

5.1.2.2 WAC FM LIGHT TRANSFER CALIBRATION RESULTS

Modified Version of Reference 5.1.2.2-1 - updates CL1/CL2 numbers in both tables

Reference 5.1.2.2-1 - IOM 388-PAG-CCA98-4, "WAC FM Calibration Results: Radiometric Slope Files", C. Avis, March 31, 1998

Reference 5.1.2.2-2 - IOM 388-PAG-CCA97-10, "WAC FM Calibration Results: System Gain", C. Avis, September 18, 1997

Reference 5.1.2.2-3 - IOM 388-PAG-CCA97-6, "WAC FM Calibration Results: Linearity", C. Avis, September 24, 1997

5.1.2.2.1 INTRODUCTION

The Flight Model thermal/vacuum testing included the acquisition of images taken in Light Transfer sequences. This memo reports on the use of those images to produce radiometric calibration files in each filter combination. These files store the slope term of the best linear fit to the response of each pixel (see Method - Slope Generation below).

The Light Transfer sequences generally consisted of 3 flat-field images at each of four exposure times plus 3 at zero exposure time. All were taken in 1x1 mode at Gain 2 with Lightflood ON and Antiblooming OFF. The detector was at -90° C and the chamber was at +5° C.

5.1.2.2.2 METHOD - Slope Generation

For each pixel, the 'energy' received is:

$$e = r(t - t_0)$$

where e is the received 'energy' (in *millisecond radiance_units*)
 r is the measured radiance of the illuminant (in *radiance_units*)
 t is the commanded exposure time (in *milliseconds*)
 t_0 is the shutter-offset correction (in *milliseconds*)

A linear model for the response of a pixel gives:

$$d = ce + d_0 + dc(t)$$

where d is the measured pixel response (in *DN*)
 c is the radiometric slope of the response (in *DN millisecond⁻¹ radiance_unit⁻¹*)
 d_0 is the pixel response at zero exposure (in *DN*)
 $dc(t)$ is the Dark-current value generated by exposure time t (in *DN*)

Both $dc(t)$ and t_0 were derived in earlier analyses and zero exposure images were available from which to extract d_0 . Therefore, given the five exposure points, c was derived by the method of Least Squares. The radiometric slope term c is actually stored as its reciprocal $z=1/c$ to speed its use in later computations of radiometric correction (see Method - Radiometric Correction below).

The radiance of the illuminant was recorded for each sequence (in units of *picoamperes* of current generated at the meter).

5.1.2.2.2.1 RESULTS

The following table lists some characteristics of the light-transfer sequences and the resulting radiometric slope for each filter combination.

Filters	# Points in sequence	Total # images	Maximum DN of input data	Mean slope (<i>picoamp-milliseconds / DN</i>)	Slope
CL1/CL2	4	12	3251	13.023	0.24
CL1/RED	4	13	3270	27.442	0.52
CL1/GRN	4	18	3561	53.269	0.86
CL1/BL1	3	9	2907	654.62	12.9
CL1/VIO	4	17	957	9448.42	240.7
CL1/HAL	4	12	3580	436.020	11.4
CL1/IRP90	4	12	3499	30.825	0.61
CL1/IR1	4	12	3245	27.923	0.55
IR3/CL2	4	12	3172	395.29	9.4
IR4/CL2	4	12	3518	6196.532	160.4
IR5/CL2	4	16	3304	45504.84	1465.1
CB3/CL2	4	12	3736	7144.816	205.3
MT3/CL2	4	12	3796	2187.655	50.0
CB2/CL2	4	12	3298	378.310	7.9
MT2/CL2 a	4	12	3226	823.517	19.6
MT2/CL2 b	4	14	3237	821.257	19.7
IR2/CL2	4	12	3179	131.941	2.9
IR3/IRP0	4	12	3356	798.067	21.1
IR4/IRP0	4	12	3691	12743.17	335.1
IR5/IRP0	3	12	3354	94405.24	2924.7
CB3/IRP0	4	11	3249	14438.65	452.6
MT3/IRP0	4	11	3462	4349.626	112.8
IR2/IRP0	4	11	3145	266.114	6.1
IR3/IRP90	3	9	2340	783.238	18.3
IR4/IRP90	4	12	3808	12277.88	323.9
IR5/IRP90	4	12	3474	91322.78	3231.3
CB3/IRP90	4	12	3309	14071.66	416.0
MT3/IRP90	4	12	3451	4316.000	99.2
IR2/IRP90	4	11	3150	264.332	5.7
IR2/IR1	4	12	3252	307.432	6.8
MT2/IR1	4	12	3530	893.235	21.2

5.1.2.2.2 ACCURACY

A check was performed to verify the consistency of the Light Transfer raw data files. Because the files were created over a period of hours, the concern was that there may have been changes in the illuminant output or other factors that would lead to data variability. Comparisons were made between files taken early in each sequence and those taken late. No significant variations were found which would compromise the results.

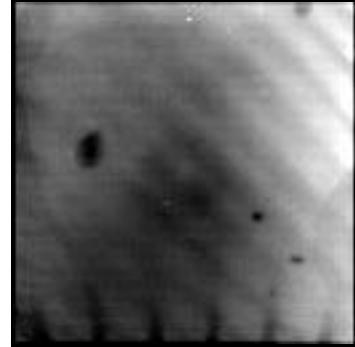
The following images are scaled-down views of the slope file of each filter combination. Each has had an optimal stretch applied to bring out any comparable characteristics. The files are ordered more-or-less in wavelength order (except for CL1/CL2) from violet to IR. In all cases, the bright areas are regions of lower sensitivity.



