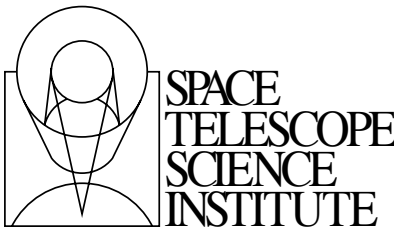

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WFC3 Instrument Science Report 2015-05

WFC3 Cycle 21 Proposal 13561: UVIS Gain

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ABSTRACT

This report summarizes the absolute gain UVIS results from HST Cycle 21 (pid 13561) and early Cycle 22 (pid 14007). Results from these data are compared to previous ground and on-orbit measurements. The gain values were measured for each quadrant using internal unbinned, 2x2 binned, and 3x3 binned flat field data with nominal gain setting (1.5 e-/DN). This report details 3 epochs of data, December 2013, June 2014, and December 2014. The latest epoch of data, for early Cycle 22, the unbinned gain measurements are 1.57, 1.55, 1.58, and 1.57 e-/DN for quadrants A, B, C, and D respectively. For all data across the three epochs covered in this report, gain measurements are with 1-2% of previous values from TV3 through early Cycle 22 and thus remain stable.

1 Introduction

The WFC3 UVIS gain measurement utilizes internal flat fields with the default calibration tungsten lamp. CCD gain, is the measurement of how many excited electrons are required to register as one count (DN). Any changes in the gain over time could be a symptom of changes occurring within the electronic signal chain of the CCD. Since the gain is a fundamental parameter of a CCD, we use it as a proxy to monitor any changes in the UVIS detectors. Any gain measurement variations will effect other measurements such as read-noise and photometric zero points. This report summarizes the two epochs of gain measurements for Cycle 21: December 2013 and June 2014, as well as the first epoch of Cycle 22, December 2014.

2 Data

The unbinned data for Program 13561 (PI: Gunning) and Program 14007 (PI: Gunning) consists of 12 full-frame internal flat fields through the F645N filter using the default tungsten lamp. The calibration flat fields were taken in pairs with the exposure times of each pair set to achieve exposure levels between ∼500-50,000 e-/pixel. Additional exposures were added to the unbinned data set to better sample the lower end of the mean signal, < 10,000 e-/pixel, where the statistical variance is more linear. Just like all previous UVIS gain monitor programs, the exposures were spread across several visits and the order was mixed to reduce systematics. At the beginning of each visit, a 60 second subarray exposure was obtained to warm up the tungsten lamp; to ensure the lamp flux is stable and that all exposures have the expected illumination intensity. The data used for the unbinned analysis are summarized in Tables 4 and 5. In addition to the unbinned data, 2x2 and 3x3 binned data were also acquired for both of these programs. For both binned datasets, 8 full-frame F645N internal flat fields were acquired with ranging exposure times to achieve the same exposure level values as expected for the unbinned data. The 2x2 and 3x3 binned data are summarized in Tables 6 - 9.

3 Method

The raw data were reduced through the standard OPUS pipeline and calibrated with CALWF3 Version 3.1.6 (15-Nov-2013). Processing of data included data quality initialization, overscan correction, and subtraction of both bias and dark files. All data in this report were processed using a specialized CRREJTAB file where:

SKYSUB = mean

CRRADIUS = 2.1 pixels

CRTHRESH = 0.5555

CRSIGMAS = 6.5, 5.5, 4.5

SCALENSE = 3.0

To verify that cosmic rays were successfully flagged, we compared the data quality flags (DQ extensions) with the image data in the science extensions. Cosmic rays are flagged with bit values of 8192 in the DQ extensions; our subsequent analysis rejects any pixels with a DQ value other than zero.

In order to conform with all previous UVIS gain measurements (Gunning 2014, Gunning 2013, Borders 2001, Baggett & Borders 2009, and Baggett 2008), we used the standard mean-variance technique where the instrumental gain is derived from the reciprocal of the slope in the mean-variance plot of the data (see Gunning et al. 2012 and references therein). In accordance to this procedure, exposures are taken in an uninterrupted sequence and an average and difference image are created for both chips at the varying exposure levels. Using the IRAF *tlinear* task, a linear fit to the mean-variance data is obtained where the weights are based on the reciprocal of the standard deviation squared, giving more weight to the lower illumination levels. This method of weighting reduces any potential effects from non-linearity. The mean signal levels were measured using the IRAF *imstat* task on the average images while the variance was

measured from the difference images (standard deviation squared divided by 2). No clipping was used for the unbinned data, but an NCLIP = 3.0 was used for the binned data. Statistics for each quadrant were based on 25 equal-sized regions, respective to the size of the quadrant. The deviation from the fit at higher mean signal levels is discussed in our results. Table 1 summarizes the unbinned gain monitoring results through early Cycle 22. Tables 2 and 3 summarize the gain values for the 2x2 and 3x3 binned data, respectively.

Quadrant	Cy22 Dec	Cy21 Jun	Cy21 Dec	Cy20 Jun	Cy20 Dec	Cy19	Cy 18	Cy 17	SMOV	TV3
A	1.57,	1.57	1.56	1.56	1.56	1.56	1.55	1.54	1.56	1.56
B	1.55	1.56	1.55	1.55	1.55	1.56	1.55	1.54	1.56	1.56
C	1.58	1.58	1.58	1.58	1.58	1.58	1.57	1.56	1.58	1.58
D	1.57	1.57	1.57	1.57	1.57	1.57	1.56	1.55	1.57	1.57

Table 1: *Unbinned gain values for TV3 testing through early Cycle 22.*

Quadrant	Cy22 Dec	Cy21 Jun	Cy21 Dec	Cy 19	TV3
A	1.56	1.56	1.56	1.56	1.56
B	1.56	1.56	1.56	1.56	1.55
C	1.58	1.58	1.58	1.57	1.58
D	1.60	1.59	1.57	1.57	1.57

Table 2: *Same as Table 1, but for 2x2 binned data*

Quadrant	Cy22 Dec	Cy21 Jun	Cy21 Dec	Cy 19	TV3
A	1.55	1.55	1.56	1.55	1.55
B	1.55	1.55	1.55	1.54	1.55
C	1.57	1.57	1.57	1.56	1.56
D	1.57	1.57	1.56	1.56	1.56

Table 3: *Same as Table 1, but for 3x3 binned data*

4 Results and Conclusions

The measured gain values for the nominal setting of 1.5 e-/DN for Cycle 21 and early Cycle 22 are summarized in Tables 1 - 3. Formal errors propagated from the errors of the linear weighted fit are ~ 0.001 e-/DN. We estimate that because the gain values are measured using smaller image subsections that the true errors are higher, ~ 0.01 e-/DN.

