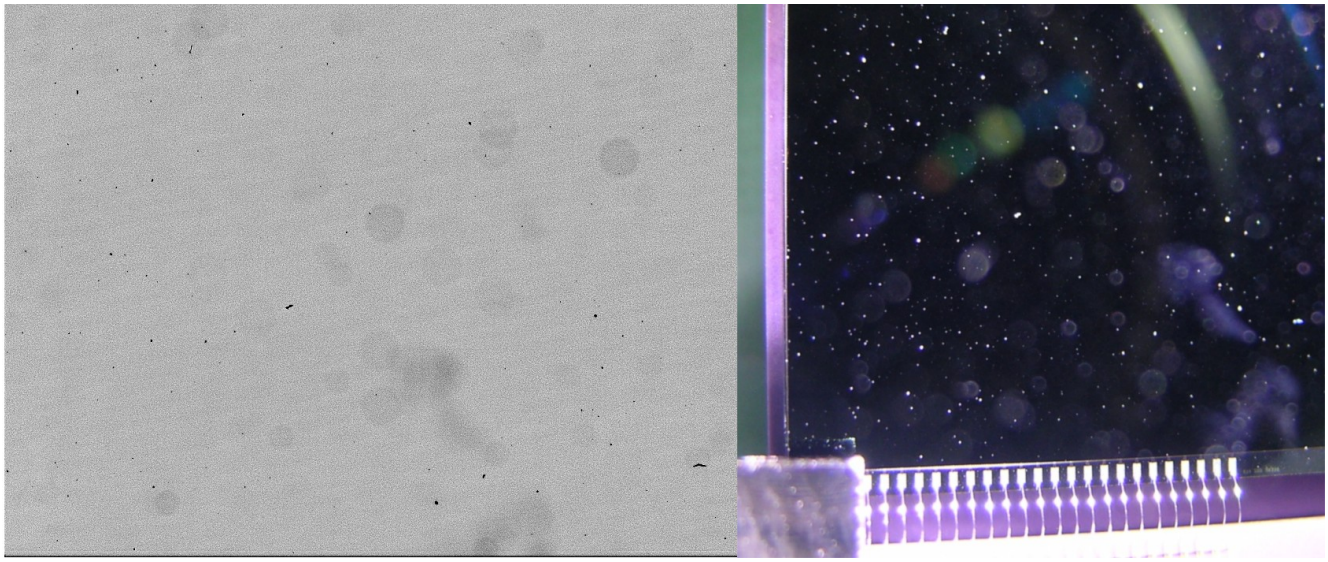


Illustration 7: Left: An approx. 900x700 section of a 550nm flatfield. Right: The corresponding area photographed with oblique illumination.

3. Remanence

A number of sources similar to star images were projected onto the detector and saturated in order to check for remanence. Immediately after the saturated exposure, 10 darks of 100 sec duration each were made. As shown in the image below, a residual can only be seen with difficulty in the first dark. Examining the average level at the position of the three brightest sources only shows a faint indication of a residual in the first dark. However, the bottom five rows show a significant excess count and a glow appears from the lower left corner in the first dark.