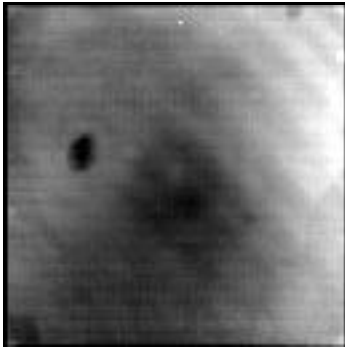
CL1/CL2



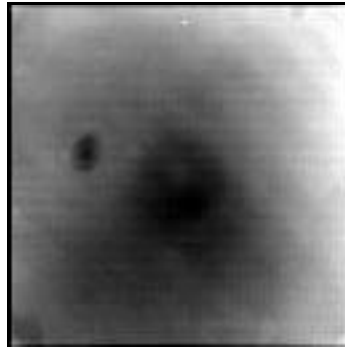
CL1/VIO



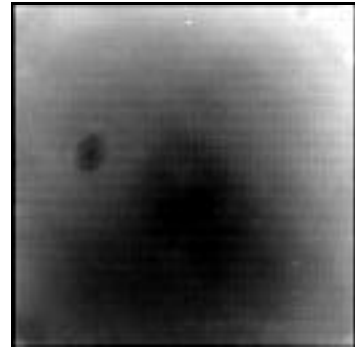
CL1/BL1



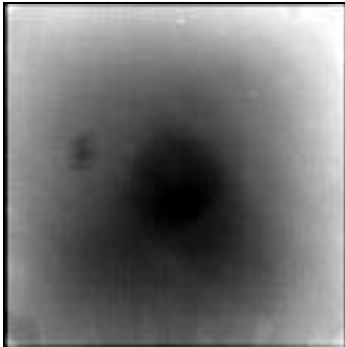
CL1/GRN



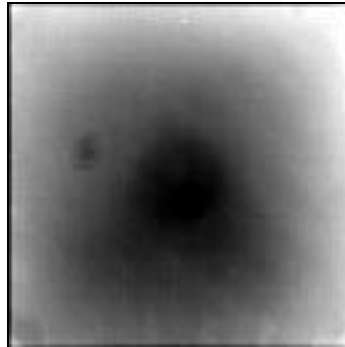
CL1/RED



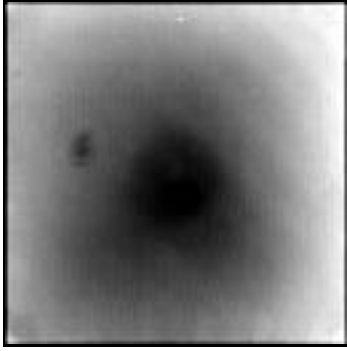
CL1/HAL



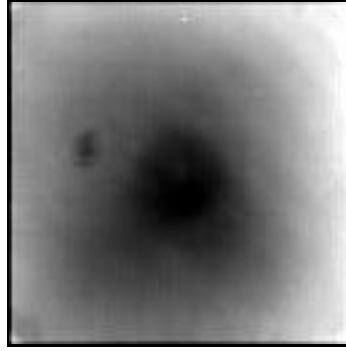
MT2/CL2



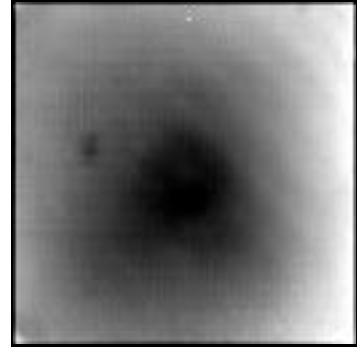
MT2/IR1



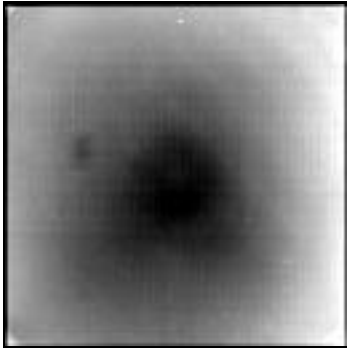
CB2/CL2



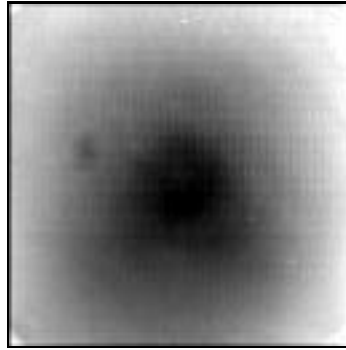
CL1/IR1



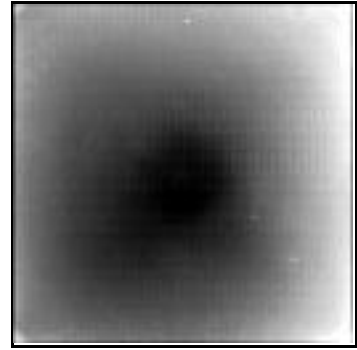
IR2/IR1



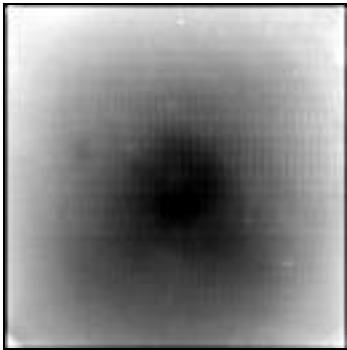
IR2/CL2



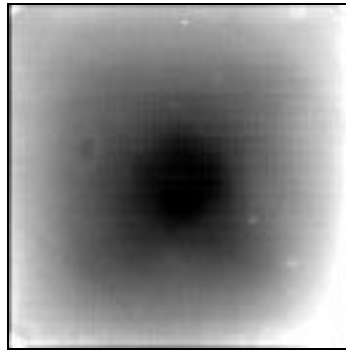
MT3/CL2



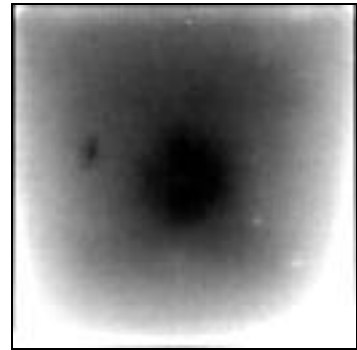
CB3/CL2



IR3/CL2

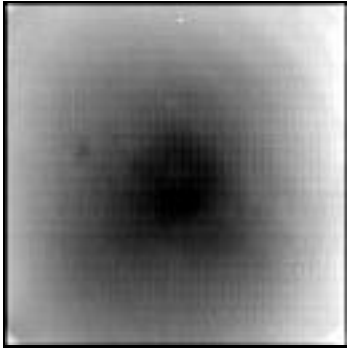


IR4/CL2

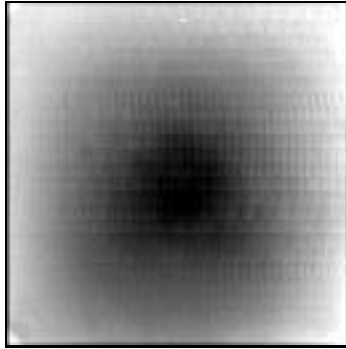


IR5/CL2

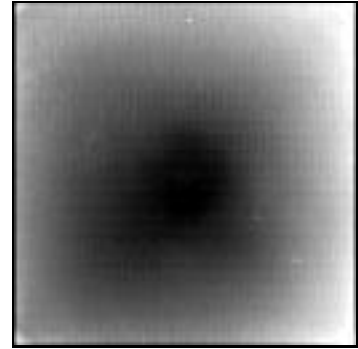
The following slope files are the IRP0 group.



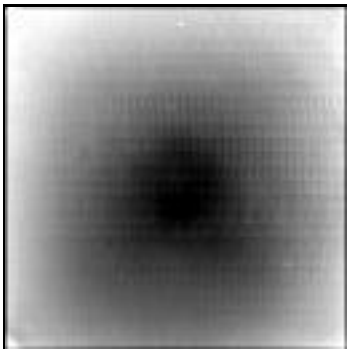
IR2/IRP0



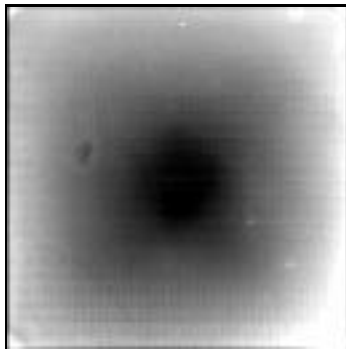
MT3/IRP0



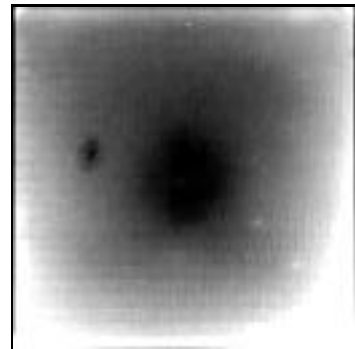
CB3/IRP0



IR3/IRP0

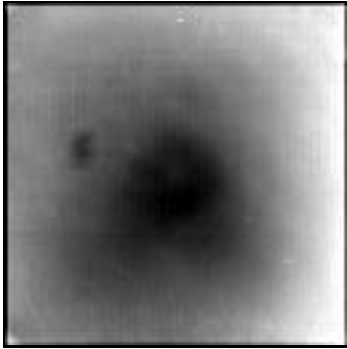


IR4/IRP0



IR5/IRP0

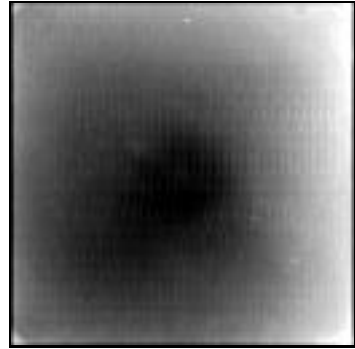
The following slope files are the IRP90 group.



