

The Accuracy of WFPC2 Photometric Zeropoints

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Abstract

The accuracy of WFPC2 photometric zeropoints is examined using two methods. The first approach compares the zeropoints from five sources: Holtzman (1995), the HST Data Handbook (1995 and 2002 versions), and Dolphin (both 2000 and 2002 versions). We find the mean scatter between the different studies to be: 0.043 mag for F336W, 0.034 mag for F439W, 0.016 mag for F555W, and 0.018 mag for F814W.

The second approach is a comparison of WFPC2 observations of NGC2419 with ground-based photometry from Stetson (from his website) and Saha et al. (private communication). The agreement between these comparisons is similar to the historical zeropoint comparisons. Hence we conclude that the true uncertainty of WFPC2 zeropoints is currently about 0.02-0.03 magnitudes. Since Poisson statistics would predict that 1% absolute accuracy should be attainable, we conclude that there are still systematic error sources which have not yet been identified.

Goals and Approach

The ultimate goal of this project is to determine if 1% absolute photometry is possible using WFPC2. In principle this should be attainable, as evidenced by the fact that the short-term rms in our photometric monitoring observations for the primary broadband filters are < 1%. The challenge is to: 1) understand the various systematic errors well enough (e.g., CTE loss, variable focus, geometric distortion, etc.) and 2) match the zeropoints to existing standards with enough precision to make this possible. In this poster we address the second issue by examining the accuracy of WFPC2 photometric zeropoints using two methods.

The first approach compares the zeropoints from five sources:

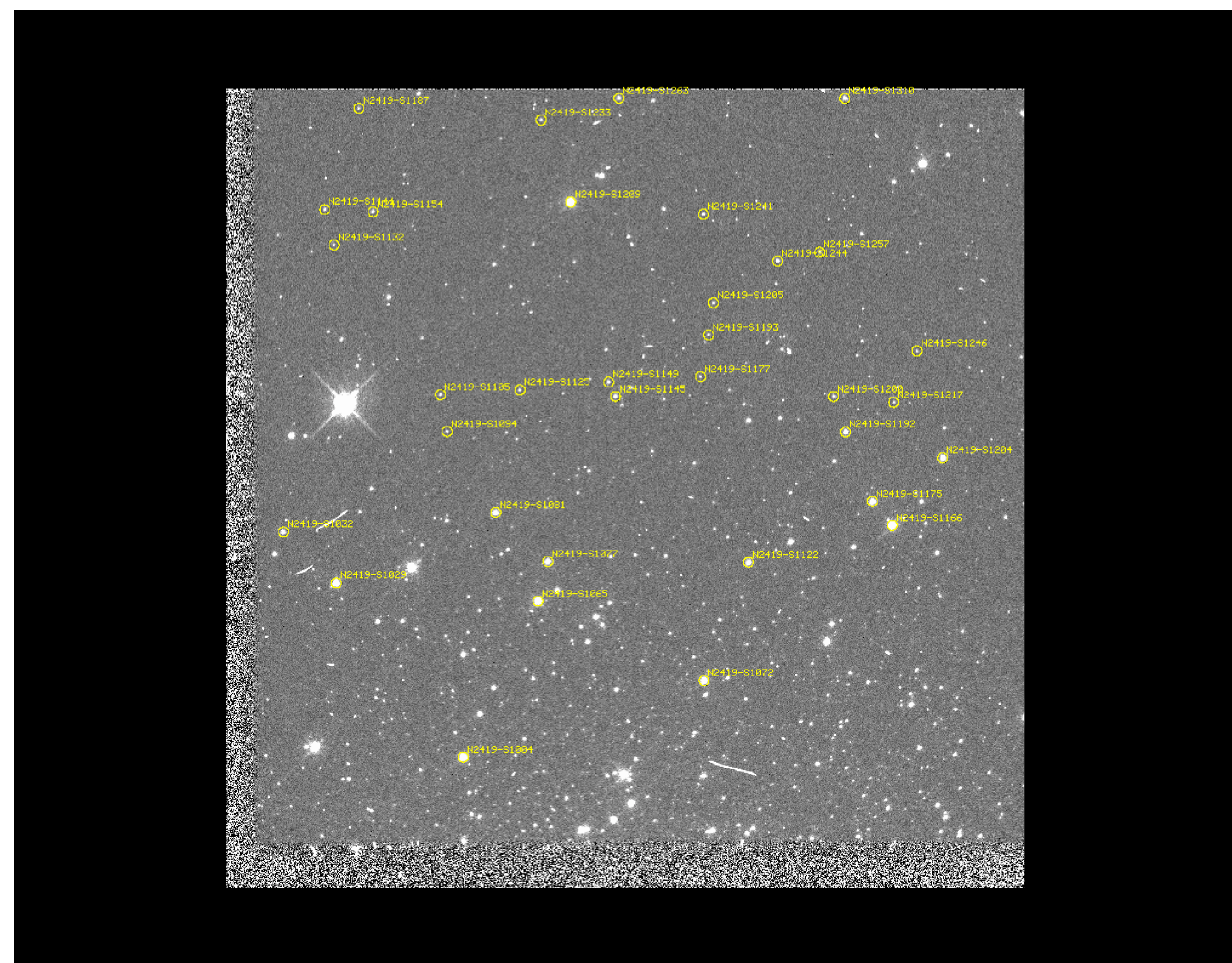
- Holtzman (1995)
- HST Data Handbook (1995)
- HST Data Handbook (2002)
- Dolphin (2000)
- Dolphin (2002)

