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WFC3 TV3 Testing: IR Channel Baffle Scatter

Thomas M. Brown
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ABSTRACT
In the first TV campaign (2004), problematic scatter was seen from the IR detector's knife-edge baffle when a point source was scanned across its edge, implying that detector's baffle was installed incorrectly. With a new detector present in the second TV campaign (2007), that scatter was greatly reduced, such that only a small glint (~1% of the source energy) could be seen when a source was scanned across the baffle edge. In the current (third) TV campaign, we repeated the test that scanned a source across the knife-edge baffle, given that yet another IR detector was installed in the instrument. The results were extremely similar to those in the previous TV campaign: faint glints (~0.5 to 1%) are present when a source hits the knife edge, but no serious scatter is seen, implying that the baffle is installed correctly and functioning as intended.

Background

One of the tests performed in the current thermal vacuum (TV) campaign for WFC3 is a check for scattered light from the knife-edge baffle of the IR detector. The test is very similar to that performed in the previous TV campaign (Brown 2007, ISR WFC3 2007-16). The procedure (SMS IR17S04A) scans a point source across the baffle's edge at eight locations (two for each of the four edges), starting from a point on the edge of the detector itself, and then stepping outward with 5 pixel steps, for a total of 9 steps, which puts the source past the edge of the baffle. These exposures are oversaturated by a factor of ~10 (i.e., 1,000,000 e^- in the peak pixel) to enable detection of faint glints (~1%). The test also includes two well-exposed images, with the source unsaturated, to allow determination of the source intensity. The point source was generated by the CASTLE optical stimulus, using the tungsten lamp and 10 micron pinhole.

When similar tests were performed in the first TV campaign (Brown 2005, ISR WFC3 2005-22), a significant glint (containing ~20% of the source flux) could sometimes be seen extending across a large region of the detector. Such large scatter implied that the IR baffle for that detector (FPA064) was installed incorrectly. A new IR detector (FPA129) was in the instrument during the second TV campaign, and so the test was repeated (Brown 2007); with that detector, a much fainter glint (containing ~1% of the source flux) could be seen when the source crossed the baffle edge. Yet another IR detector (FPA165) was installed prior to the current (third) TV campaign, warranting a repeat of the test.

Results

Fortunately, the new test revealed no significant problems with baffle scatter. No large scatter from the knife-edge baffle was seen in any of the scans, but a small glint can be seen every time the source is scanned across the knife edge (Figure 1). The glint can extend up to ~100 pixels in length, and at its peak brightness in each scan, it contains anywhere from ~0.5% to ~1% of the flux in the source (similar to the diffraction spikes). These results are very similar to those found with the previous detector in the second TV campaign (Brown 2007), verifying that the knife-edge baffle was once again installed correctly for the latest IR detector package. Such small glints should cause no significant science impacts for observers.

Note that Figure 1a shows other artifacts not relevant to this test. In both of the bottom edge scans (last two columns of the figure), a faint secondary source can be seen, due to an unused (but partially illuminated) fiber in the CASTLE fiber stage. Also, in the bottom (left) edge scan (shown in the 3rd column of the figure), a circular artifact can be seen in the lower right-hand corner of the postage stamps; these are defective pixels on the IR detector itself.