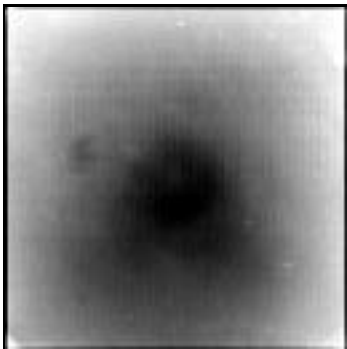
IR2/IRP90



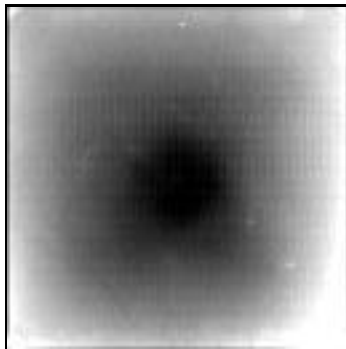
MT3/IRP90



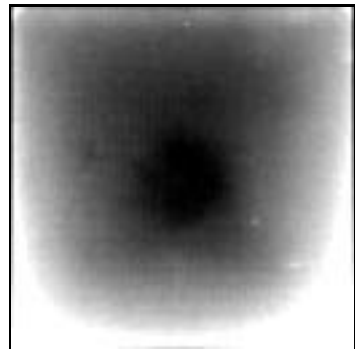
CB3/IRP90



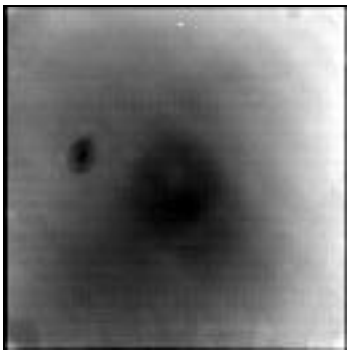
IR3/IRP90



IR4/IRP90

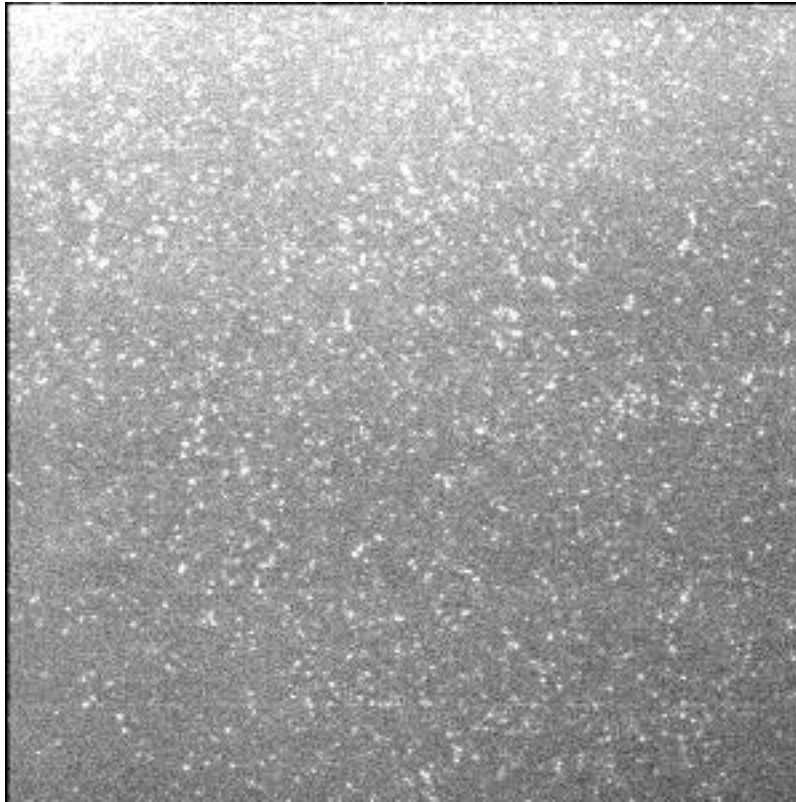


IR5/IRP90



CL1/IRP90

The following image shows a section of the CL1/VIO slope file at full resolution (300x300 in upper left corner). The bright speckles are small regions of low sensitivity. This filter is the only one which shows this effect. This is most likely due to non-uniformity of the Lumogen coating.



CL1/VIO

5.1.2.2.3 METHOD - Radiometric Correction

Radiometric Correction is the process by which the value of a physical property of the scene is derived from a recorded DN value. For this calibration analysis, a derivation of the radiance of the illuminant is desired so it can be compared to the value noted at the time of the exposure. This analysis makes no attempt to convert the measured radiance units (*picoamperes*) to physically meaningful units like *nanowatts cm⁻² ster⁻¹ nm⁻¹*. This filter-dependent correction can be applied to the corrected data at a later stage of the process.

Rearranging the above equations, the application of the derived radiometric slope is straightforward. For each pixel:

$$r = \frac{(d - d_0 - dc(t))z}{(t - t_0)}$$

Now that z has been derived, these values are all known and r can be easily derived from the raw DN value d . The value for d_0 can be taken from the above Least Squares fit or from any zero-exposure images (hopefully averaged).

The correction gets a little messier in real life. Appropriate corrections by the gain ratios will be necessary if all terms are not available in the same gain state. In addition, proper correction for the value of the overclocked pixels (bias level) must be included. Also, a scale factor may be included to produce output DN values in a certain range.

5.1.2.2.3.1 RESULTS

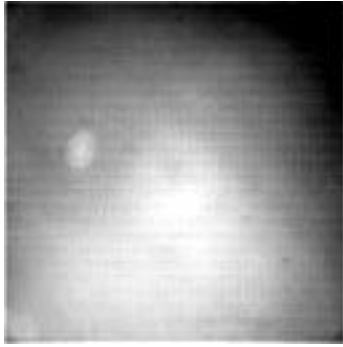
Flat-field images in various filters from non-light-transfer observations were corrected using the above equation and the derived slopes. Ideally, each corrected pixel value should equal the recorded actual radiance (times a scale factor). All are in 1x1 mode at Gain 2.

The two right-hand columns evaluate the quality of the correction. The “Percent Deviation from Expected” compares the corrected DN value to the value expected based upon the recorded radiance of the source. The “Flatness of Corrected Image” is the ratio of the DN of the upper-left corner to the DN of the center.