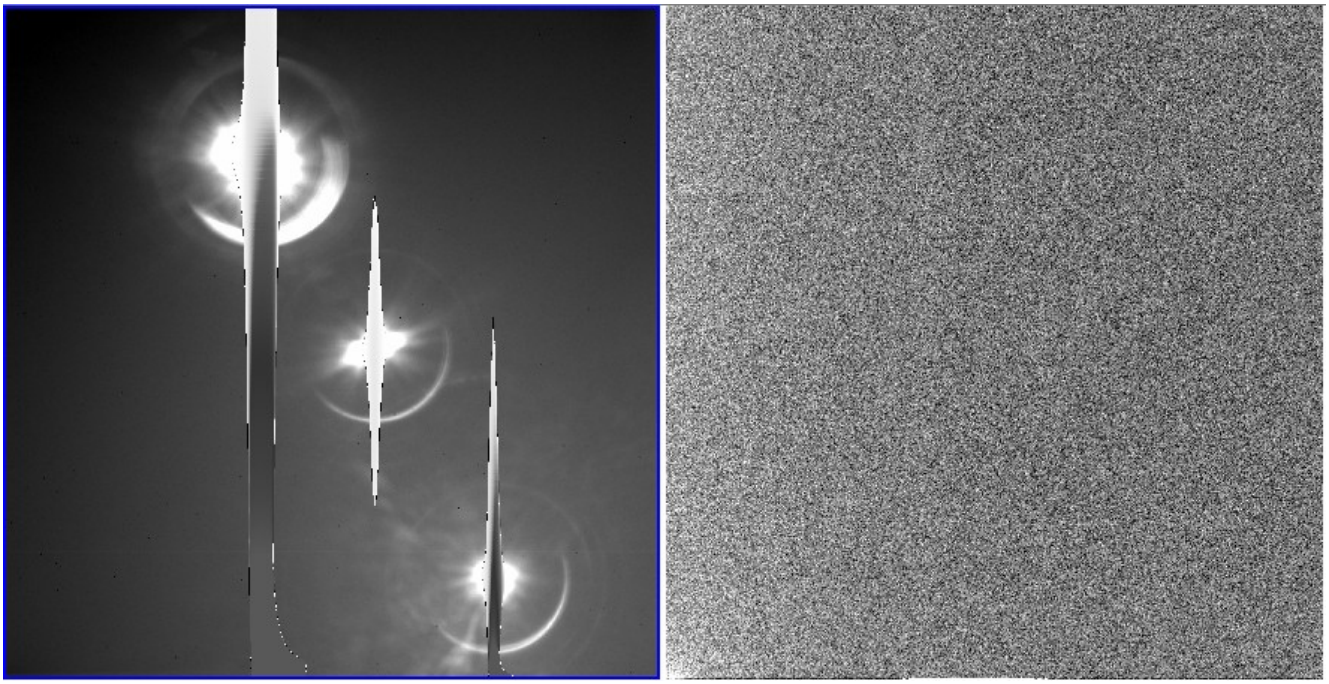


Illustration 8: Left: Saturated exposure. Right: First 100sec dark out of 10.