The unbinned figures 1, 4, and 7, show a systematic deviation from the weighted fit at the higher illumination levels, which is not evident in the binned modes (Gunning 2013). This effect could be caused by variations in the lamp output or shutter-shading differences, but both of these circumstances have been

ruled out. Additional data < 10,000 e-/pixel acquired during Cycles 21 and 22 add additional weight towards the lower end of the mean signal, where measuring the gain is more optimal (Downing 2006). As mentioned in the data section, a short subarray internal flat field is taken at the beginning of every visit; this ensures the lamp is fully operational, warmed up, and stable before the gain exposures are acquired. In addition, comparisons of the illumination levels of pairs of identical full-frame exposures show count rates are stable to $<< 0.5\%$.

Shutter-shading effects, a difference in effective exposure time due to variations in shutter blade travel time, are negligible. Analysis of on-orbit shutter behavior shows that exposure time variations are < 0.0009 sec and no shutter-shading corrections are required (Hilbert 2009). There remains some evidence for a low level ($\sim$1%) of shutter non-repeatability for the shortest exposure (<1 sec); if real, this affects the data in this report only at the lowest exposure level.

Downing et al. (2006) have reported seeing a non-linear mean variance in similar CCDs on the NTT telescope at La Silla Paranal Observatories. They speculate that the non-linearity might be caused by charge diffusion or migration. They concluded that although their gain value was affected $\sim$ 15%, the signal linearity remained excellent and unaffected. The possibility that this effect may be present for the WFC3 UVIS CCDs is under investigation. We note that the UVIS CCDs are linear up to and even somewhat beyond saturation (Gilliland et al. 2010).

The goal of this report has been to evaluate the Cycle 21 and early Cycle 22 gain measurements in order to monitor any relative changes over time, using the same techniques as previous cycles. We find the gain values for all quadrants have remained stable to within 1-2% of previously calculated values.

Acknowledgments

We would like to thank Dr. Gabriel Brammer for reviewing and providing helpful comments on this ISR. We would also like to thank Dr. Sylvia Baggett for her continued mentorship.

References

Baggett, S., WFC3 ISR 2008-12, "WFC3 TV3 Testing: UVIS Channel Calibration Subsystem Performance"

Baggett, S., WFC3 ISR 2008-13, "WFC3 TV3 Testing: UVIS-1 Gain Results"

Baggett, S. and T. Borders, WFC3 ISR 2009-29, "WFC3 SMOV Proposal 11419: UVIS Gain"

Borders, T., C. Pavlovsky, S. Baggett, WFC3 ISR 2011-13, "WFC3 Cycle 17 Proposal 11906: UVIS Gain"

Downing, M. et al., Proc. SPIE 6276, 627609 (2006)

Dressel, L., 2012. "Wide Field Camera 3 Instrument Handbook, Version 5.0"

Gilliland, R.L, A. Rajan, S. Deustua, WFC3 ISR 2010-10, " WFC3 UVIS Full Well Depths, and Linearity Near and Beyond Saturation"

Gunning, H. et al., WFC3 ISR 2013-02, "WFC3 Cycle 19 Proposal 12690: UVIS Gain"

Gunning, H. et al., WFC3 ISR 2014-05, "WFC3 Cycle 20 Proposal 13168: UVIS Gain"

Hilbert, B., WFC3 ISR 2009-25, "WFC3 SMOV Program 11427: UVIS Channel Shutter Shading,"

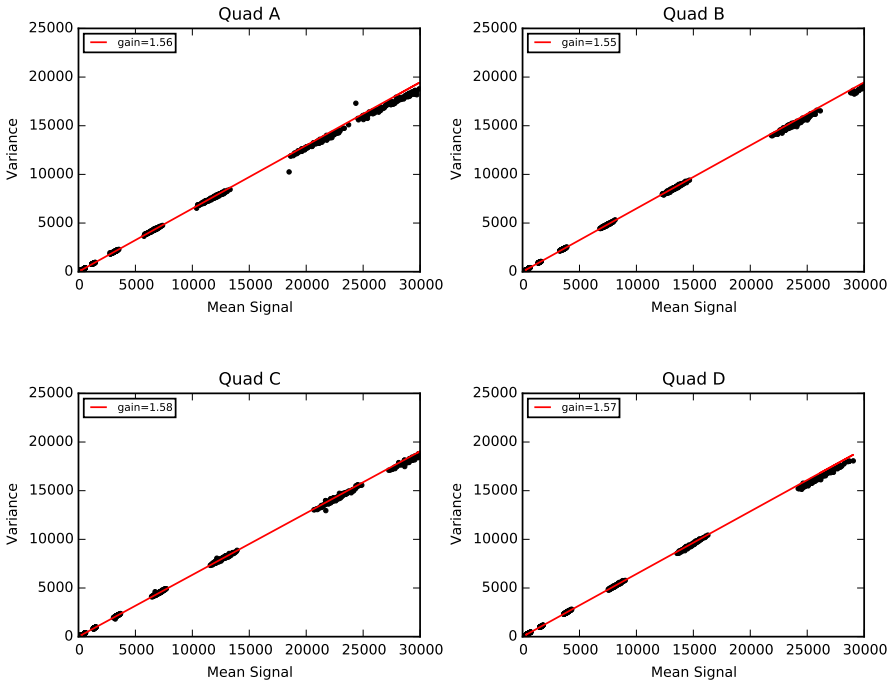

Figure 1: *Variance as a function of the Mean for the unbinned Cycle 21 data obtained in December 2013, PID 13561. Errors ∼ 0.01 e-/DN*