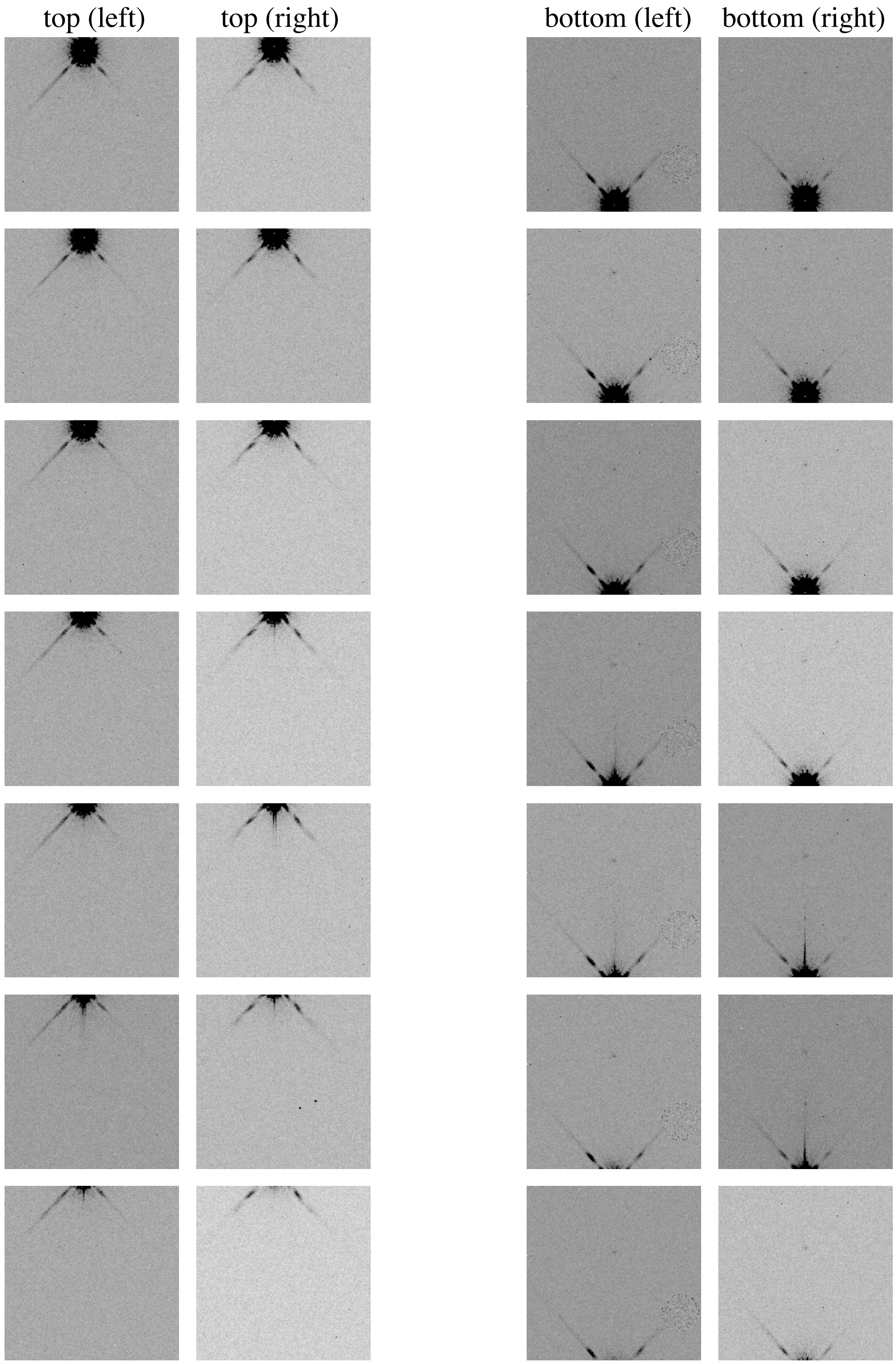

Figure 1a: A subset of positions during the baffle scans, shown as a 200x200 pixel subsection with a hard logarithmic stretch. The columns of postage stamps are for the top baffle edge (left and right sides of the detector) and bottom baffle edge (left and right side of the detector). The small glint can be seen between the diffraction spikes as the source crosses the knife edge.