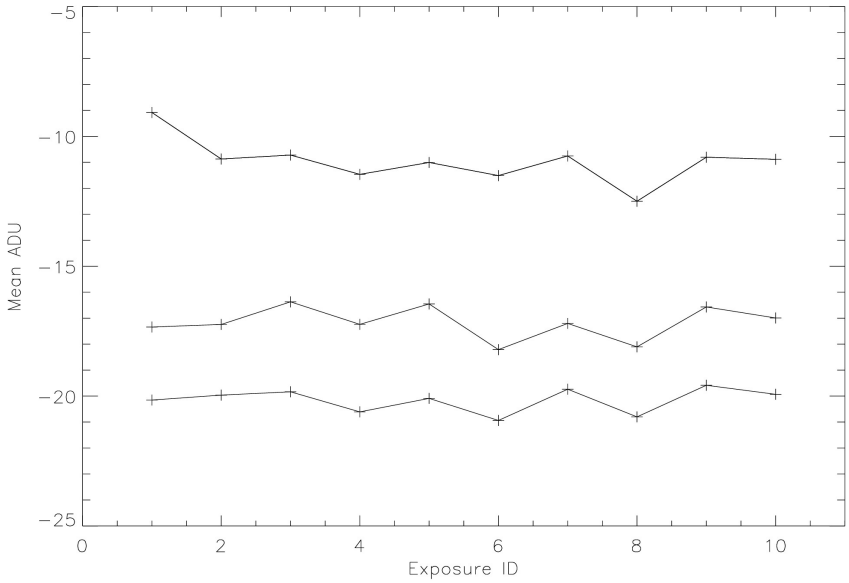
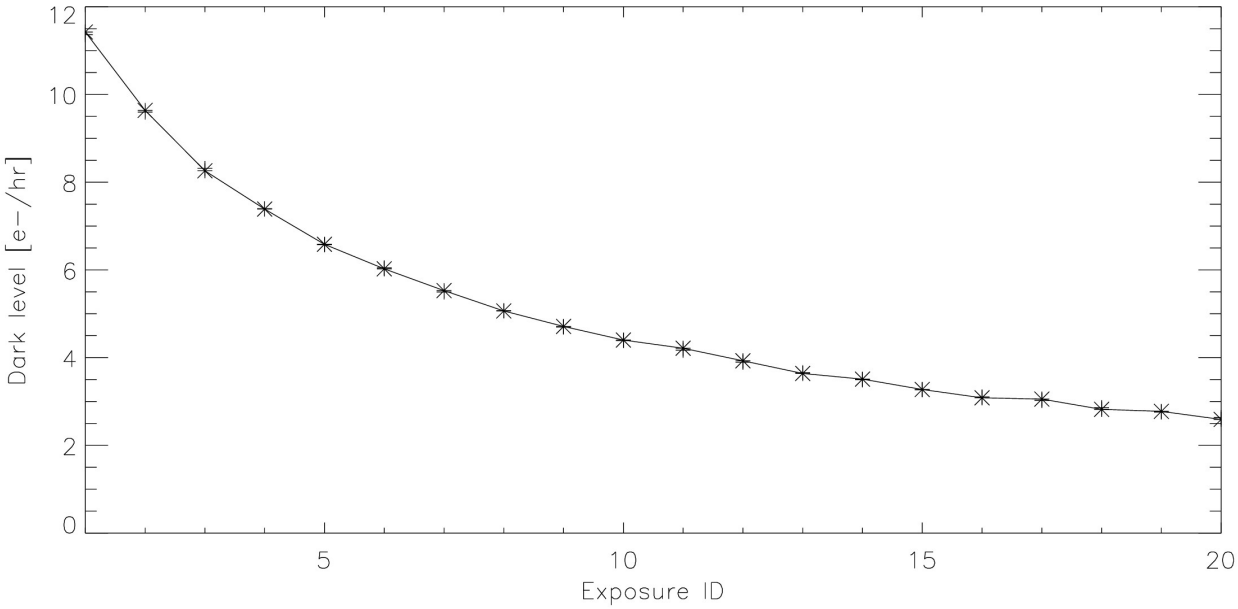


Illustration 9: Average background at the position of the three brightest saturated sources during a sequence of 10 100 sec darks.

4. Dark current

Dark current was measured in a series of 10 half-hour darks.
The declining level indicates a significant remanence. The detector was not strongly saturated before the sequence. As residual from point-like sources appear well suppressed, this global residual is a somewhat surprising result.
Some structure is seen in the stacked dark, with bright regions near the corners and horizontal bands from bias level fluctuations.
Cosmics are well defined, indicating that CTE is good.