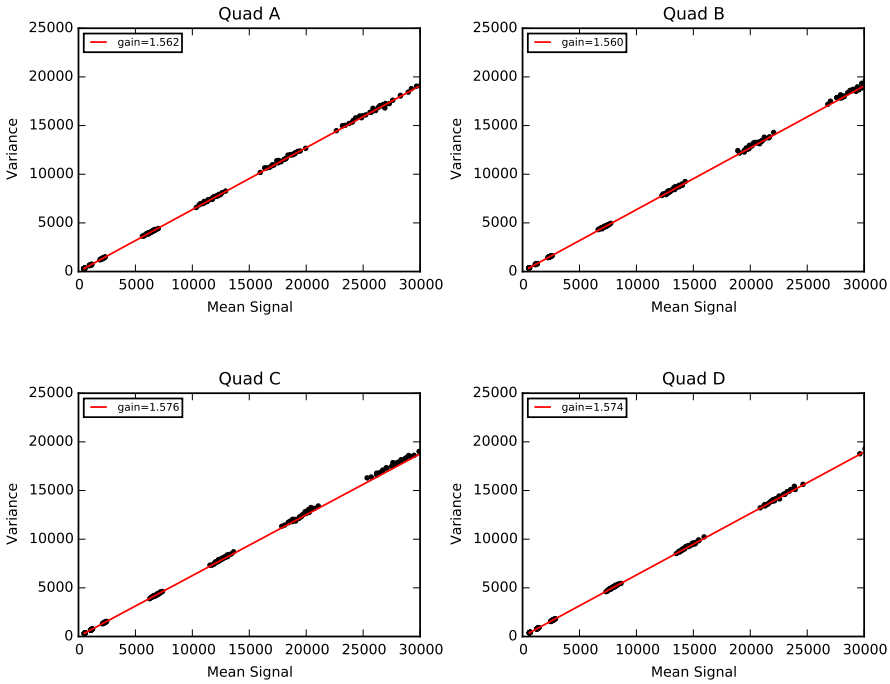

Figure 2: *Same as 1, but for the 2x2 binned data.*

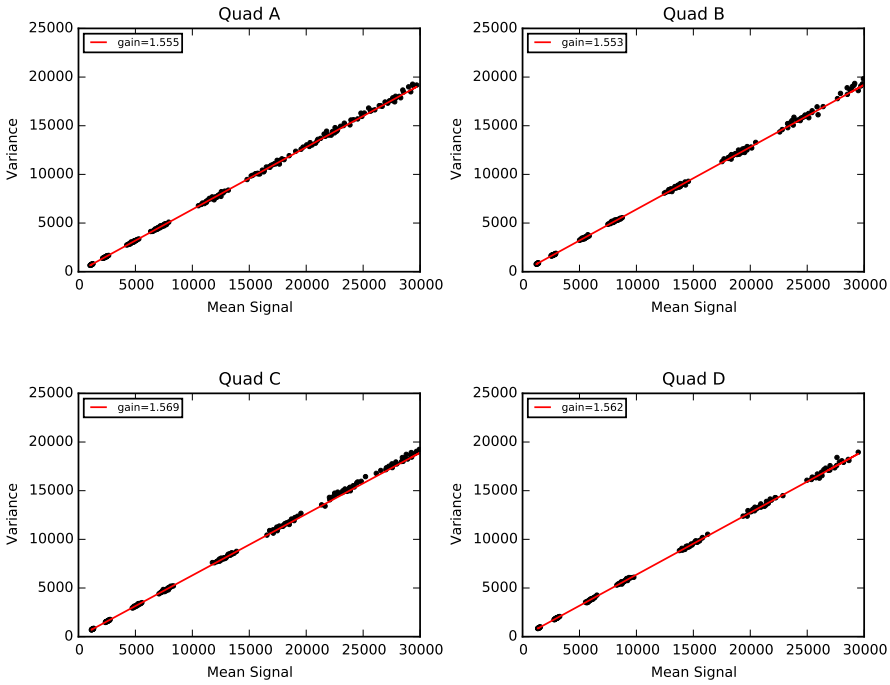

Figure 3: *Same as 1, but for the 3x3 binned data.*

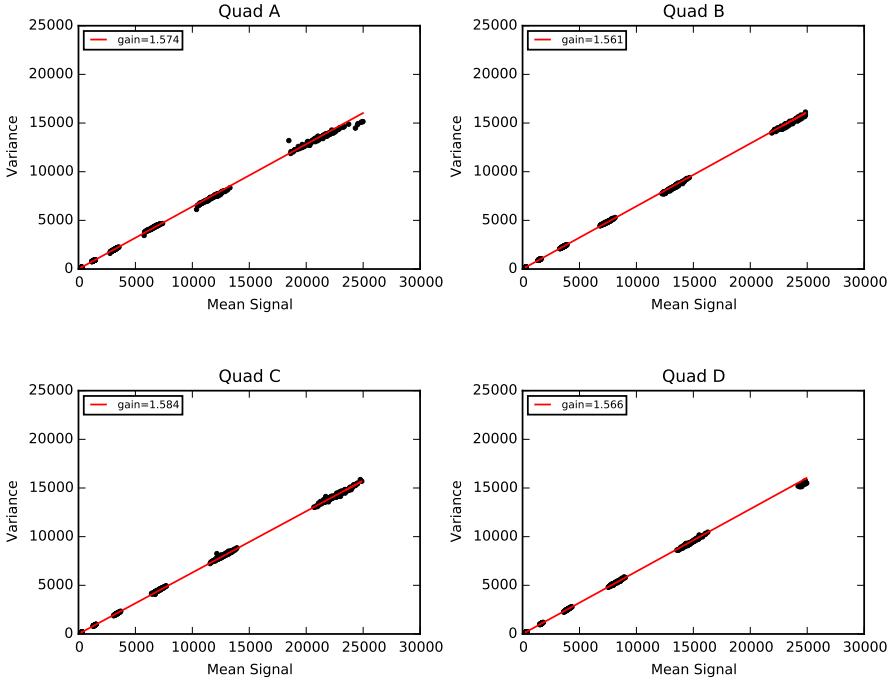

Figure 4: *Variance as a function of the Mean for the unbinned Cycle 21 data obtained in June 2014, PID 13561. Errors* $\sim$ *0.01 e-/DN*

