THE ACS SOLAR BLIND CHANNEL CALIBRATION

Colin Cox, Space Telescope Science Institute

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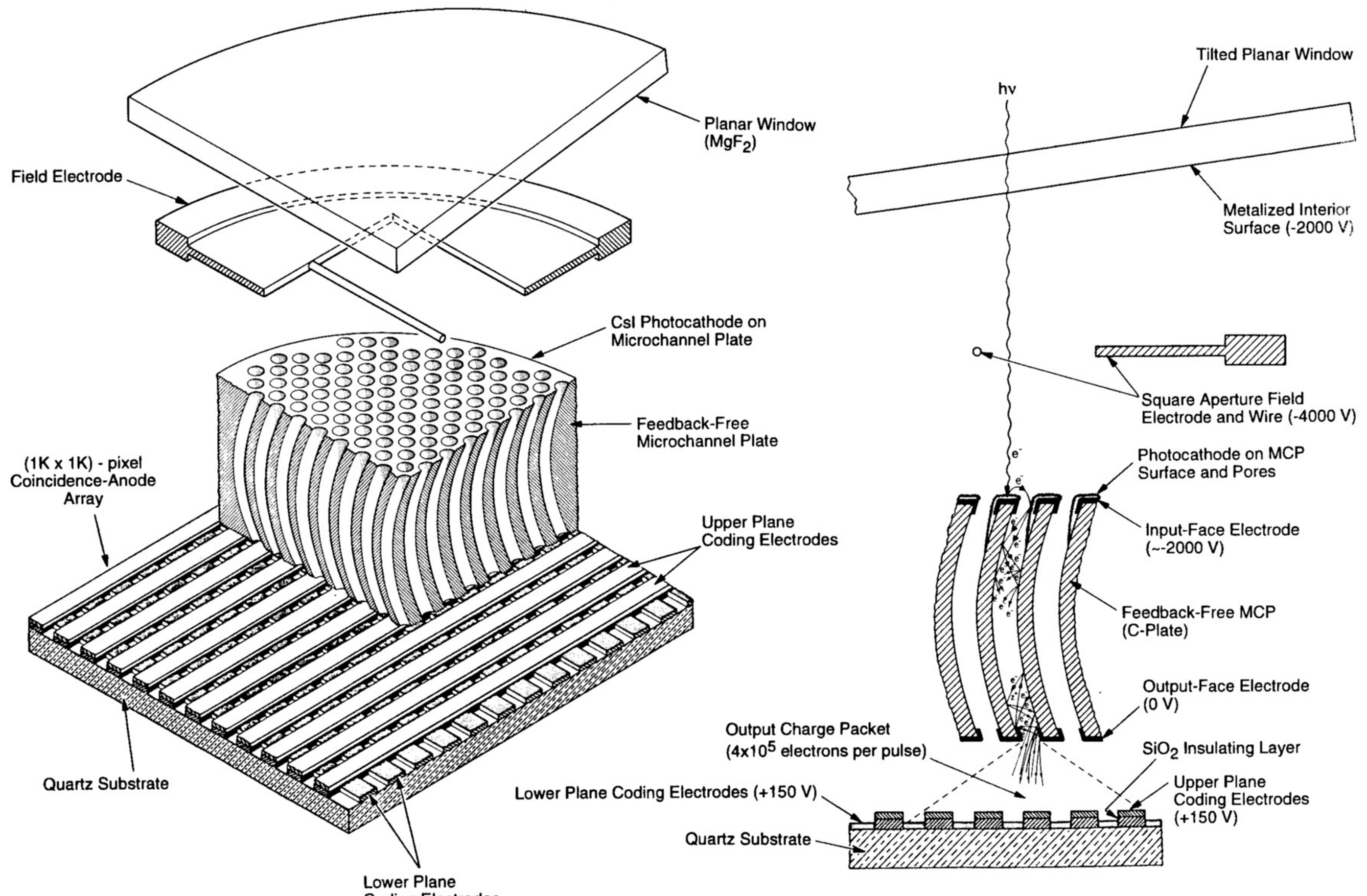
The ACS MAMA detector, also known as the Solar Blind Channel (SBC) is currently HST's principal detector in the far UV. WFPC2 does operate down to 1150 with a wider field of view but at lower resolution and efficiency. Since the loss of STIS, more attention is now being paid to SBC calibration. New dark images have been supplied and the flat fields formerly measured on the ground have been refined. The prism modes have also been recently calibrated and an improved distortion correction is being prepared.