These five studies use largely independent methods to determine zeropoints (e.g., the Data Handbook uses a single photometric monitoring star and SYNPHOT while Dolphin uses ground-based photometry of Omega Cen and NGC 2419). Hence the resulting scatter provides an empirical estimate of the true uncertainty. The second approach is a comparison of WFPC2 observations of NGC2419 with ground-based photometry from Stetson (from his website) and Saha et al. (private communication). The resulting scatter between these two determinations, along with the historical scatter outlined above, provides our best estimate of the true uncertainty in the WFPC2 zeropoints. A weighted combination of all determinations will be used to determine new WFPC2 zeropoints for the F336W, F439W, F555W, and F814W filters. A fifth filter (F675W) will be included in the near future.

Caveat - The current results should be considered **tentative**, pending some additional checks. Please refer to the publication and the WFPC2 WWW site for the final values. This is why actual values for the zeropoints are not included in this poster.

The Target NGC2419

A representative image from NGC2419 (F814W, u4ct0106r, WF3, exptime = 40s, date-obs = 1997-11-18).



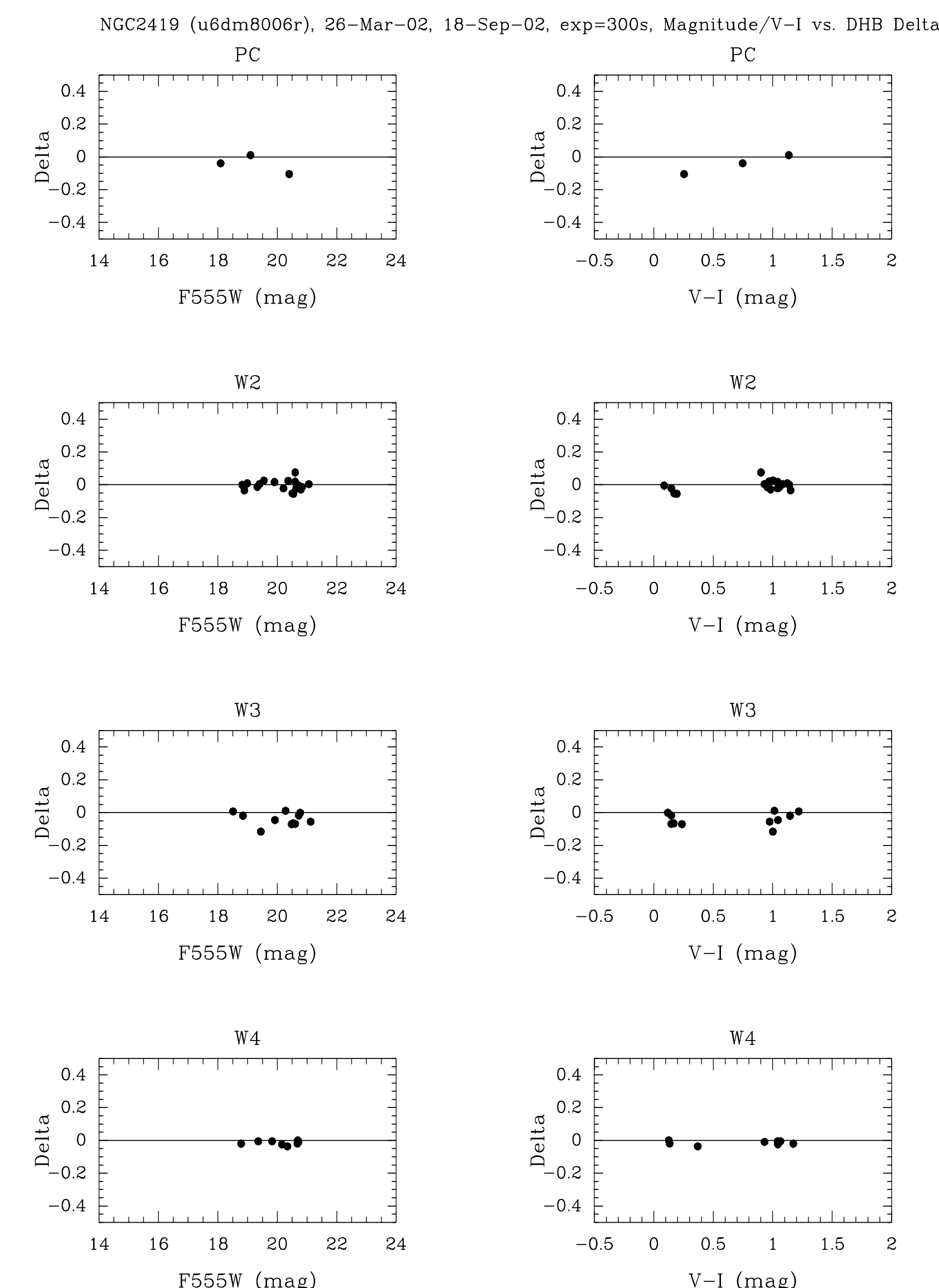
References

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- Dolphin, A. E. 2002, private communication, http://www.noao.edu/staff/dolphin/wfpc2_calib/
- Holtzman, J., et al. 1995, "The Photometric Performance and Calibration of WFPC," PASP, 107, 1065.