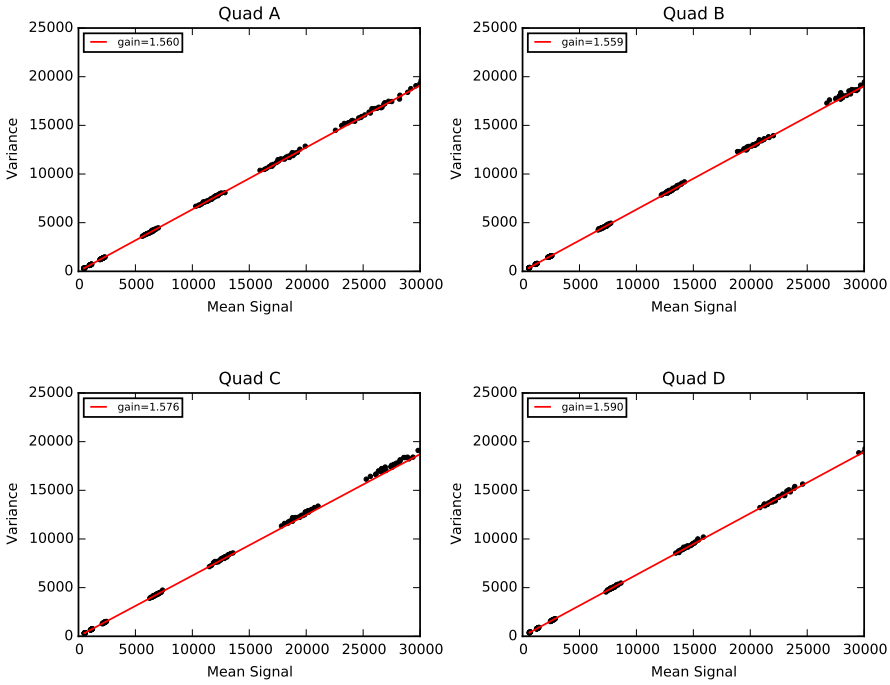

Figure 5: *Same as 4, but for the 2x2 binned data.*

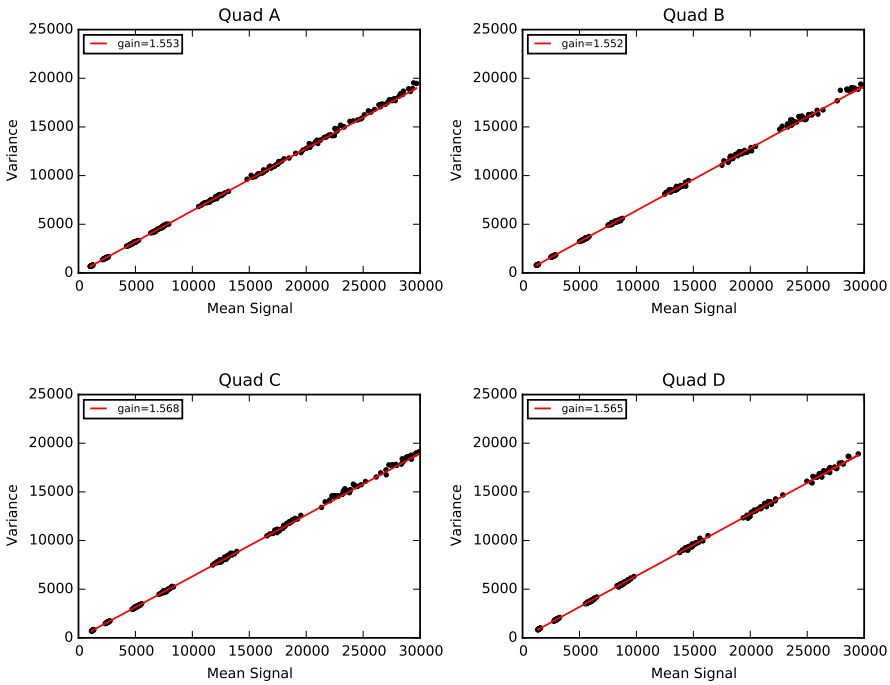

Figure 6: *Same as 4, but for the 3x3 binned data.*

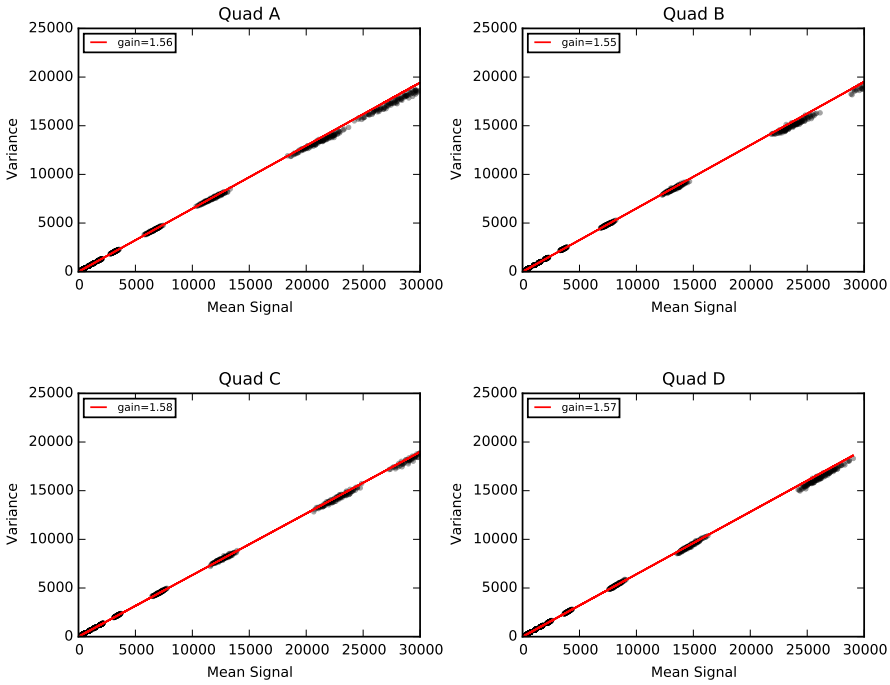

Figure 7: *Variance as a function of the Mean for the unbinned Cycle 22 data obtained in December 2014, PID 14007. Errors ∼ 0.01 e-/DN*