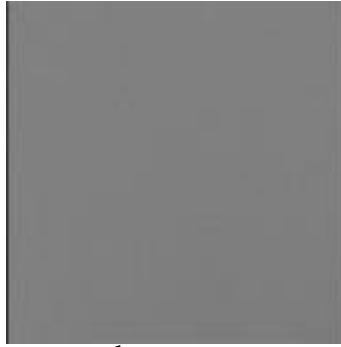
image	Filters	mean raw DN	raw	Actual radiance (picoamps)	Expected DN (scaled)	Mean corrected DN	Corrected	Percent Deviation from Expected	Flatness of Corrected Image
130275	CL1/CL2	3149.8	56.231	58.5	5850	5870.8	22.386	0.4	1.001
130338	CL1/RED	3146.9	58.639	58.5	5850	5622.6	20.904	-3.9	.9996
130274	CL1/RED	3776.7	66.373	58.5	5850	5629.4	24.843	-3.8	1.000
130339	CL1/BL1	3239.6	61.709	58.5	5850	4478.2	17.641	-23.4	1.002
130280	CL1/BL1	3400.6	64.470	58.5	5850	4707.1	18.147	-19.5	1.002
130340	CL1/HAL	3438.7	88.080	58.5	5850	5614.9	20.063	-4.0	1.000
130282	CL1/HAL	3501.2	89.364	58.5	5850	5719.6	20.274	-2.2	1.001
130341	CL1/IRP90	3464.5	65.870	58.5	5850	5789.4	20.997	-1.0	.9993
130285	CL1/IRP90	3524.3	66.615	58.5	5850	5891.6	21.176	0.7	1.001
130343	CL1/GRN	3221.8	50.912	58.5	5850	5223.9	19.552	-10.7	1.002
130276	CL1/GRN	3290.3	52.042	58.5	5850	5352.2	19.412	-8.5	1.001
130342	CL1/IR1	3295.0	63.951	58.5	5850	5977.8	22.411	2.2	1.001
130287	CL1/IR1	3338.6	64.700	59.0	5850	6059.0	22.571	3.6	1.001
130288	CL1/VIO	2701.9	65.988	59.0	5850	4373.3	19.400	-25.2	1.002
130359	IR5/CL2	1006.1	30.708	6000.0	6000	6177.2	44.541	3.0	.9919
130361	IR4/CL2	3395.5	86.578	8000.0	8000	7889.9	28.665	-1.4	1.000
130367	CB3/CL2	3611.1	101.579	8000.0	8000	7870.4	27.155	-1.6	.9996
130370	MT3/CL2	3704.9	84.013	8000.0	8000	7918.9	26.643	-1.0	1.000
130376	IR2/CL2	3120.9	66.988	8000.0	8000	7923.7	30.834	-1.0	1.000
130379	CB2/CL2	2193.9	46.087	8000.0	8000	7945.8	36.373	-0.7	.9982
130385	IR3/CL2	3673.8	86.280	8000.0	8000	7859.3	28.747	-1.8	1.001
931105	IR3/IRP0	3327.4	88.583	8000.0	8000	8075.8	30.461	0.9	.9962
931108	IR4/IRP0	2998.0	79.477	8000.0	8000	8069.3	31.771	0.9	.9968
931111	IR5/IRP0	3282.3	95.697	8000.0	8000	7922.3	30.949	-1.0	.9967
931114	CB3/IRP0	3203.1	98.310	8000.0	8000	8036.1	30.205	0.5	.9994
931118	MT3/IRP0	3420.8	87.771	8000.0	8000	8061.3	29.763	0.8	1.000
931121	IR2/IRP0	3159.9	71.042	8000.0	8000	8141.1	32.698	1.8	1.000
931125	IR2/IR1	3827.1	79.387	8000.0	8000	7643.3	35.359	-4.5	1.001
931131	MT2/IR1	3405.8	80.023	8000.0	8000	7799.0	27.786	-2.5	1.000
931133	MT2/CL2	3129.3	74.150	8000.0	8000	7826.5	29.944	-2.2	.9994
931134	IR3/IRP90	3213.4	77.178	8000.0	8000	7648.8	33.491	-4.4	.9928
931135	IR4/IRP90	3570.6	93.757	8000.0	8000	7639.8	26.914	-4.5	.9966
931136	IR5/IRP90	3241.6	108.844	8000.0	8000	7563.9	27.740	-5.5	1.001
931137	CB3/IRP90	3120.3	90.955	8000.0	8000	7624.8	29.291	-4.7	.9963
931138	MT3/IRP90	3286.4	77.467	8000.0	8000	7677.9	30.320	-4.0	.9935
931140	IR2/IRP90	3018.7	64.626	8000.0	8000	7716.4	31.461	-3.5	.9986

The significant deviations reported above are entirely due to the raw data have unexpectedly low values for the exposure times and radiances used. No cause has been determined. These data were tabulated anyway because they were the only examples of these filter combinations other than the Light Transfer data. Note that the corrected images were extremely flat.

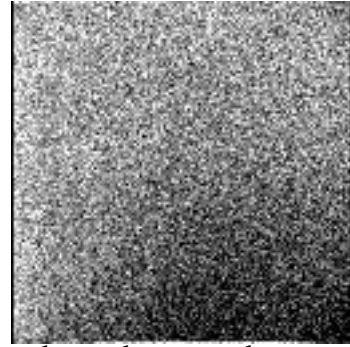
The images below show the effect of radiometric correction of a typical raw flat-field image. The raw image (with appropriate contrast enhancement) is compared to the corrected version (with the same enhancement) and to the corrected version with a strong enhancement to bring out any residual shading.



raw

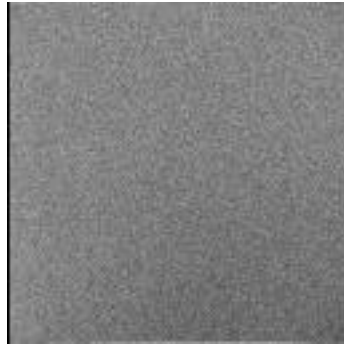


corrected



enhanced corrected

As reported in Reference 5.1.2.2-2 and Reference 5.1.2.2-3, Gain 2 goes non-linear at high DN values. The slope files created in the activity reported on here used the Light Transfer data which stayed in the linear regime. The images below show the attempted radiometric correction of a medium DN image and high DN image (identical contrast enhancements). The artifacts begin to appear (i.e., the response starts to go non-linear) when the raw pixels reach about 3500 DN.



medium-level input



high-level input

5.1.2.2.4 CONCLUSIONS

1. The radiometric slope files have been created for all filter combinations.
2. The accuracy of these files cannot be checked rigorously due the small number of non-Light Transfer images taken in the various filter combinations. The available images in the various filters were corrected using these files, but in some cases the input raw data does not agree closely with the raw Light Transfer data. This causes some of the corrected data to differ from the expected value. All corrected images were extremely flat, even if some had DN levels that were suspect.
3. The only residual structure seen consistently in the corrected images was dark corners in the IR filter data. There is currently no explanation for this behavior.
4. Gain 2 images with DN values greater than about 3500 showed poor correction by the linear function used. This is because the sensor goes non-linear above that DN level and can't be modelled by this linear scheme.
5. The CL1/VIO filter shows small regions of low sensitivity due to non-uniformity of the Lumigen coating.