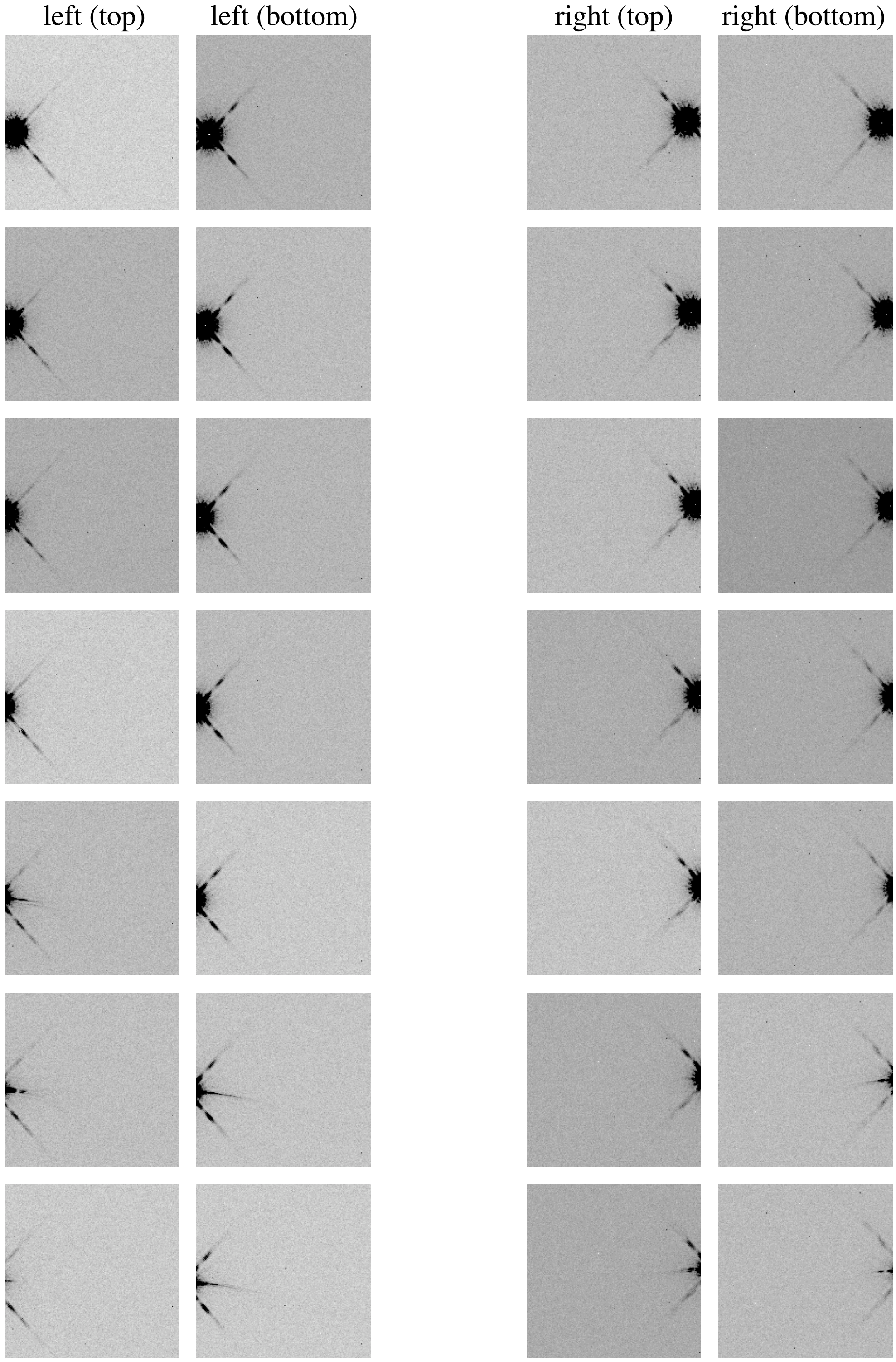

Figure 1b: A subset of positions during the baffle scans, shown as a 200x200 pixel subsection with a hard logarithmic stretch. The columns of postage stamps are for the left baffle edge (top and bottom halves of the detector) and right baffle edge (top and bottom halves of the detector). A small glint can be seen between the diffraction spikes as the source crosses the knife edge.