- HST Data Handbook, C. Leitherer, ed., (Version 2.0, December 1995).
- HST Data Handbook, T. Keyes, ed., (Version 3.1 Vol. I, March 1998).
- HST Data Handbook (WFPC2), S. Baggett, ed., (Version 4.0, October 2002) http://www.stsci.edu/instruments/wfpc2/Wfpc2_dhb/WFPC2_longdnhbcover.html
- Saha, A. 2002, (private communication)
- Stetson, P. 1995 (unpublished), reported in Kelson et al. 1996 and Saha et al. 1996

Data Reduction

The images were multiplied by a geometric distortion correction image, since we are doing point-source, rather than surface photometry. Aperture photometry was performed on each dataset using a 0.5" radius, and the values were corrected to infinity by subtracting 0.1 magnitudes (Holtzman 1995). Very bright stars and very faint stars were trimmed from the sample, due to suspected saturation and excessive noise, respectively. Searches were then performed to identify stars that matched stars from Stetson's (www site) data files. The Dolphin (2002) CTE correction and the Holtzman color transformations were applied. The sample was further trimmed by applying graduated isolation criteria with a limit approximating a 4-magnitude difference at 5" distance. Finally plots were produced for each dataset showing the magnitude and V-I versus the zeropoint delta.

Example plot for F555W (dataset = u6dm8006r, exptime = 300s, observation date=2002-03-26). The delta refers to our magnitude when using zeropoints from the HST Data Handbook (DHB, 2002) minus the Stetson magnitude.