Description

The ACS Solar Blind Channel (SBC) is a spare STIS MAMA operating in the far-UV from 1150 to 1700Å. It contains a CsI photocathode deposited directly on a curved microchannel plate. Electrons generated by photons striking the photocathode enter the microchannel plate which sends an amplified electron cloud onto a multi anode plate configured so that the incident position can be decoded. The SBC has high resolution (pixel size of 0.03 arcsec) and sensitivity plus extremely low noise (~10^{-5} cps per pixel) The perfor-

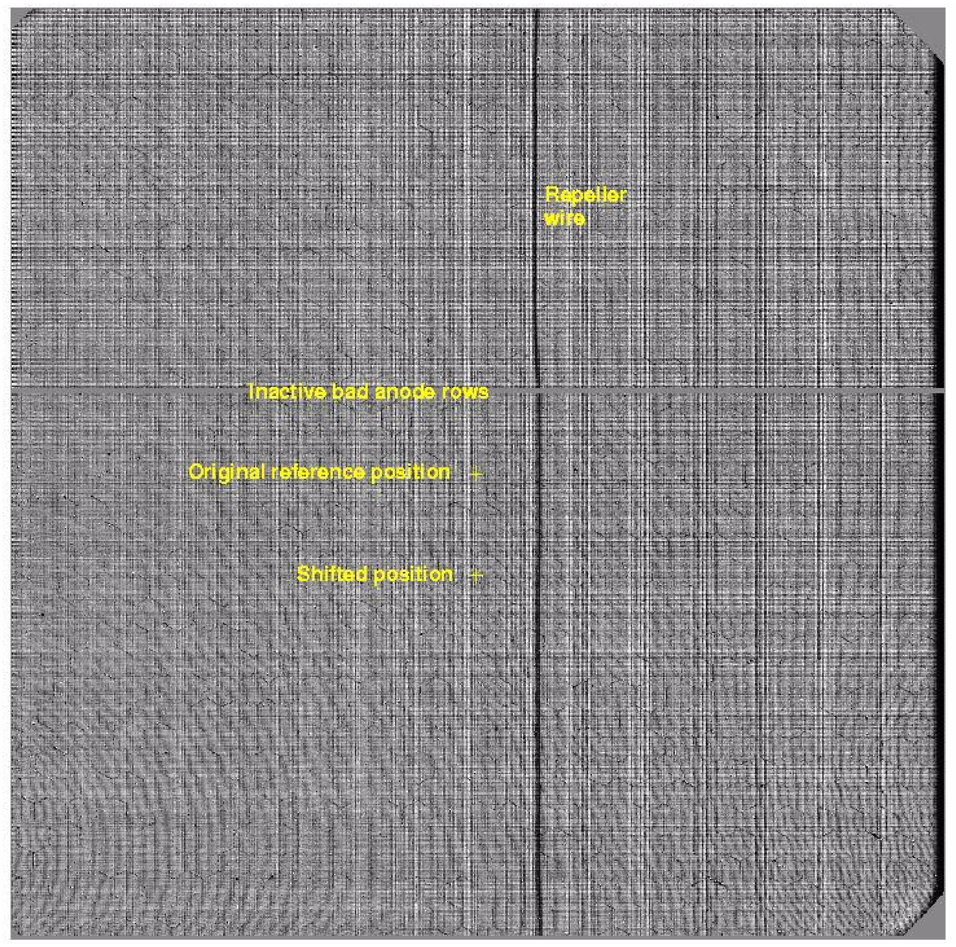


mance and principal calibrations were reported at the HST Calibration Workshop in 2002 (Tran et al.) Here we describe what changes have been made or are planned.