5.1.2.2.5 IMAGES USED FOR ANALYSIS

image	day	eventtime	observation	filters	expos	temp						
130619	196	17:39:32.0	LIGHT_TRANSFER_507	CL1/RED	0	8.48	130697	196	22:53:54.0	LIGHT_TRANSFER_512	CL1/IRP90	460 8.48
130620	196	17:40:31.0	LIGHT_TRANSFER_507	CL1/RED	0	8.48	130698	196	22:55:0.0	LIGHT_TRANSFER_512	CL1/IRP90	1200 8.48
130621	196	17:41:30.0	LIGHT_TRANSFER_507	CL1/RED	0	8.48	130699	196	22:55:59.0	LIGHT_TRANSFER_512	CL1/IRP90	1200 8.48
130622	196	17:42:29.0	LIGHT_TRANSFER_507	CL1/RED	380	8.48	130700	196	0:53:14.0	LIGHT_TRANSFER_512	CL1/IRP90	1200 8.48
130623	196	17:43:28.0	LIGHT_TRANSFER_507	CL1/RED	380	8.48	130701	196	22:57:57.0	LIGHT_TRANSFER_512	CL1/IRP90	1800 8.48
130624	196	17:44:27.0	LIGHT_TRANSFER_507	CL1/RED	380	8.48	130702	196	22:58:56.0	LIGHT_TRANSFER_512	CL1/IRP90	1800 8.48
130625	196	17:45:33.0	LIGHT_TRANSFER_507	CL1/RED	1000	8.48	130703	196	22:59:55.0	LIGHT_TRANSFER_512	CL1/IRP90	1800 8.48
130626	196	17:46:32.0	LIGHT_TRANSFER_507	CL1/RED	1000	8.48	130704	196	23:1:6.0	LIGHT_TRANSFER_513	CL1/IR1	0 8.48
130627	196	17:47:31.0	LIGHT_TRANSFER_507	CL1/RED	1000	8.48	130705	196	23:2:5.0	LIGHT_TRANSFER_513	CL1/IR1	0 8.48
130660	196	21:15:38.0	LIGHT_TRANSFER_507	CL1/RED	1000	8.48	130734	197	0:54:24.0	LIGHT_TRANSFER_513	CL1/IR1	0 8.48
130628	196	17:48:30.0	LIGHT_TRANSFER_507	CL1/RED	1500	8.48	130735	197	0:55:23.0	LIGHT_TRANSFER_513	CL1/IR1	380 8.48
130661	196	21:16:37.0	LIGHT_TRANSFER_507	CL1/RED	1500	8.48	130736	197	0:56:22.0	LIGHT_TRANSFER_513	CL1/IR1	380 8.48
130662	196	21:17:36.0	LIGHT_TRANSFER_507	CL1/RED	1500	8.48	130737	197	0:57:21.0	LIGHT_TRANSFER_513	CL1/IR1	380 8.48
130631	196	17:51:52.0	LIGHT_TRANSFER_508	CL1/GRN	0	8.48	130710	196	23:7:17.0	LIGHT_TRANSFER_513	CL1/IR1	1000 8.48
130632	196	17:52:51.0	LIGHT_TRANSFER_508	CL1/GRN	0	8.48	130711	196	23:8:16.0	LIGHT_TRANSFER_513	CL1/IR1	1000 8.48
130633	196	17:53:50.0	LIGHT_TRANSFER_508	CL1/GRN	0	8.48	130712	196	23:9:15.0	LIGHT_TRANSFER_513	CL1/IR1	1000 8.48
130634	196	17:54:49.0	LIGHT_TRANSFER_508	CL1/GRN	820	8.48	130713	196	23:10:14.0	LIGHT_TRANSFER_513	CL1/IR1	1500 8.48
130635	196	17:55:48.0	LIGHT_TRANSFER_508	CL1/GRN	820	8.48	130714	196	23:11:13.0	LIGHT_TRANSFER_513	CL1/IR1	1500 8.48
130636	196	17:56:47.0	LIGHT_TRANSFER_508	CL1/GRN	820	8.48	130715	196	23:12:12.0	LIGHT_TRANSFER_513	CL1/IR1	1500 8.48
130637	196	17:58:0.0	LIGHT_TRANSFER_508	CL1/GRN	2000	8.48	130507	196	8:53:13.0	LIGHT_TRANSFER_520	IR3/CL2	0 8.48
130638	196	17:59:2.0	LIGHT_TRANSFER_508	CL1/GRN	2000	8.48	130508	196	8:54:12.0	LIGHT_TRANSFER_520	IR3/CL2	0 8.48
130639	196	18:0:4.0	LIGHT_TRANSFER_508	CL1/GRN	2000	8.48	130536	196	10:18:32.0	LIGHT_TRANSFER_520	IR3/CL2	0 7.45
130663	196	21:18:52.0	LIGHT_TRANSFER_508	CL1/GRN	2000	8.48	130537	196	10:19:31.0	LIGHT_TRANSFER_520	IR3/CL2	35 7.45
130664	196	21:19:54.0	LIGHT_TRANSFER_508	CL1/GRN	2000	8.48	130538	196	10:20:30.0	LIGHT_TRANSFER_520	IR3/CL2	35 7.54
130665	196	21:20:56.0	LIGHT_TRANSFER_508	CL1/GRN	2000	8.48	130539	196	10:21:29.0	LIGHT_TRANSFER_520	IR3/CL2	35 7.54
130666	196	21:21:58.0	LIGHT_TRANSFER_508	CL1/GRN	2000	8.48	130465	196	7:50:7.0	LIGHT_TRANSFER_520	IR3/CL2	90 8.48
130668	196	21:24:2.0	LIGHT_TRANSFER_508	CL1/GRN	2000	8.48	130467	196	7:52:5.0	LIGHT_TRANSFER_520	IR3/CL2	90 8.48
130669	196	21:25:4.0	LIGHT_TRANSFER_508	CL1/GRN	2000	8.48	130513	196	8:59:25.0	LIGHT_TRANSFER_520	IR3/CL2	90 8.48
130640	196	18:1:6.0	LIGHT_TRANSFER_508	CL1/GRN	3200	8.48	130468	196	7:53:5.0	LIGHT_TRANSFER_520	IR3/CL2	150 8.48
130718	196	23:32:48.0	LIGHT_TRANSFER_508	CL1/GRN	3200	8.48	130469	196	7:54:4.0	LIGHT_TRANSFER_520	IR3/CL2	150 8.48
130719	196	23:33:50.0	LIGHT_TRANSFER_508	CL1/GRN	3200	8.48	130470	196	7:55:3.0	LIGHT_TRANSFER_520	IR3/CL2	150 8.48
130643	196	18:4:31.0	LIGHT_TRANSFER_509	CL1/BL1	0	8.48	130471	196	7:56:13.0	LIGHT_TRANSFER_521	IR4/CL2	0 8.48
130645	196	18:6:29.0	LIGHT_TRANSFER_509	CL1/BL1	0	8.48	130472	196	7:57:12.0	LIGHT_TRANSFER_521	IR4/CL2	0 8.48
130720	196	23:35:1.0	LIGHT_TRANSFER_509	CL1/BL1	0	8.48	130773	196	7:58:11.0	LIGHT_TRANSFER_521	IR4/CL2	0 8.48
130647	196	18:8:49.0	LIGHT_TRANSFER_509	CL1/BL1	12000	8.48	130474	196	7:59:11.0	LIGHT_TRANSFER_521	IR4/CL2	70 8.48
130648	196	18:9:59.0	LIGHT_TRANSFER_509	CL1/BL1	12000	8.48	130475	196	8:0:10.0	LIGHT_TRANSFER_521	IR4/CL2	70 8.48
130721	196	23:36:11.0	LIGHT_TRANSFER_509	CL1/BL1	12000	8.48	130476	196	8:1:9.0	LIGHT_TRANSFER_521	IR4/CL2	70 8.48
130649	196	18:11:42.0	LIGHT_TRANSFER_509	CL1/BL1	32000	8.48	130477	196	8:2:16.0	LIGHT_TRANSFER_521	IR4/CL2	1500 8.48