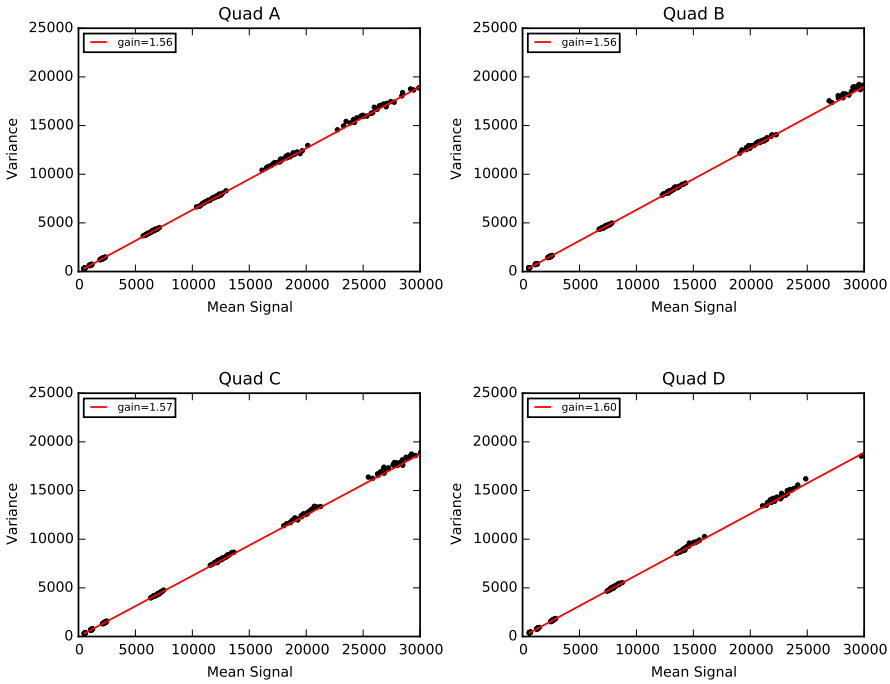

Figure 8: *Same as 7, but for the 2x2 binned data.*

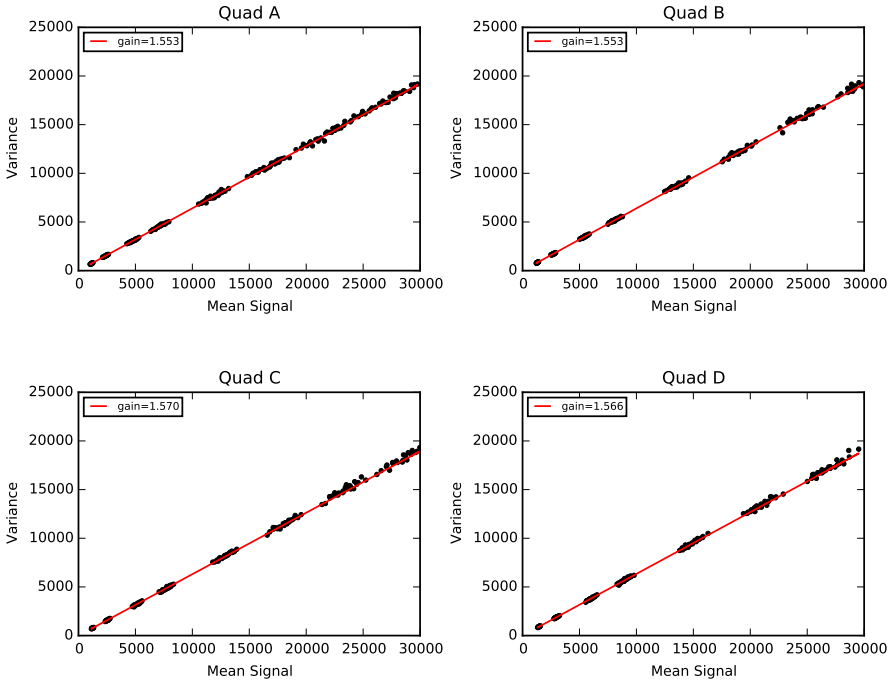

Figure 9: *Same as 7, but for the 3x3 binned data.*

				Chip 1			Chip 2		
Image name	**Obs date**	**Exp time**	**Binning**	**Mean**	**Stdev**	**Median**	**Mean**	**Stdev**	**Median**
icgf09opq	11-Dec-13	0.48	1	134.7	34.9	134.3	146.5	30.3	145.8
icgf09oqq	11-Dec-13	0.48	1	135.0	31.8	135.0	147.0	32.7	146.1
icgf06emq	9-Dec-13	1	1	279.5	74.5	279.7	304.0	49.9	302.7
icgf06enq	9-Dec-13	1	1	280.8	38.2	281.1	305.7	46.8	304.3
icgf09osq	11-Dec-13	1.5	1	419.1	48.4	420.5	456.4	62.8	454.9
icgf09otq	11-Dec-13	1.5	1	420.0	46.8	421.7	457.3	47.8	455.7
icgf08unq	8-Dec-13	2	1	560.7	81.5	562.9	610.3	62.6	608.0
icgf08uoq	8-Dec-13	2	1	561.7	62.3	563.5	611.4	90.9	609.2
icgf09ovq	11-Dec-13	3.5	1	984.7	92.6	989.3	1072.2	135.3	1069.1
icgf09owq	11-Dec-13	3.5	1	985.9	102.5	990.5	1073.2	101.9	1070.1
icgf07trq	12-Dec-13	5	1	1403.4	122.8	1410.6	1528.1	137.3	1524.2
icgf07tsq	12-Dec-13	5	1	1401.8	129.9	1408.9	1526.2	138.1	1522.6
icgf07tuq	12-Dec-13	7	1	1966.7	172.1	1977.3	2141.4	191.6	2137.1
icgf07tvq	12-Dec-13	7	1	1970.9	170.3	1981.4	2146.2	191.3	2141.9
icgf07toq	12-Dec-13	12	1	3342.7	281.9	3360.6	3640.6	319.4	3634.7
icgf07tpq	12-Dec-13	12	1	3352.5	286.0	3371.1	3651.3	322.7	3644.8
icgf08ukq	8-Dec-13	25	1	6968.0	587.9	7006.3	7563.4	659.8	7563.1
icgf08ulq	8-Dec-13	25	1	6985.5	589.3	7024.0	7612.6	661.3	7602.5
icgf06eiq	9-Dec-13	45	1	12563.7	1089.8	12632.9	13703.6	1212.6	13868.9
icgf06ekq	9-Dec-13	45	1	12594.8	1091.4	12664.6	13738.3	1215.3	13721.4
icgf05auq	5-Dec-13	80	1	22394.3	1919.0	22519.7	24457.1	2141.2	24429.4
icgf05avq	5-Dec-13	80	1	22454.4	1923.1	22579.6	24524.0	2146.1	24496.9
icgf04j5q	3-Dec-13	105	1	29499.8	2490.9	29664.9	32245.4	2782.4	32210.9
icgf04j6q	3-Dec-13	105	1	29578.6	2497.0	29744.0	32332.4	2788.1	32298.6
icgf18ssq	8-Jun-14	0.48	1	134.8	47.8	134.8	146.8	42.9	146.0
icgf18stq	8-Jun-14	0.48	1	135.5	70.2	135.1	147.2	42.8	146.4
icgf15n6q	7-Jun-14	1	1	279.9	90.0	279.8	304.6	43.3	303.5
icgf15n7q	7-Jun-14	1	1	280.5	46.8	280.8	305.5	49.7	304.1
icgf18svq	8-Jun-14	1.5	1	418.7	52.1	419.8	456.0	53.9	454.2
icgf18swq	8-Jun-14	1.5	1	420.3	75.9	421.5	457.6	55.9	455.8
icgf17rlq	8-Jun-14	2	1	561.6	56.5	563.8	611.2	66.8	609.3
icgf17rmq	8-Jun-14	2	1	560.8	61.0	562.6	610.6	70.9	608.6
icgf18syq	8-Jun-14	3.5	1	983.7	92.7	988.3	1071.3	103.2	1068.2
icgf18szq	8-Jun-14	3.5	1	984.2	88.6	989.1	1071.7	99.4	1069.0
icgf16u0q	4-Jun-14	5	1	1403.9	124.2	1410.8	1528.9	140.7	1525.1
icgf16u1q	4-Jun-14	5	1	1403.6	124.0	1410.5	1528.4	142.3	1524.9
icgf16u3q	4-Jun-14	7	1	1966.8	173.1	1977.0	2141.8	190.9	2137.7
icgf16u4q	4-Jun-14	7	1	1967.1	177.7	1977.3	2141.9	191.3	2137.4
icgf16txq	4-Jun-14	12	1	3353.2	282.9	3371.5	3652.3	321.1	3645.9
icgf16tyq	4-Jun-14	12	1	3362.9	282.5	3381.3	3663.2	327.8	3657.5
icgf17riq	8-Jun-14	25	1	6973.0	589.7	7010.6	7599.5	662.4	7589.1
icgf17rjq	8-Jun-14	25	1	6986.9	590.2	7024.9	7614.7	663.7	7604.2
icgf15n2q	7-Jun-14	45	1	12551.8	1086.7	12620.2	13693.5	1216.6	13675.9
icgf15n4q	7-Jun-14	45	1	12581.1	1089.2	12649.5	13724.6	1215.4	13707.4
icgf14wfq	5-Jun-14	80	1	22400.9	1920.6	22522.6	24468.5	2142.3	24441.0
icgf14wgq	5-Jun-14	80	1	22443.6	1924.0	22565.3	24516.2	2145.5	24489.0
icgf13i1q	3-Jun-14	105	1	29483.2	2489.3	29645.8	32230.0	2779.6	32197.1
icgf13i2q	3-Jun-14	105	1	29502.4	2490.4	29665.1	32251.1	2780.2	32217.4