Flat Field

The flat field image illustrates various features of the SBC. The general ribbed pattern of the anodes and the hexagonal bunching of the micro-channels can be seen. Although disconcerting in this strongly stretched image, the effects of these features are eliminated by the pipeline flat field processing. Slightly more troublesome are the non-functioning rows due to a broken anode and the partial obscuration of several columns by the repeller wire. Because of the missing rows, we have recently (November 2004) moved the target reference point from the central row 512 to row 400 so as to reduce the likelihood of a target landing on the unresponsive region.

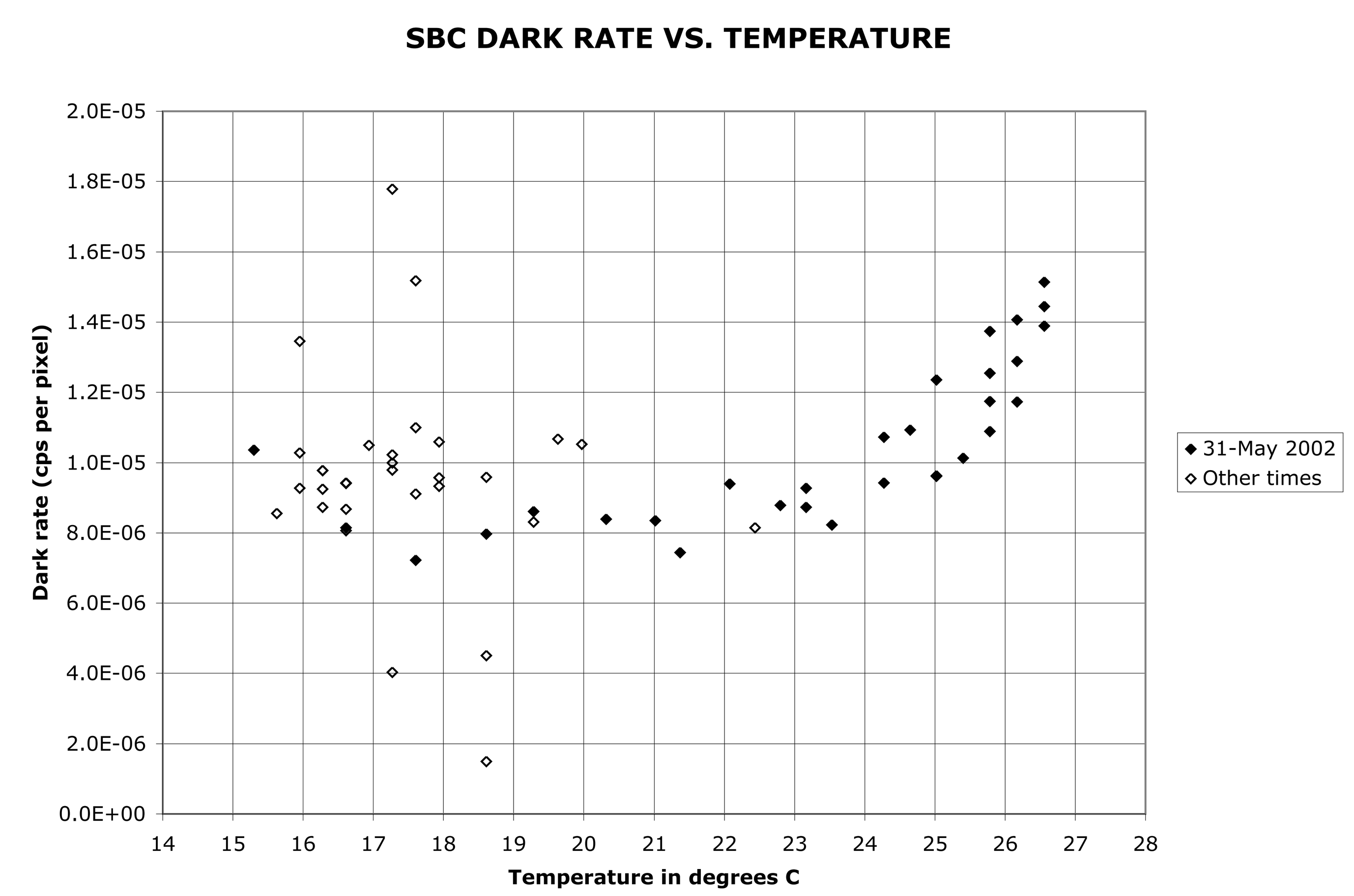
ACS MAMA FLAT FIELD



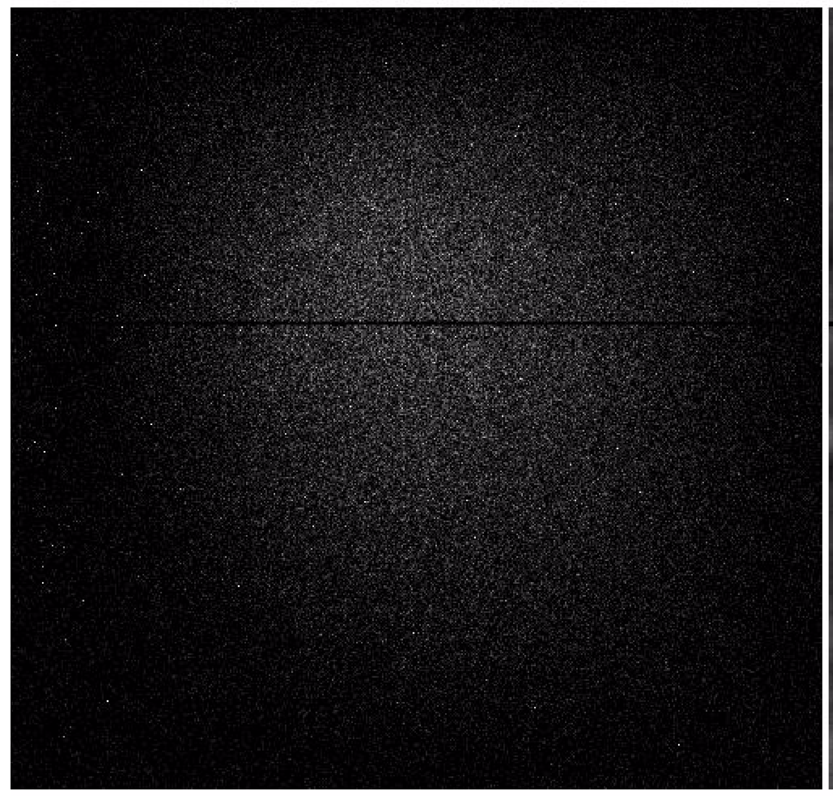
The SBC flats, originally developed from ground based measurements, have been recently revisited and refined incorporating in-flight data.   A report on this topic is given at this workshop (Jennifer Mack, 2005) and there is a recent related ACS Instrument Science Report (Bohlin and Mack, 2005)

