Inter-Pixel Capacitance (IPC)

Inter-pixel capacitance (IPC) is a form of crosstalk present in many array detectors due to capacitance coupling between adjacent pixels. This results in some of the signal from a given pixel spreading out into its nearest neighbors, producing correlated signals between those pixels. In the case of a single high-signal pixel, such as a pixel with high dark current or impacted by a cosmic ray, IPC will cause elevated signals in the four pixels surrounding the high-signal pixel, producing a cross-like source in the image. Examples are shown in the sources in the top image, the bottom left image shows the snowballs produced when a bright starimpacted the camera we injected four fake snowballs into a couple of images. The plots to the right shows the snowball appearance rate during Cycles 17 and 18. The plot to the right shows histograms of the snowball areas and the number of saturated pixels. The plot below and to the right shows a histogram of the amount of flux contained within the snowballs.

Persistence

Persistence has been observed in the IR channel whenever a pixel is exposed to light that exceeds more than about half of the well. Persistence is most easily detectable when bright targets are observed in previous visits (of others), but self-persistence also occurs when exposures containing bright targets are dithered on the detector within a visit. The image at right shows an example of persistence resulting from a previous observation composed of 4 dither positions in a diagonal line.

Photonmetry

During Cycle 17, observations of GD71, GD153, G191B2B and P330C, in all 15 IR filters, were taken to measure the photometric characteristics of the IR channel. The accompanying figure shows the repeatability of the photometry in drizzled images, over ~12 months during Cycle 17 for GD71 in several filters. Signal to Noise in each individual exposure is at least 100 in the narrow band filters, and ranges up to 1000 in the wide filters. This data is for a 0.4 arcsec aperture.

High Contrast Imaging

Proposal 12354 was designed to measure the capability of the WFC3 camera to perform high contrast imaging. In the IR we observed the bright standard star HD165459 (V=6.86 mag) in the F128N filter for 3 orbits, with 3 orients per orbit.

The exposures were carefully designed with two goals in mind. First we wanted to have the maximum possible orients in 3 orbits, to perform angular differential imaging (ADI) (Marois et al. 2005). Second, we wanted to saturate the inner half arcsec to get sufficient flux in the wings of the PSF. In our observations we managed to saturate the inner 0.3" using 10s exposures with a total of 9 orients. Note that the IR channel pixel scale is 0.13"/pixel.

To measure the detection limit of the camera we injected four fake planets in the images (at 0.5", 0.8", 1.1", and 1.7" from the star) with a delta magnitude of 10 with respect to the star (as measured by the ETC).

Count Rate Non-linearity

Past studies have found that the WFC3/IR detector suffers from a count rate-based non-linearity (a.k.a the Bohlin Effect), similar to that seen in NICMOS detectors. An initial measurement of this effect was made by comparing photometry of stellar clusters between WFC3/IR and ACS/WFC and NICMOS, where the count rate non-linearity effects are well characterized. This study revealed a non-linearity in the IR channel of 0.019 ± 0.003 magnitudes per dex of count rate, in the sense that low count-rate sources appear fainter than they should. Results are discussed in WFC3 ISR 2010-07. A second study, using reflected Earth limb light, is detailed in WFC3 ISR 2010-15, and produced identical results.

This can have a non-negligible effect on photometry of faint sources. For example, if the photometry of a sky-dominated source (which is ~10 magnitudes, or 4 dex, fainter than the star used to calculate the IR zero-point) is calibrated using the IR zeropoint, the count rate non-linearity will cause the source’s brightness to be too faint by 0.04 ± 0.01 magnitudes. Currently, no correction for this effect is made in any of the standard WFC3 data reduction software. Observers must manually correct their results.