Table 4: *Summary of data used in the Cycle 21 UVIS gain analysis. Mean, Stdev, and Median statistics are in DN, exposure time is in seconds.*

				Chip 1			Chip 2		
Image name	**Obs date**	**Exp time**	**Binning**	**Mean**	**Stdev**	**Median**	**Mean**	**Stdev**	**Median**
icrn09mdq	6-Dec-14	0.48	1	134.8	55.3	134.3	146.7	52.3	145.9
icrn09meq	6-Dec-14	0.48	1	134.9	35.8	134.7	147.0	60.0	146.0
icrn06l3q	5-Dec-14	1	1	280.7	40.6	281.2	305.9	106.2	304.5
icrn06l4q	5-Dec-14	1	1	282.8	51.6	283.5	308.0	42.4	306.7
icrn09mgq	6-Dec-14	1.5	1	420.3	57.4	421.4	457.7	98.4	455.8
icrn09mhq	6-Dec-14	1.5	1	420.5	49.1	421.7	457.7	53.5	456.1
icrn08n4q	6-Dec-14	2	1	566.8	63.3	568.6	617.1	110.4	614.7
icrn08n5q	6-Dec-14	2	1	566.2	115.7	568.0	616.1	83.8	613.6
icrn09mjq	6-Dec-14	3.5	1	986.6	111.3	990.9	1073.9	113.5	1070.9
icrn09mkq	6-Dec-14	3.5	1	988.5	96.0	993.0	1076.1	105.1	1073.1
icrn07msq	6-Dec-14	5	1	1406.5	126.1	1413.8	1531.5	146.5	1527.7
icrn07mtq	6-Dec-14	5	1	1407.0	131.0	1414.1	1532.0	140.3	1528.6
icrn07mvq	6-Dec-14	7	1	1973.9	175.6	1984.0	2149.7	214.5	2145.0
icrn07mwq	6-Dec-14	7	1	1973.3	173.3	1983.8	2149.2	211.2	2144.6
icrn07mpq	6-Dec-14	12	1	3380.6	287.8	3399.2	3681.9	321.8	3675.9
icrn07mqq	6-Dec-14	12	1	3380.2	283.5	3399.0	3681.5	325.2	3675.5
icrn08n1q	6-Dec-14	25	1	7021.6	589.5	7059.8	7651.7	665.0	7641.1
icrn08n2q	6-Dec-14	25	1	7042.5	594.1	7080.6	7674.7	666.7	7664.1
icrn06kzq	5-Dec-14	45	1	12572.2	1088.1	12641.3	13712.5	1213.8	13695.1
icrn06l1q	5-Dec-14	45	1	12602.0	1089.9	12670.9	13745.4	1216.2	13728.2
icrn05y1q	3-Dec-14	80	1	22396.2	1917.2	22519.7	24460.6	2144.3	24432.1
icrn05y2q	3-Dec-14	80	1	22438.1	1920.3	22561.0	24506.6	2146.9	24478.1
icrn04ghq	5-Dec-14	105	1	29615.9	2498.1	29780.6	32371.5	2789.4	32337.8
icrn04ggq	5-Dec-14	105	1	29533.6	2492.9	29697.5	32280.0	2783.3	32245.9

Table 5: *Summary of data used in the December Cycle 22 UVIS gain analysis. Mean, Stdev, and Median statistics are in DN, exposure time is in seconds.*

