Scatter from the ACS WFC Inter-chip Gap

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Introduction

A brief investigation was made to assess the scatter properties of the gap between the two WFC chips. The geometry of this gap is complex and composed of materials, notably the aluminum nitride chip carriers, which present white diffusive surfaces, and the indium solder used to mount the chips to the carriers, that might potentially scatter light in an undesired fashion such that spurious features result in images obtained with bright sources located in the gap. Nevertheless, this gap could provide a useful "dump" for the unwanted light from a bright point source in a field of fainter sources under study, minimizing the area of the image affected by blooming (along the CCD columns).

Method

The test was performed on 22 Feb 01 with ACS in its flight configuration in the RAS/HOMS OTA simulator at Ball Aerospace. The RAS source delivery system, employing a HeNe laser (wavelength 632.8 nm), was used to generate 9 very bright point sources covering the WFC field. The point source intensities were adjusted to produce ~ 40 ke$^-$ in the peak pixel in the minimum 0.5 sec exposure, with two ND3 filters in tandem in each beam path. The central field point was positioned near the center of the gap and moved, using the RAS source plate micrometer stage, in small (~10 px) increments in the cross-gap direction, followed by two additional positionings, about +/- 100 px along the gap. 50 sec full-frame exposures were obtained through the F625W filter at each position with one ND3 filter removed, such that the peak pixel level was ~4×10^9 e$^-$, or 50,000 times full-well. (Ref IDT DB entries 25617:25624; log gc2001053b)

Results

Figure 1 shows a 0.5 sec exposure of the nine point source images, with a single ND3 filter in each beam path. This results in peak pixel exposure levels of about 4×10^7 e$^-$, or 500 times the well capacity, hence the strong bleeding up and down the columns of all of the sources except the one centered slightly above the center of the gap. In this log stretch, the psf wings and spider diffraction can be discerned for all of the sources. A deeper, 50 sec, exposure at a slightly different source positioning is shown in Figure 2. The images have been moved down by about 20 px (1 arcsec). Note the increased level of bleeding, which is nevertheless confined to the columns containing pixels which are substantially over the well capacity. There is a very narrow area at the edge of each chip, in the vicinity of the image in the gap, that contains excess signal. No other significant effects due to scatter in the gap are detected.

The "donut" ghost images are due to reflections from the detector windows and the filters. Bands in the donuts are produced by interference of the monochromatic light between the optical surfaces and will not be seen with continuum sources. Each of these ghosts was found to contain less than 0.1% of the energy detected in the direct image, meeting the ACS specification. The elliptical ghosts along the LL-UR diagonal are produced by reflection from the CCD surface up to the inner window and back; in some source locations near the UR (D amp) corner these ghosts are bright enough that the specification is slightly exceeded. Although not included here, the other 5 images, obtained with the central point source at slightly different locations in the gap, show no substantial differences from Figure 2.

No strong spurious features due to scatter from the inter-chip gap were detected in these images. Although the test was necessarily limited to a few locations in the gap near field center there is no reason to expect that other positionings of a bright point source would produce very different results. However, as mentioned above, the geometry of the gap is complex (e.g., the solder fillets along the edge of each chip at the base of the gap are irregular), so it is possible that other locations might produce some form of undesirable scatter.