Dark Rate

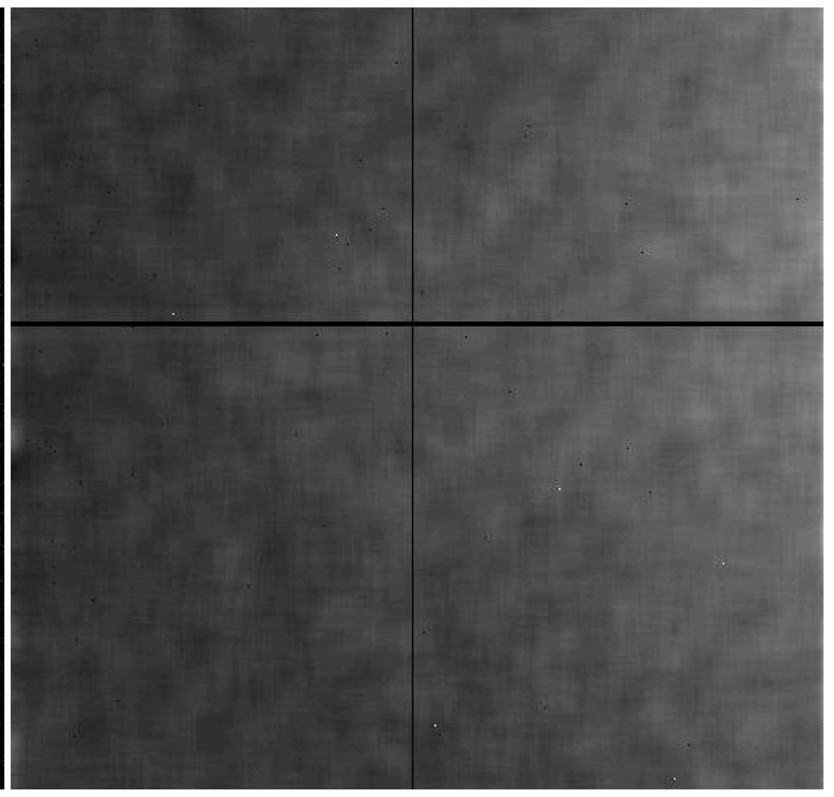
The SBC dark rate although low, is temperature dependant. The SBC temperature is not controlled. The temperature and hence the dark rate depend principally on how long the high voltage has been switched on. A series of dark measurements led to the following graph.The data points indicated by solid markers are part of a contiguous series of measurements. It is seen that the dark noise starts to increase fairly rapidly when the temperature exceeds about 24°C.



In normal operation this only happens when the high voltage has been turned on for about three hours. The original dark current image included all the data illustrated. The calibration file has been replaced by one which uses only data from observations taken when the detector temperature was not above 22°C. This results in a mean dark rate of 8.0x 10^{-6} counts per second per pixel, whereas the previously supplied file had a count rate 4.0×10^{-5}. The raw data show typically one or two counts per pixel with many pixels having zero counts. Using these data directly would imply in many cases that one pixel has a dark current while it s neighbor does not. To provide a statistically more meaningful dark image the data have been smoothed.



Original dark image using data at full range of temperatures



Current smoothed dark image using data taken up to 22°C

Although the dark rate shows clear temperature dependence, we have not embarked on a program to supply a series of darks at different temperatures. The low rate, while desirable for standard observations, makes it very time-consuming to collect enough counts for a useful dark image. The SBC is normally turned off and observations which keep the SBC on for less than three hours will be well served by the supplied dark image. The dark rate will, in any case, normally be small compared with the background and statistical noise.

Distortion

The SBC distortion has not so far received the same attention as have distortions in the WFC and HRC. The current polynomial fit is based on that of the HRC. The rationale for this is that the HRC and SBC are in almost identical optical paths, the only difference being a flat fold mirror which selects the active channel. The SBC solution is derived directly from the HRC with a modification of the scale, a displacement of a few arcseconds in the field of view and a small rotation. These relative adjustments were derived from back to back observations of the same field in each detector. Small distortions in the detector itself have been measured and are on file, but have not been applied to the published calibration. A distortion analysis of the STIS MAMAs is under way and will be extended to include the ACS MAMA. The detector distortions, having very localised features, could not be expressed as polynomials which describe the overall distortion shape. For the WFC and HRC we have now incorporated a residual correction image which allows for just this sort of correction, going beyond the polynomial fit. This mechanism could well be used to include the intrinsic detector distortion once we have refined the SBC polynomial fit.

Spectroscopy

A report at this conference (Walsh, 2005) will describe the calibration of the prism modes of the SBC and software to extract the spectra.

References

Hien D. Tran et al, On-orbit performance of the ACS solar blind channel., 2002 HST Calibration Workshop
JenniferMack, ACS Flatfield Update and New SBC L-flats, 2005 HST Calibration Workshop
R.C. Bohlin and J. Mack, Flats: SBC Internal Lamp P-Flat, ACS ISR 05-04, May 2005
JeremyWalsh, Recent developments of the ACS spectral extraction software aXe, 2005 HST Calibration Workshop