				Chip 1			Chip 2		
Image name	**Obs date**	**Exp time**	**Binning**	**Mean**	**Stdev**	**Median**	**Mean**	**Stdev**	**Median**
icgf01j6q	6-Dec-13	0.48	2	543.3	71.6	545.2	592.2	134.5	590.1
icgf01j5q	6-Dec-13	0.48	2	543.0	75.9	544.7	592.5	284.0	589.6
icgf02duq	5-Dec-13	1	2	1134.2	117.9	1140.1	1235.5	134.9	1232.8
icgf02dtq	5-Dec-13	1	2	1132.1	133.1	1137.4	1233.2	144.7	1230.7
icgf02dwq	5-Dec-13	2	2	2266.4	205.9	2279.2	2469.9	236.6	2467.3
icgf02dvq	5-Dec-13	2	2	2264.9	223.1	2277.4	2468.3	238.4	2464.7
icgf01j2q	6-Dec-13	6	2	6746.5	571.1	6788.1	7357.4	648.6	7354.9
icgf01j1q	6-Dec-13	6	2	6735.1	565.0	6776.3	7345.5	647.0	7341.9
icgf02dsq	5-Dec-13	11	2	12436.6	1036.6	12512.8	13575.8	1187.5	13572.7
icgf02drq	5-Dec-13	11	2	12408.5	1036.8	12484.8	13545.3	1185.4	13542.9
icgf01j4q	6-Dec-13	17	2	19185.8	1612.7	19305.0	20961.8	1827.7	20960.4
icgf01j3q	6-Dec-13	17	2	19174.0	1610.2	19293.9	20948.7	1826.1	20946.8
icgf02dyq	5-Dec-13	24	2	27195.5	2334.7	27362.3	29740.1	2612.3	29742.1
icgf02dxq	5-Dec-13	24	2	27199.9	2333.1	27367.6	29745.5	2613.4	29747.4
icgf01j8q	6-Dec-13	30	2	33989.2	2949.8	34198.8	37193.0	3285.0	37195.8
icgf01j7q	6-Dec-13	30	2	33965.7	2945.5	34175.6	37166.5	3282.6	37168.3
icgf10x1q	5-Jun-14	0.48	2	545.9	227.3	546.5	593.9	138.5	591.6
icgf10x2q	5-Jun-14	0.48	2	545.4	99.3	546.3	593.4	101.8	591.0
icgf11tcq	4-Jun-14	1	2	1125.6	124.2	1131.4	1226.4	121.8	1223.9
icgf11tdq	4-Jun-14	1	2	1126.1	117.3	1131.5	1226.7	187.7	1223.7
icgf11teq	4-Jun-14	2	2	2249.3	200.1	2262.3	2451.9	240.2	2448.9
icgf11tfq	4-Jun-14	2	2	2248.5	200.2	2262.0	2450.9	224.9	2447.8
icgf10wxq	5-Jun-14	6	2	6733.9	567.5	6774.6	7345.1	654.1	7342.1
icgf10wyq	5-Jun-14	6	2	6747.2	572.1	6788.2	7359.6	659.2	7356.1
icgf11taq	4-Jun-14	11	2	12361.6	1032.9	12437.4	13494.6	1180.7	13492.3
icgf11tbq	4-Jun-14	11	2	12381.0	1033.4	12457.5	13515.7	1185.5	13513.3
icgf10wzq	5-Jun-14	17	2	19149.5	1614.4	19265.4	20923.8	1824.9	20921.2
icgf10x0q	5-Jun-14	17	2	19162.2	1612.7	19277.4	20938.5	1826.7	20936.9
icgf11thq	4-Jun-14	24	2	27115.2	2323.3	27281.1	29655.9	2603.7	29657.7
icgf11tgq	4-Jun-14	24	2	27112.6	2322.4	27278.0	29652.7	2604.7	29654.6
icgf10x3q	5-Jun-14	30	2	33908.4	2942.3	34113.2	37109.0	3277.3	37112.6
icgf10x4q	5-Jun-14	30	2	33927.7	2945.0	34132.2	37128.7	3278.6	37130.9

Table 6: *Summary of data used in the Cycle 21 2x2 binned UVIS gain analysis. Mean, Stdev, and Median statistics are in DN, exposure time is in seconds.*

				Chip 1			Chip 2		
Image name	**Obs date**	**Exp time**	**Binning**	**Mean**	**Stdev**	**Median**	**Mean**	**Stdev**	**Median**
icrn01neq	6-Dec-14	0.48	2	547.7	70.7	549.9	597.0	96.5	595.1
icrn01nfq	6-Dec-14	0.48	2	547.6	84.2	549.7	596.7	73.6	594.8
icrn02noq	6-Dec-14	1	2	1137.0	128.6	1142.4	1238.9	159.5	1235.6
icrn02npq	6-Dec-14	1	2	1135.3	145.0	1140.6	1236.8	166.7	1233.7
icrn02nqq	6-Dec-14	2	2	2269.5	227.7	2282.2	2472.8	228.0	2469.5
icrn02nrq	6-Dec-14	2	2	2271.0	201.3	2284.0	2476.4	353.1	2471.5
icrn01naq	6-Dec-14	6	2	6826.5	571.5	6868.3	7445.4	659.3	7442.4
icrn01nbq	6-Dec-14	6	2	6822.6	570.4	6864.4	7440.7	654.6	7438.0
icrn02nmq	6-Dec-14	11	2	12444.2	1037.9	12519.8	13583.8	1198.9	13579.7
icrn02nnq	6-Dec-14	11	2	12461.9	1042.3	12537.7	13604.1	1196.4	13601.3
icrn01ncq	6-Dec-14	17	2	19364.0	1627.5	19482.1	21157.0	1845.9	21155.3
icrn01ndq	6-Dec-14	17	2	19368.2	1629.8	19486.2	21161.1	1845.3	21157.8
icrn02nsq	6-Dec-14	24	2	27312.0	2341.0	27476.6	29868.4	2625.5	29869.4
icrn02ntq	6-Dec-14	24	2	27319.3	2341.0	27485.0	29876.7	2626.4	29877.8
icrn01nhq	6-Dec-14	30	2	34214.3	2968.7	34420.3	37439.4	3308.1	37440.0
icrn01ngq	6-Dec-14	30	2	34212.6	2971.8	34417.8	37436.8	3307.9	37440.0

Table 7: *Summary of data used in the December Cycle 22 2x2 binned UVIS gain analysis. Mean, Stdev, and Median statistics are in DN, exposure time is in seconds.*

