First On-orbit Measurements of the WFC3-IR Count-rate Non-Linearity

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Abstract.

Previous HgCdTe detectors on HST have suffered from a count-rate dependent non-linearity, motivating an investigation of a similar effect on the WFC3-IR detector. An initial measurement of this effect was made by comparing the photometry of star clusters observed over a wide dynamic range and at overlapping wavelengths in WFC3-IR and NICMOS and/or ACS-WFC. Utilizing a color term to account for differences in the observed bandpasses, we find a significant detection of a non-linearity in WFC3-IR photometry which is in the same direction but a few times smaller than that of NICMOS. From 235 stars in 47Tuc observed with WFC3-IR in F110W and F160W and in similar bandpasses in NICMOS Camera 2, we measure a non-linearity of WFC3-IR of 0.011+/-0.0023 and 0.010+/-0.0025 mag per dex, respectively, over a range of 10 magnitudes (4 dex). An independent measurement utilizes 1390 stars in NGC 3603 observed with ACS-WFC F850LP and WFC3-IR F098M and yields a very similar result, 0.010 +/- 0.0033 mag/dex. The consistency of this measurement from two different comparison detectors of different technology indicates this result is robust. The impact of this non-linearity is that photometry of faint (i.e., sky dominated) sources calibrated with WFC3-IR zeropoints will appear 0.04 +/-0.01 mag too faint.