130650	196	18:13:16.0	LIGHT_TRANSFER_509	CL1/BL1	32000	8.48	130524	196	9:0:40.0	LIGHT_TRANSFER_521	IR4/CL2	1500 8.48
130651	196	18:14:50.0	LIGHT_TRANSFER_509	CL1/BL1	32000	8.48	130515	196	9:1:39.0	LIGHT_TRANSFER_521	IR4/CL2	1500 8.48
130655	196	18:21:31.0	LIGHT_TRANSFER_510	CL1/VIO	0	8.48	130516	196	9:2:42.0	LIGHT_TRANSFER_521	IR4/CL2	2600 8.48
130656	196	18:22:30.0	LIGHT_TRANSFER_510	CL1/VIO	0	8.48	130517	196	9:3:44.0	LIGHT_TRANSFER_521	IR4/CL2	2600 8.48
930670	196	22:6:13.0	LIGHT_TRANSFER_510	CL1/VIO	0	8.39	130540	196	10:22:50.0	LIGHT_TRANSFER_521	IR4/CL2	2600 7.62
130658	196	18:25:19.0	LIGHT_TRANSFER_510	CL1/VIO	38000	8.48	130519	196	9:6:6.0	LIGHT_TRANSFER_522	IR5/CL2	0 8.48
930671	196	22:8:3.0	LIGHT_TRANSFER_510	CL1/VIO	38000	8.39	130520	196	9:7:5.0	LIGHT_TRANSFER_522	IR5/CL2	0 8.48
930672	196	22:9:53.0	LIGHT_TRANSFER_510	CL1/VIO	38000	8.39	130521	196	9:8:5.0	LIGHT_TRANSFER_522	IR5/CL2	0 8.48
930673	196	22:11:43.0	LIGHT_TRANSFER_510	CL1/VIO	38000	8.48	130522	196	9:9:7.0	LIGHT_TRANSFER_522	IR5/CL2	4600 8.48
130675	196	22:17:38.0	LIGHT_TRANSFER_510	CL1/VIO	100000	8.48	130547	196	11:33:16.0	LIGHT_TRANSFER_522	IR5/CL2	4600 8.39
130676	196	22:20:32.0	LIGHT_TRANSFER_510	CL1/VIO	100000	8.48	130548	196	11:34:18.0	LIGHT_TRANSFER_522	IR5/CL2	4600 8.39
130723	196	23:42:8.0	LIGHT_TRANSFER_510	CL1/VIO	100000	8.48	130489	196	8:15:14.0	LIGHT_TRANSFER_522	IR5/CL2	12000 8.48
130724	196	23:45:2.0	LIGHT_TRANSFER_510	CL1/VIO	100000	8.48	130490	196	8:16:24.0	LIGHT_TRANSFER_522	IR5/CL2	12000 8.48
130674	196	22:14:44.0	LIGHT_TRANSFER_510	CL1/VIO	100000	8.48	130525	196	9:12:39.0	LIGHT_TRANSFER_522	IR5/CL2	12000 8.48
130677	196	22:24:30.0	LIGHT_TRANSFER_510	CL1/VIO	150000	8.48	130526	196	9:13:49.0	LIGHT_TRANSFER_522	IR5/CL2	12000 8.48
130678	196	22:28:28.0	LIGHT_TRANSFER_510	CL1/VIO	150000	8.48	130492	196	8:18:53.0	LIGHT_TRANSFER_522	IR5/CL2	18000 8.48
130679	196	22:32:26.0	LIGHT_TRANSFER_510	CL1/VIO	150000	8.48	130493	196	8:20:11.0	LIGHT_TRANSFER_522	IR5/CL2	18000 8.48
130725	196	23:49:0.0	LIGHT_TRANSFER_510	CL1/VIO	150000	8.48	130494	196	8:21:29.0	LIGHT_TRANSFER_522	IR5/CL2	18000 8.48
130726	196	23:52:58.0	LIGHT_TRANSFER_510	CL1/VIO	150000	8.48	130498	196	8:15:8.0	LIGHT_TRANSFER_522	IR5/CL2	18000 8.48
130727	196	23:56:56.0	LIGHT_TRANSFER_510	CL1/VIO	150000	8.48	130528	196	9:16:26.0	LIGHT_TRANSFER_522	IR5/CL2	18000 8.48
130680	196	22:33:37.0	LIGHT_TRANSFER_511	CL1/HAL	0	8.48	130529	196	9:17:44.0	LIGHT_TRANSFER_522	IR5/CL2	18000 8.48
130681	196	22:34:36.0	LIGHT_TRANSFER_511	CL1/HAL	0	8.48	130495	196	8:22:39.0	LIGHT_TRANSFER_523	CB3/CL2	0 8.48
130682	196	22:35:35.0	LIGHT_TRANSFER_511	CL1/HAL	0	8.48	130496	196	8:23:38.0	LIGHT_TRANSFER_523	CB3/CL2	0 8.48
130683	196	22:36:45.0	LIGHT_TRANSFER_511	CL1/HAL	6800	8.48	130497	196	8:24:37.0	LIGHT_TRANSFER_523	CB3/CL2	0 8.48
130684	196	22:37:55.0	LIGHT_TRANSFER_511	CL1/HAL	6800	8.48	130498	196	8:25:37.0	LIGHT_TRANSFER_523	CB3/CL2	70 8.48
130685	196	22:39:5.0	LIGHT_TRANSFER_511	CL1/HAL	6800	8.48	130530	196	9:18:53.0	LIGHT_TRANSFER_523	CB3/CL2	70 8.48
130686	196	22:40:30.0	LIGHT_TRANSFER_511	CL1/HAL	15000	8.48	130531	196	9:19:52.0	LIGHT_TRANSFER_523	CB3/CL2	70 8.48
130687	196	22:41:48.0	LIGHT_TRANSFER_511	CL1/HAL	15000	8.48	130501	196	8:28:50.0	LIGHT_TRANSFER_523	CB3/CL2	1800 8.48
130688	196	22:43:6.0	LIGHT_TRANSFER_511	CL1/HAL	15000	8.48	130502	196	8:29:49.0	LIGHT_TRANSFER_523	CB3/CL2	1800 8.48
130689	196	22:44:40.0	LIGHT_TRANSFER_511	CL1/HAL	26000	8.48	130543	196	10:26:34.0	LIGHT_TRANSFER_523	CB3/CL2	1800 7.79
130690	196	22:46:14.0	LIGHT_TRANSFER_511	CL1/HAL	26000	8.48	130544	196	10:27:37.0	LIGHT_TRANSFER_523	CB3/CL2	3200 7.79
130691	196	22:47:48.0	LIGHT_TRANSFER_511	CL1/HAL	26000	8.48	130549	196	11:35:36.0	LIGHT_TRANSFER_523	CB3/CL2	3200 8.39
130692	196	22:48:59.0	LIGHT_TRANSFER_512	CL1/IRP90	0	8.48	130550	196	11:36:38.0	LIGHT_TRANSFER_523	CB3/CL2	3200 8.39
130693	196	22:49:58.0	LIGHT_TRANSFER_512	CL1/IRP90	0	8.48	130551	196	11:54:39.0	LIGHT_TRANSFER_524	MT3/CL2	0 8.48
130694	196	22:50:57.0	LIGHT_TRANSFER_512	CL1/IRP90	0	8.48	130552	196	11:55:38.0	LIGHT_TRANSFER_524	MT3/CL2	0 8.48
130695	196	22:51:56.0	LIGHT_TRANSFER_512	CL1/IRP90	460	8.48	130553	196	11:56:37.0	LIGHT_TRANSFER_524	MT3/CL2	0 8.48
130696	196	22:52:55.0	LIGHT_TRANSFER_512	CL1/IRP90	460	8.48	130611	196	15:44:18.0	LIGHT_TRANSFER_524	MT3/CL2	260 8.48
							130612	196	15:45:17.0	LIGHT_TRANSFER_524	MT3/CL2	260 8.48