				Chip 1			Chip 2		
Image name	**Obs date**	**Exp time**	**Binning**	**Mean**	**Stdev**	**Median**	**Mean**	**Stdev**	**Median**
icgf03jtq	6-Dec-13	0.48	3	1223.2	138.9	1228.8	1333.3	176.6	1330.2
icgf03juq	6-Dec-13	0.48	3	1222.9	119.6	1228.6	1332.9	133.8	1328.2
icgf03jnq	6-Dec-13	1	3	2543.0	219.1	2556.8	2771.6	251.7	2767.6
icgf03joq	6-Dec-13	1	3	2546.5	218.0	2559.7	2774.7	258.5	2769.6
icgf03jxq	6-Dec-13	2	3	5085.7	430.7	5113.7	5545.0	481.2	5539.4
icgf03jyq	6-Dec-13	2	3	5094.0	420.5	5122.2	5555.8	553.3	5548.5
icgf03jrq	6-Dec-13	3	3	7613.8	618.6	7656.5	8305.9	718.4	8299.8
icgf03jsq	6-Dec-13	3	3	7615.9	621.3	7658.2	8307.2	717.0	8299.7
icgf03jlq	6-Dec-13	5	3	12645.3	1024.2	12717.0	13803.7	1182.2	13796.1
icgf03jmq	6-Dec-13	5	3	12670.4	1036.6	12742.1	13830.2	1185.0	13822.4
icgf03jpq	6-Dec-13	7	3	17797.0	1442.8	17897.3	19442.3	1657.4	19431.7
icgf03jqq	6-Dec-13	7	3	17789.8	1441.9	17890.4	19434.7	1657.8	19426.6
icgf03jvq	6-Dec-13	9	3	22937.0	1861.6	23065.7	25072.3	2129.5	25060.0
icgf03jwq	6-Dec-13	9	3	22932.3	1863.2	23060.7	25067.7	2128.0	25056.8
icgf03jzq	6-Dec-13	11	3	28072.1	2277.6	28228.1	30703.7	2599.9	30690.2
icgf03k0q	6-Dec-13	11	3	28075.0	2279.0	28232.2	30706.3	2598.1	30691.0
icgf03k1q	6-Dec-13	13	3	33202.9	2697.2	33387.7	36331.3	3066.0	36314.7
icgf12lmq	3-Jun-14	0.48	3	1228.2	121.9	1234.1	1338.7	131.2	1335.2
icgf12lnq	3-Jun-14	0.48	3	1227.7	118.4	1233.6	1338.2	138.5	1335.4
icgf12lgq	3-Jun-14	1	3	2535.6	215.4	2548.9	2764.5	263.5	2761.0
icgf12lhq	3-Jun-14	1	3	2532.8	223.0	2546.6	2761.0	250.6	2757.3
icgf12lqq	3-Jun-14	2	3	5077.9	421.4	5106.5	5537.4	482.5	5531.3
icgf12lrq	3-Jun-14	2	3	5075.8	442.4	5103.2	5535.0	480.9	5529.5
icgf12llq	3-Jun-14	3	3	7627.6	627.8	7670.0	8322.5	766.1	8315.8
icgf12lkq	3-Jun-14	3	3	7618.6	621.6	7660.9	8311.3	725.7	8303.9
icgf12leq	3-Jun-14	5	3	12678.5	1030.2	12750.4	13840.9	1185.4	13832.2
icgf12lfq	3-Jun-14	5	3	12681.9	1027.3	12753.2	13846.6	1194.6	13838.9
icgf12liq	3-Jun-14	7	3	17793.2	1444.7	17892.9	19439.8	1656.0	19428.7
icgf12ljq	3-Jun-14	7	3	17784.1	1448.8	17883.0	19429.0	1657.1	19419.0
icgf12loq	3-Jun-14	9	3	22923.6	1859.5	23049.4	25060.8	2128.1	25047.4
icgf12lpq	3-Jun-14	9	3	22927.1	1861.0	23052.7	25065.0	2128.0	25053.2
icgf12ltq	3-Jun-14	11	3	28060.2	2279.5	28214.4	30691.3	2597.8	30679.2
icgf12lsq	3-Jun-14	11	3	28058.7	2278.0	28212.5	30692.3	2597.1	30676.3
icgf12luq	3-Jun-14	13	3	33204.1	2696.8	33384.0	36335.7	3065.2	36315.9
icgf12lvq	3-Jun-14	13	3	33191.1	2696.1	33371.9	36321.5	3065.4	36306.5

Table 8: *Summary of data used in the Cycle 21 3x3 binned UVIS gain analysis. Mean, Stdev, and Median statistics are in DN, exposure time is in seconds.*

				Chip 1			Chip 2		
Image name	**Obs date**	**Exp time**	**Binning**	**Mean**	**Stdev**	**Median**	**Mean**	**Stdev**	**Median**
icrn03jhq	5-Dec-14	0.48	3	1224.3	164.7	1229.9	1334.4	135.2	1331.4
icrn03jiq	5-Dec-14	0.48	3	1223.3	132.0	1228.8	1333.3	130.2	1330.3
icrn03jbq	5-Dec-14	1	3	2539.0	223.5	2552.9	2767.8	255.4	2763.4
icrn03jcq	5-Dec-14	1	3	2527.0	217.7	2540.9	2754.0	244.9	2751.1
icrn03jmq	5-Dec-14	2	3	5093.7	420.5	5122.0	5553.9	482.3	5547.6
icrn03jlq	5-Dec-14	2	3	5106.0	419.5	5134.8	5567.4	482.6	5561.7
icrn03jfq	5-Dec-14	3	3	7629.8	618.8	7673.1	8323.1	717.5	8317.5
icrn03jgq	5-Dec-14	3	3	7629.5	620.4	7673.1	8323.2	750.8	8315.5
icrn03j9q	5-Dec-14	5	3	12667.4	1027.7	12739.0	13827.5	1185.0	13819.5
icrn03jaq	5-Dec-14	5	3	12693.7	1027.6	12765.5	13856.8	1190.6	13847.7
icrn03jdq	5-Dec-14	7	3	17809.8	1445.2	17909.9	19454.3	1660.5	19444.0
icrn03jeq	5-Dec-14	7	3	17826.1	1442.6	17927.1	19472.7	1667.6	19461.5
icrn03jjq	5-Dec-14	9	3	22943.3	1857.9	23072.2	25078.9	2129.8	25065.7
icrn03jkq	5-Dec-14	9	3	22982.5	1861.6	23111.0	25122.4	2141.1	25106.4
icrn03jnq	5-Dec-14	11	3	28115.4	2280.5	28271.0	30749.4	2603.8	30732.5
icrn03joq	5-Dec-14	11	3	28141.8	2282.8	28297.0	30777.4	2605.9	30762.4
icrn03jpq	5-Dec-14	13	3	33279.3	2701.6	33462.2	36411.9	3072.4	36393.4
icrn03jqq	5-Dec-14	13	3	33314.8	2704.1	33499.6	36452.1	3076.1	36433.5

Table 9: *Summary of data used in the December Cycle 22 3x3 binned UVIS gain analysis. Mean, Stdev, and Median statistics are in DN, exposure time is in seconds.*