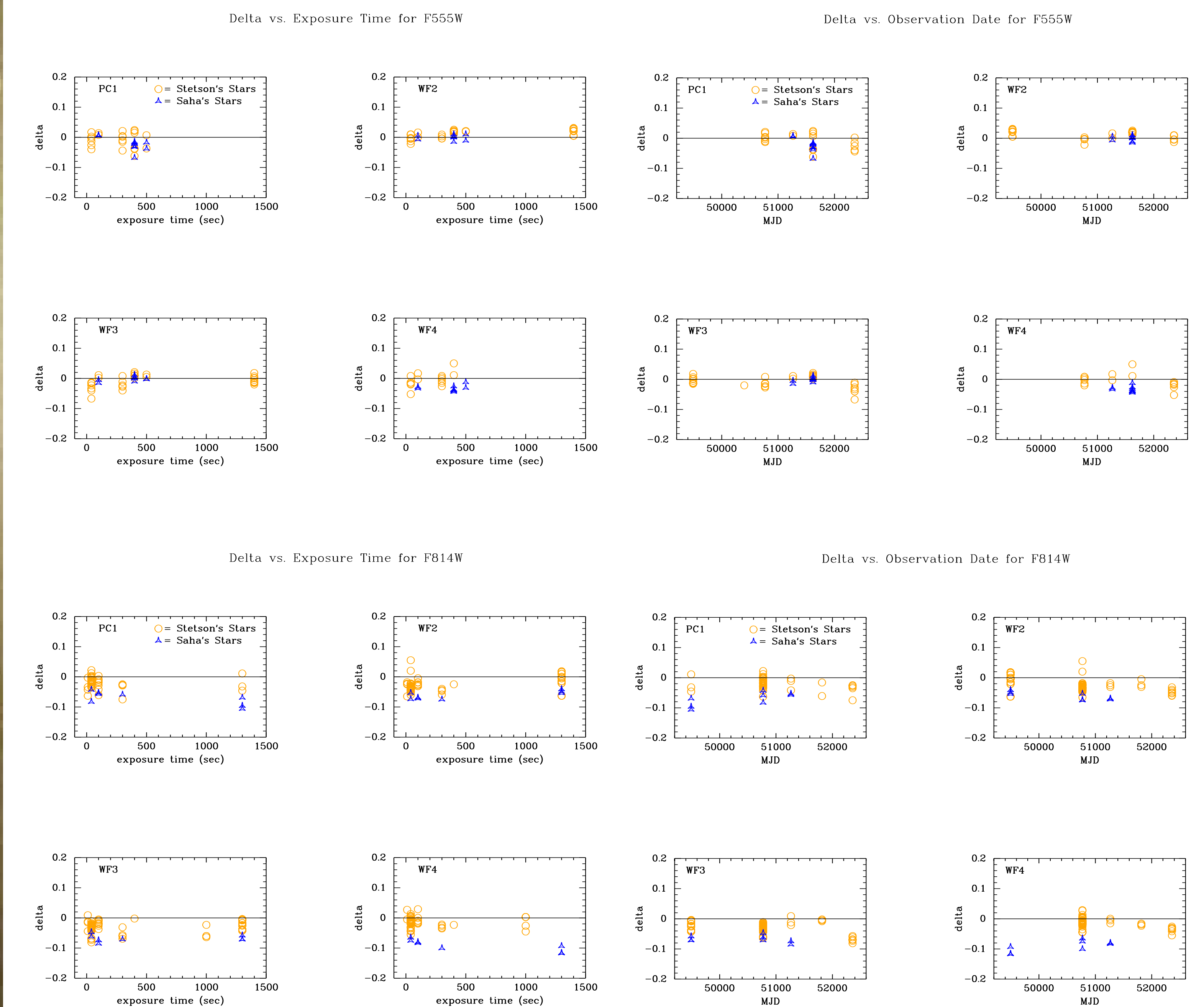


Results

We present the results of our examination for the target NGC2419 in the filters F555W and F814W. The table shows the averaged means and mean residuals of the deltas for each filter and chip.