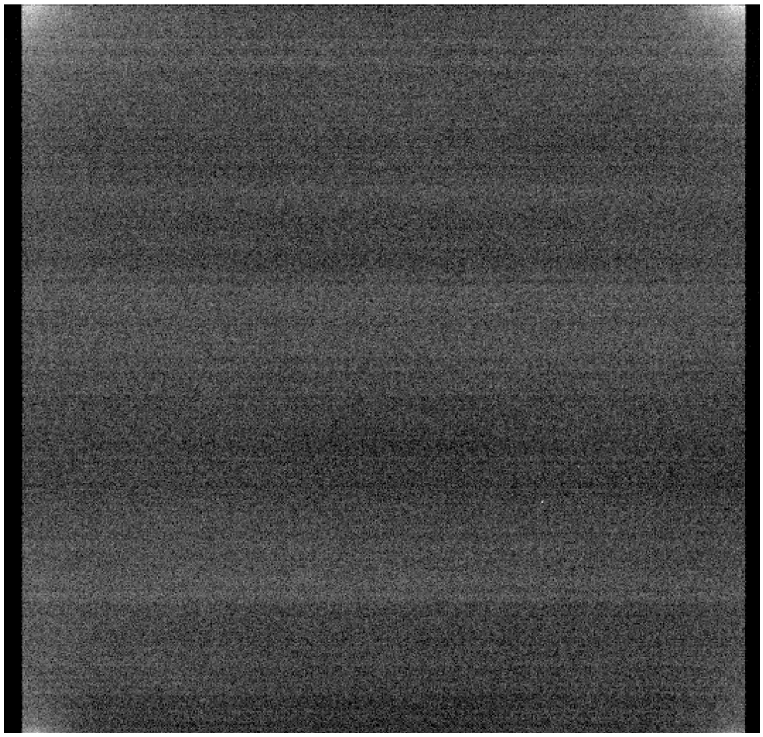


Illustration 10: Map of 20 stacked dark integrations, for a total integration time of 10 hours. The image area is clearly brighter than the overscan region, and brightest near the corners. Horisontal bands appear due to bias level fluctuations.

5. Bias structure

The bias frames used for creating a combined bias for analysis of the dark current in the previous section are examined below.
The vertical profile of each frame is plotted by taking the mean level of each row and using a median filter of width 5 on the sequence to eliminate cosmics. Slow changes with an amplitude of about 10 ADU are visible.

On rare occasions, about one in 10 full frame images, a single row with raised level in a random position is encountered.

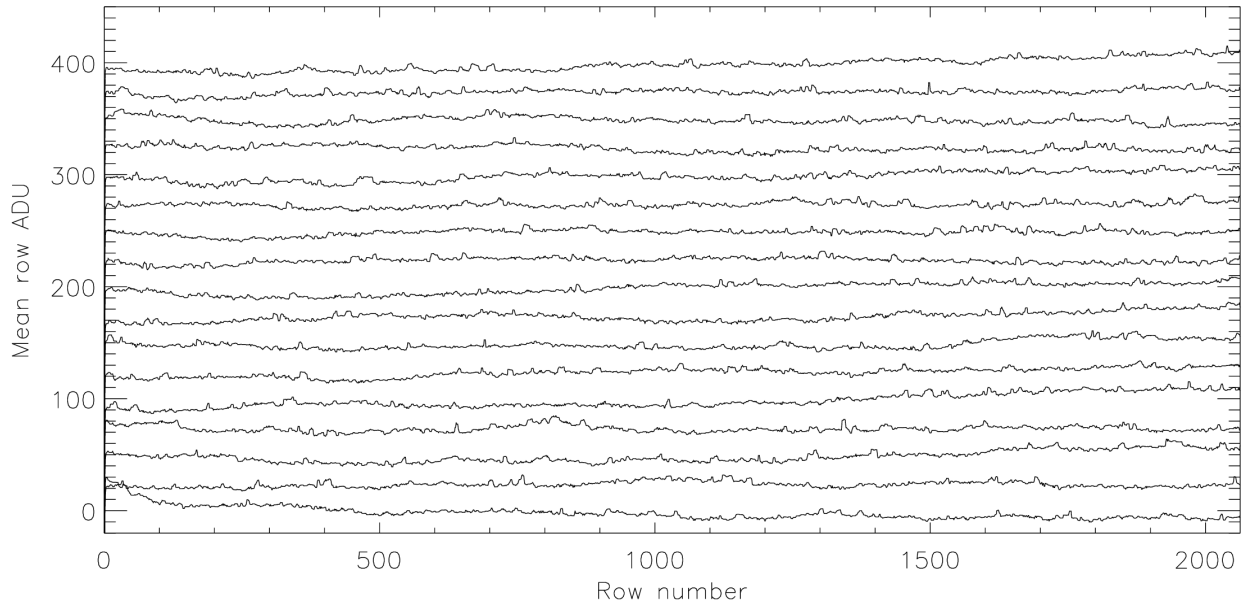


Illustration 11: Vertical profiles of 17 full-frame biases. A separation of 25 ADU between profiles has been added.