130613	196	15:46:16.0	LIGHT_TRANSFER_524	MT3/CL2	260	8.48	131917	200	5:2:41.0	LIGHT_TRANSFER_544	IR3/IRP90	80	8.48
130557	196	12:0:51.0	LIGHT_TRANSFER_524	MT3/CL2	560	8.48	131918	200	5:3:40.0	LIGHT_TRANSFER_544	IR3/IRP90	80	8.48
130558	196	12:1:50.0	LIGHT_TRANSFER_524	MT3/CL2	560	8.48	131919	200	5:4:46.0	LIGHT_TRANSFER_544	IR3/IRP90	220	8.48
130559	196	12:3:48.0	LIGHT_TRANSFER_524	MT3/CL2	560	8.48	131920	200	7:2:1.0	LIGHT_TRANSFER_544	IR3/IRP90	220	8.48
130560	196	12:3:49.0	LIGHT_TRANSFER_524	MT3/CL2	1000	8.48	131979	200	7:26:0.0	LIGHT_TRANSFER_544	IR3/IRP90	220	8.48
130561	196	12:4:48.0	LIGHT_TRANSFER_524	MT3/CL2	1000	8.48	131925	200	5:11:1.0	LIGHT_TRANSFER_545	IR4/IRP90	0	8.48
130562	196	12:5:47.0	LIGHT_TRANSFER_524	MT3/CL2	1000	8.48	131926	200	5:12:0.0	LIGHT_TRANSFER_545	IR4/IRP90	0	8.48
130563	196	12:6:58.0	LIGHT_TRANSFER_525	CB2/CL2	0	8.48	131927	200	5:12:59.0	LIGHT_TRANSFER_545	IR4/IRP90	0	8.48
130564	196	12:7:56.0	LIGHT_TRANSFER_525	CB2/CL2	0	8.48	131984	200	7:30:8.0	LIGHT_TRANSFER_545	IR4/IRP90	1200	8.48
130565	196	12:8:55.0	LIGHT_TRANSFER_525	CB2/CL2	0	8.48	131985	200	7:31:7.0	LIGHT_TRANSFER_545	IR4/IRP90	1200	8.48
130566	196	12:9:55.0	LIGHT_TRANSFER_525	CB2/CL2	35	8.48	131986	200	7:32:6.0	LIGHT_TRANSFER_545	IR4/IRP90	1200	8.48
130567	196	12:10:54.0	LIGHT_TRANSFER_525	CB2/CL2	35	8.48	131931	200	5:17:19.0	LIGHT_TRANSFER_545	IR4/IRP90	3200	8.48
130568	196	12:11:53.0	LIGHT_TRANSFER_525	CB2/CL2	35	8.48	131932	200	5:18:21.0	LIGHT_TRANSFER_545	IR4/IRP90	3200	8.48
130569	196	12:12:58.0	LIGHT_TRANSFER_525	CB2/CL2	90	8.48	131987	200	7:33:17.0	LIGHT_TRANSFER_545	IR4/IRP90	3200	8.48
130570	196	12:13:57.0	LIGHT_TRANSFER_525	CB2/CL2	90	8.48	131934	200	5:20:33.0	LIGHT_TRANSFER_545	IR4/IRP90	5600	8.48
130602	196	12:54:58.0	LIGHT_TRANSFER_525	CB2/CL2	90	8.48	131935	200	5:21:43.0	LIGHT_TRANSFER_545	IR4/IRP90	5600	8.48
130603	196	12:55:57.0	LIGHT_TRANSFER_525	CB2/CL2	150	8.48	131936	200	5:22:53.0	LIGHT_TRANSFER_545	IR4/IRP90	5600	8.48
130604	196	12:56:56.0	LIGHT_TRANSFER_525	CB2/CL2	150	8.48	131937	200	5:24:4.0	LIGHT_TRANSFER_546	IR5/IRP90	0	8.48
130605	196	12:57:56.0	LIGHT_TRANSFER_525	CB2/CL2	150	8.48	131938	200	5:25:3.0	LIGHT_TRANSFER_546	IR5/IRP90	0	8.48
130575	196	12:19:17.0	LIGHT_TRANSFER_526	MT2/CL2	0	8.48	131939	200	5:26:2.0	LIGHT_TRANSFER_546	IR5/IRP90	0	8.48
130576	196	12:20:16.0	LIGHT_TRANSFER_526	MT2/CL2	0	8.48	131941	200	5:28:22.0	LIGHT_TRANSFER_546	IR5/IRP90	10000	8.48
130577	196	12:21:15.0	LIGHT_TRANSFER_526	MT2/CL2	0	8.48	131942	200	5:29:32.0	LIGHT_TRANSFER_546	IR5/IRP90	10000	8.48
130578	196	12:22:15.0	LIGHT_TRANSFER_526	MT2/CL2	80	8.48	131988	200	7:34:39.0	LIGHT_TRANSFER_546	IR5/IRP90	10000	8.48
130579	196	12:23:14.0	LIGHT_TRANSFER_526	MT2/CL2	80	8.48	131943	200	5:31:15.0	LIGHT_TRANSFER_546	IR5/IRP90	22000	8.48
130580	196	12:24:13.0	LIGHT_TRANSFER_526	MT2/CL2	80	8.48	131944	200	5:32:49.0	LIGHT_TRANSFER_546	IR5/IRP90	22000	8.48
130581	196	12:25:18.0	LIGHT_TRANSFER_526	MT2/CL2	180	8.48	131945	200	5:34:23.0	LIGHT_TRANSFER_546	IR5/IRP90	22000	8.48
130582	196	12:26:17.0	LIGHT_TRANSFER_526	MT2/CL2	180	8.48	131946	200	5:36:13.0	LIGHT_TRANSFER_546	IR5/IRP90	38000	8.48
130583	196	12:27:16.0	LIGHT_TRANSFER_526	MT2/CL2	180	8.48	131947	200	5:38:3.0	LIGHT_TRANSFER_546	IR5/IRP90	38000	8.48
130584	196	12:28:16.0	LIGHT_TRANSFER_526	MT2/CL2	320	8.48	132009	200	8:4:54.0	LIGHT_TRANSFER_546	IR5/IRP90	38000	8.48
130586	196	12:30:14.0	LIGHT_TRANSFER_526	MT2/CL2	320	8.48	131949	200	5:41:3.0	LIGHT_TRANSFER_547	CB3/IRP90	0	8.48
130606	196	12:59:10.0	LIGHT_TRANSFER_526	MT2/CL2	320	8.48	131950	200	5:42:2.0	LIGHT_TRANSFER_547	CB3/IRP90	0	8.48
130587	196	12:31:26.0	LIGHT_TRANSFER_527	IR2/CL2	0	8.48	131951	200	5:43:1.0	LIGHT_TRANSFER_547	CB3/IRP90	0	8.48
130588	196	12:32:25.0	LIGHT_TRANSFER_527	IR2/CL2	0	8.48	131952	200	5:44:0.0	LIGHT_TRANSFER_547	CB3/IRP90	1200	8.48
130589	196	12:33:24.0	LIGHT_TRANSFER_527	IR2/CL2	0	8.48	131990	200	7:37:59.0	LIGHT_TRANSFER_547	CB3/IRP90	1200	8.48
130607	196	13:0:23.0	LIGHT_TRANSFER_527	IR2/CL2	10	8.48	131991	200	7:38:58.0	LIGHT_TRANSFER_547	CB3/IRP90	1200	8.48
130616	196	16:1:1.0	LIGHT_TRANSFER_527	IR2/CL2	10	8.48	131955	200	5:47:16.0	LIGHT_TRANSFER_547	CB3/IRP90	3200	8.48
130618	196	16:6:13.0	LIGHT_TRANSFER_527	IR2/CL2	10	8.48	131956	200	5:48:18.0	LIGHT_TRANSFER_547	CB3/IRP90	3200	8.48
130593	196	12:37:40.0	LIGHT_TRANSFER_527	IR2/CL2	30	8.48	131957	200	5:49:20.0	LIGHT_TRANSFER_547	CB3/IRP90	3200	8.48
130594	196	12:38:39.0	LIGHT_TRANSFER_527	IR2/CL2	30	8.48	131958	200	5:50:30.0	LIGHT_TRANSFER_547	CB3/IRP90	5600	8.48
130610	196	12:39:36.0	LIGHT_TRANSFER_527	IR2/CL2	30	8.48	131959	200	5:51:47.0	LIGHT_TRANSFER_547	CB3/IRP90	5600	8.48
130596	196	12:40:38.0	LIGHT_TRANSFER_527	IR2/CL2	50	8.48	131960	200	5:52:50.0	LIGHT_TRANSFER_547	CB3/IRP90	5600	8.48