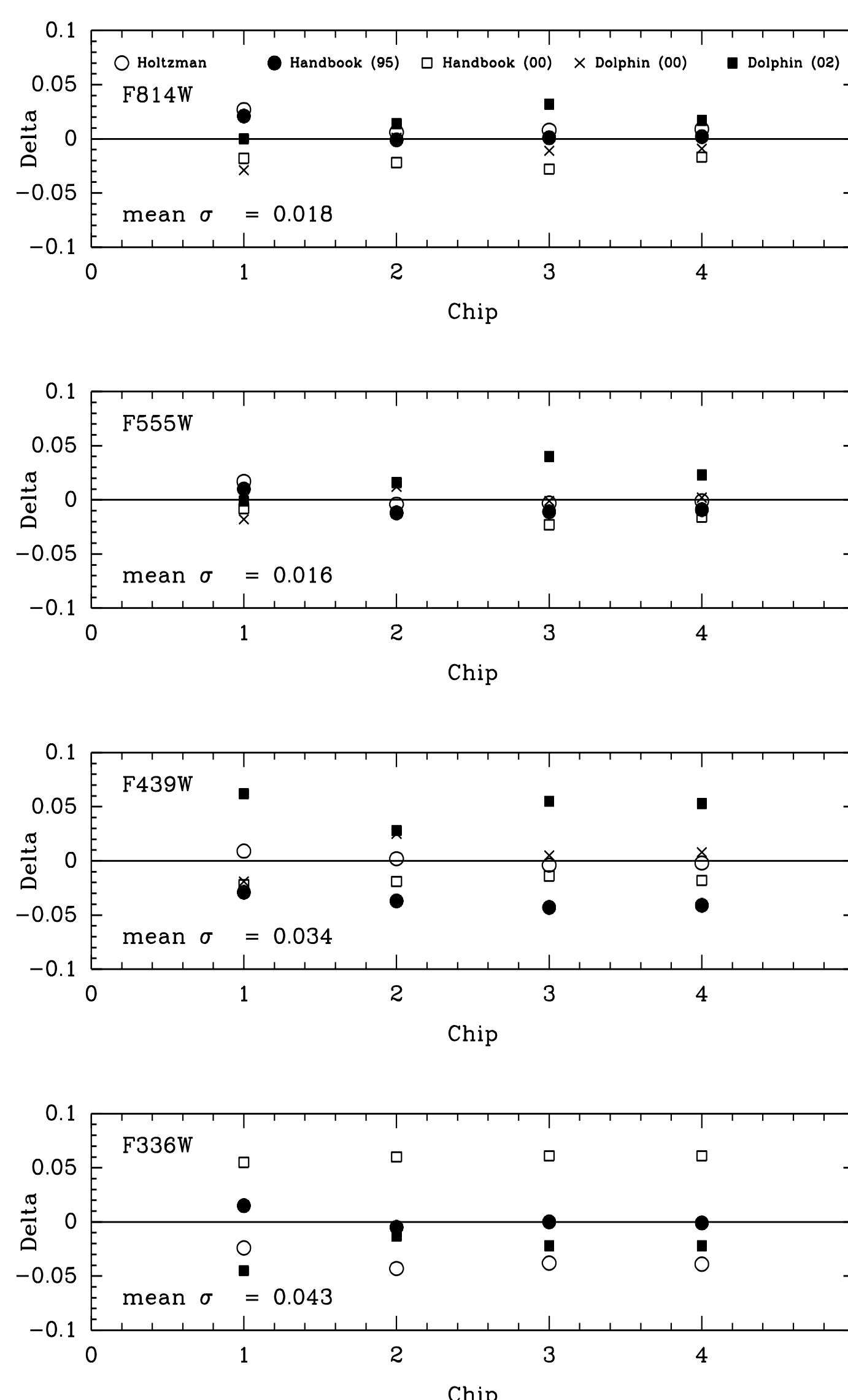
Filter	Chip	# of Sample	Stetson Average Mean	Stetson Mean Residual	# of Sample	Saha Average Mean	Saha Mean Residual
F555W	PC1	22	-0.0087	0.0303	10	-0.0229	0.0412
	WF2	29	0.0106	0.0412	13	0.0010	0.0293
	WF3	32	-0.0083	0.0403	13	-0.0025	0.0321
F814W	WF4	16	-0.0048	0.0270	12	-0.0264	0.0531
	PC1	46	-0.0197	0.0346	8	-0.0708	0.0394
	WF2	64	-0.0255	0.0374	16	-0.0573	0.0304
	WF3	68	-0.0310	0.0306	14	-0.0654	0.0269
WF4	48	-0.0143	0.0313	11	-0.0746	0.0414	

The figures below show the mean as a function of exposure time and observation date (in MJD) for F555W (top two sets of four) and F814W (bottom two sets of four). The orange circles show the results from the comparison with Stetson's stars, the blue crosses show the results from the comparison with Saha's stars.



Historical Zeropoint Comparisons

The plot below shows a comparison between five different historical zeropoint determinations. The sources are Holtzman (empty circle), HST Handbook (1995, filled circle), HST Handbook (2002, empty square), Dolphin (2000, crosses), and Dolphin (2002, filled squares).



Conclusions

1. The true uncertainty in the current WFPC2 zeropoints, as judged by either the historical zeropoints or comparisons of HST observations of NGC2419 with ground-based photometry is about 0.02 for F555W and F814W, and about 0.03-0.04 for F439W and F336W.
2. The statistical uncertainty would predict that an accuracy of 1% should be attainable. The fact that the true uncertainty is currently about 0.02-0.03 magnitudes indicates that there are as yet unidentified error sources.
3. While there appear to be some possible trends in the zeropoint deltas versus exposure time and time of observation, the lack of agreement in these trends for the different filters suggests that the underlying source of the error is still unknown.
4. Results of the four methods used here will be averaged together to produce new values for the zeropoints. These will be included in the publication, and on the WFPC2 WWW site.