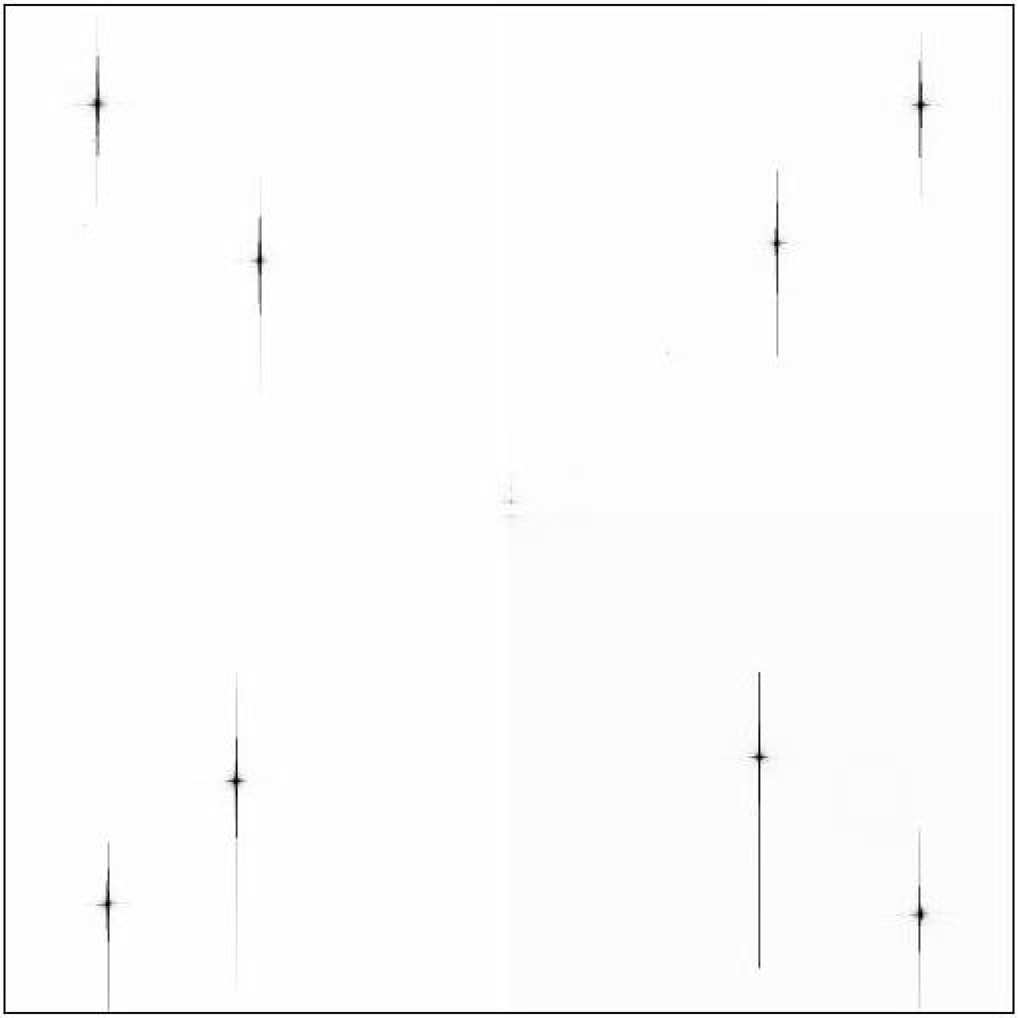

Figure 1.

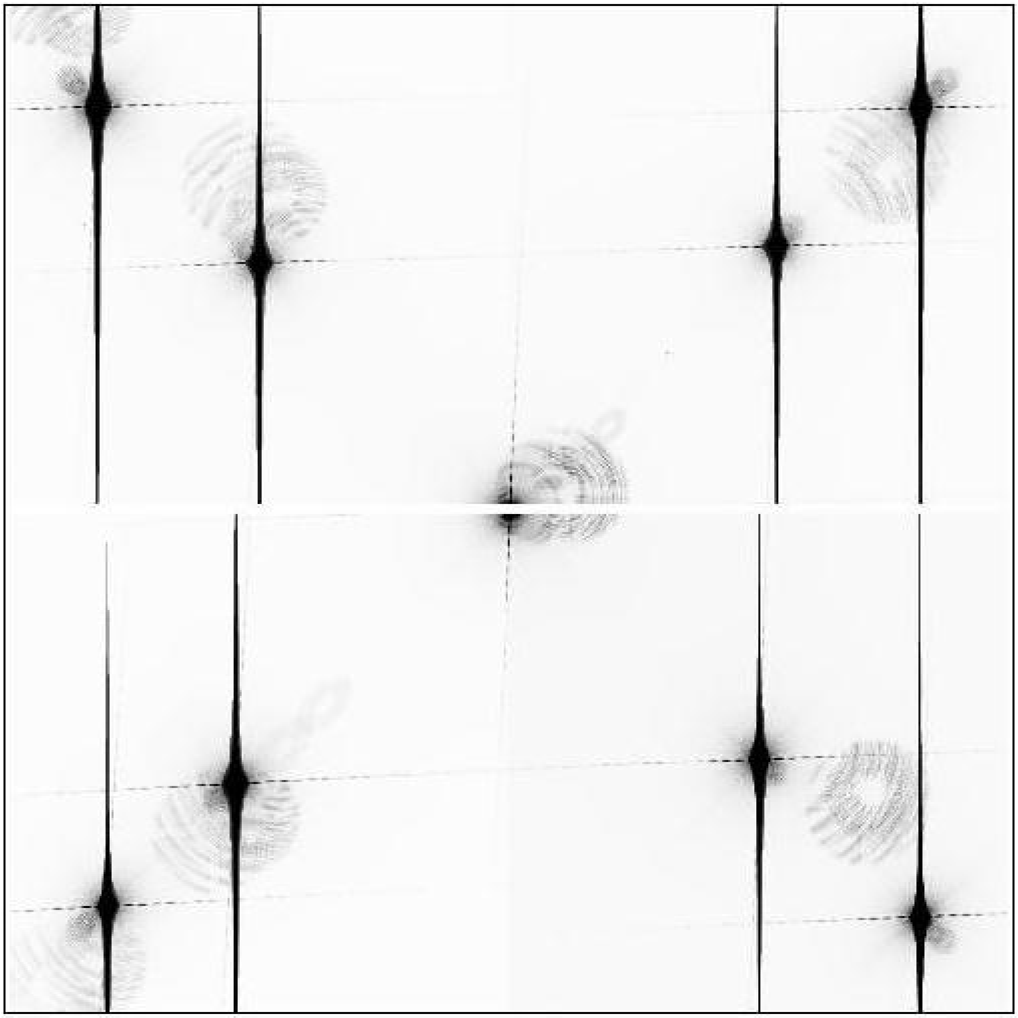

Figure 2.