130597	196	12:41:37.0	LIGHT_TRANSFER_527	IR2/CL2	50	8.48	131961	200	5:54:1.0	LIGHT_TRANSFER_548	MT3/IRP90	0	8.48
130598	196	12:42:36.0	LIGHT_TRANSFER_527	IR2/CL2	50	8.48	131962	200	5:55:0.0	LIGHT_TRANSFER_548	MT3/IRP90	0	8.48
131141	198	17:49:42.0	LIGHT_TRANSFER_532	IR3/IRP0	0	8.48	131992	200	7:40:9.0	LIGHT_TRANSFER_548	MT3/IRP90	0	8.48
131142	198	17:50:41.0	LIGHT_TRANSFER_532	IR3/IRP0	0	8.48	131993	200	7:41:18.0	LIGHT_TRANSFER_548	MT3/IRP90	460	8.48
131143	198	17:51:40.0	LIGHT_TRANSFER_532	IR3/IRP0	0	8.48	131994	200	7:42:7.0	LIGHT_TRANSFER_548	MT3/IRP90	460	8.48
131233	198	20:10:54.0	LIGHT_TRANSFER_532	IR3/IRP0	80	8.48	131995	200	7:43:6.0	LIGHT_TRANSFER_548	MT3/IRP90	460	8.48
131234	198	20:11:54.0	LIGHT_TRANSFER_532	IR3/IRP0	80	8.48	131996	200	7:44:12.0	LIGHT_TRANSFER_548	MT3/IRP90	1200	8.48
131235	198	20:12:53.0	LIGHT_TRANSFER_532	IR3/IRP0	80	8.48	131997	200	7:45:11.0	LIGHT_TRANSFER_548	MT3/IRP90	1200	8.48
131207	198	19:27:37.0	LIGHT_TRANSFER_532	IR3/IRP0	220	8.48	131998	200	7:46:10.0	LIGHT_TRANSFER_548	MT3/IRP90	1200	8.48
931147	198	17:55:53.0	LIGHT_TRANSFER_532	IR3/IRP0	220	8.48	131999	200	7:47:9.0	LIGHT_TRANSFER_548	MT3/IRP90	1600	8.48
931148	198	17:56:52.0	LIGHT_TRANSFER_532	IR3/IRP0	220	8.48	132001	200	7:49:7.0	LIGHT_TRANSFER_548	MT3/IRP90	1600	8.48
131208	198	19:28:36.0	LIGHT_TRANSFER_532	IR3/IRP0	320	8.48	132010	200	8:6:5.0	LIGHT_TRANSFER_548	MT3/IRP90	1800	8.48
131209	198	19:29:36.0	LIGHT_TRANSFER_532	IR3/IRP0	320	8.48	131973	200	6:6:31.0	LIGHT_TRANSFER_549	IR2/IRP90	0	8.48
131210	198	19:30:35.0	LIGHT_TRANSFER_532	IR3/IRP0	320	8.48	131974	200	6:7:30.0	LIGHT_TRANSFER_549	IR2/IRP90	0	8.48
931153	198	18:2:9.0	LIGHT_TRANSFER_533	IR4/IRP0	0	8.48	131975	200	6:8:29.0	LIGHT_TRANSFER_549	IR2/IRP90	0	8.48
931154	198	18:3:8.0	LIGHT_TRANSFER_533	IR4/IRP0	0	8.48	131976	200	6:9:28.0	LIGHT_TRANSFER_549	IR2/IRP90	20	8.48
931155	198	18:4:7.0	LIGHT_TRANSFER_533	IR4/IRP0	0	8.48	131977	200	6:10:27.0	LIGHT_TRANSFER_549	IR2/IRP90	20	8.48
131211	198	19:31:44.0	LIGHT_TRANSFER_533	IR4/IRP0	1200	8.48	132002	200	7:50:18.0	LIGHT_TRANSFER_549	IR2/IRP90	20	8.48
931156	198	18:5:7.0	LIGHT_TRANSFER_533	IR4/IRP0	1200	8.48	132003	200	7:51:24.0	LIGHT_TRANSFER_549	IR2/IRP90	50	8.48
931158	198	18:8:13.0	LIGHT_TRANSFER_533	IR4/IRP0	1200	8.48	132004	200	7:52:23.0	LIGHT_TRANSFER_549	IR2/IRP90	50	8.48
131212	198	19:32:55.0	LIGHT_TRANSFER_533	IR4/IRP0	3200	8.48	132005	200	7:53:22.0	LIGHT_TRANSFER_549	IR2/IRP90	50	8.48
131213	198	19:33:57.0	LIGHT_TRANSFER_533	IR4/IRP0	3200	8.48	132006	200	7:54:21.0	LIGHT_TRANSFER_549	IR2/IRP90	100	8.48
131249	198	20:3:41.0	LIGHT_TRANSFER_533	IR4/IRP0	3200	8.48	132007	200	7:55:20.0	LIGHT_TRANSFER_549	IR2/IRP90	100	8.48
131215	198	19:36:10.0	LIGHT_TRANSFER_533	IR4/IRP0	5600	8.48	132011	200	11:20:50.0	LIGHT_TRANSFER_555	MT2/CL2	0	8.48
131216	198	19:37:20.0	LIGHT_TRANSFER_533	IR4/IRP0	5600	8.48	132012	200	11:21:49.0	LIGHT_TRANSFER_555	MT2/CL2	0	8.48
131217	198	19:38:30.0	LIGHT_TRANSFER_533	IR4/IRP0	5600	8.48	132013	200	11:22:48.0	LIGHT_TRANSFER_555	MT2/CL2	0	8.48
131237	198	20:15:35.0	LIGHT_TRANSFER_534	IR5/IRP0	10000	8.48	132014	200	11:23:47.0	LIGHT_TRANSFER_555	MT2/CL2	80	8.48
131238	198	20:16:46.0	LIGHT_TRANSFER_534	IR5/IRP0	10000	8.48	132015	200	11:24:46.0	LIGHT_TRANSFER_555	MT2/CL2	80	8.48
131239	198	20:17:56.0	LIGHT_TRANSFER_534	IR5/IRP0	1000	8.48	132016	200	11:25:45.0	LIGHT_TRANSFER_555	MT2/CL2	80	8.48
931159	198	18:9:23.0	LIGHT_TRANSFER_534	IR5/IRP0	10000	8.48	132017	200	11:27:2.0	LIGHT_TRANSFER_555	MT2/CL2	220	8.48
931160	198	18:10:34.0	LIGHT_TRANSFER_534	IR5/IRP0	10000	8.48	132018	200	11:28:1.0	LIGHT_TRANSFER_555	MT2/CL2	220	8.48
931161	198	18:11:44.0	LIGHT_TRANSFER_534	IR5/IRP0	10000	8.48	132029	200	11:43:33.0	LIGHT_TRANSFER_555	MT2/CL2	220	8.48
931162	198	18:13:27.0	LIGHT_TRANSFER_534	IR5/IRP0	22000	8.48	132030	200	11:44:32.0	LIGHT_TRANSFER_555	MT2/CL2	220	8.48
931163	198	18:15:1.0	LIGHT_TRANSFER_534	IR5/IRP0	22000	8.48	132031	200	11:45:31.0	LIGHT_TRANSFER_555	MT2/CL2	220	8.48
931164	198	18:16:5.0	LIGHT_TRANSFER_534	IR5/IRP0	2200	8.48	132033	200	11:47:29.0	LIGHT_TRANSFER_555	MT2/CL2	320	8.48
131218	198	19:40:51.0	LIGHT_TRANSFER_534	IR5/IRP0	38000	8.48	132034	200	11:48:28.0	LIGHT_TRANSFER_555	MT2/CL2	320	8.48
931165	198	18:18:26.0	LIGHT_TRANSFER_534	IR5/IRP0	38000	8.48	132059	200	12:29:14.0	LIGHT_TRANSFER_555	MT2/CL2	320	8.48
931167	198	18:22:6.0	LIGHT_TRANSFER_534	IR5/IRP0	38000	8.48	132035	200	11:50:39.0	LIGHT_TRANSFER_556	IR2/IR1	0	8.48
931168	198	18:23:16.0	LIGHT_TRANSFER_535	CB3/IRP0	0	8.48	132036	200	11:51:38.0	LIGHT_TRANSFER_556	IR2/IR1	0	8.48
931169	198	18:24:15.0	LIGHT_TRANSFER_535	CB3/IRP0	0	8.48	132037	200	11:52:37.0	LIGHT_TRANSFER_556	IR2/IR1	0	8.48
931170	198	18:25:15.0	LIGHT_TRANSFER_535	CB3/IRP0	0	8.48	132038	200	11:53:36.0	LIGHT_TRANSFER_556	IR2/IR1	30	8.48
131172	198	18:27:13.0	LIGHT_TRANSFER_535	CB3/IRP0	1200	8.48	132039</						