THE JOHNS HOPKINS UNIVERSITY

DEPARTMENT OF PHYSICS

TECHNICAL REPORT No. 24

NASA Research Grant NGR 21-001-001

A REPORT ON SOME RESULTS FROM THE NASA 1968 AIRBORNE AURORAL EXPEDITION

by

K. A. Dick and W. G. Fastie

August 1970

Baltimore, Maryland 21218

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K. A. Dick* and W. G. Fastie

The Johns Hopkins University
Department of Physics
Baltimore, Maryland 21218

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*Present address: Kitt Peak National Observatory, Tucson, Arizona 85717

Introduction

The Johns Hopkins University participated in the 1968 Airborne Auroral Expedition flown aboard NASA's Convair 990 Airborne Laboratory "Galileo." The instrumentation has been described elsewhere (Dick et al., 1970) and consisted of a 5-position filter wheel photometer, having a full field of view of 12^{o}, and a 1-meter Ebert spectrophotometer. The filters used were: N_2 1PG (5, 2) 6704 Å; OI 6300 Å, OI 5577 Å; N_2^+ 1NG (0, 0) 3914 Å; and N_2 2PG (0, 0) 3371 Å. The spectrometer normally scanned a region nλ (12,400 - 14,000 Å), with the capability of isolating second, third, and fourth orders by means of Corning color glass filters. The photometer sampled each feature two out of every ten seconds; the spectrometer scanned every 15 seconds. The results of some 124 hours of flying consist of approximately a quarter million photometer readings and thirty thousand spectral scans (each with as many as 400 resolution intervals).

The results of those portions of the expedition flown under non-auroral conditions have already been published (Dick et al., 1970). A preliminary survey of the photometer results for the entire expedition was made in order to provide an impression of the total content. This

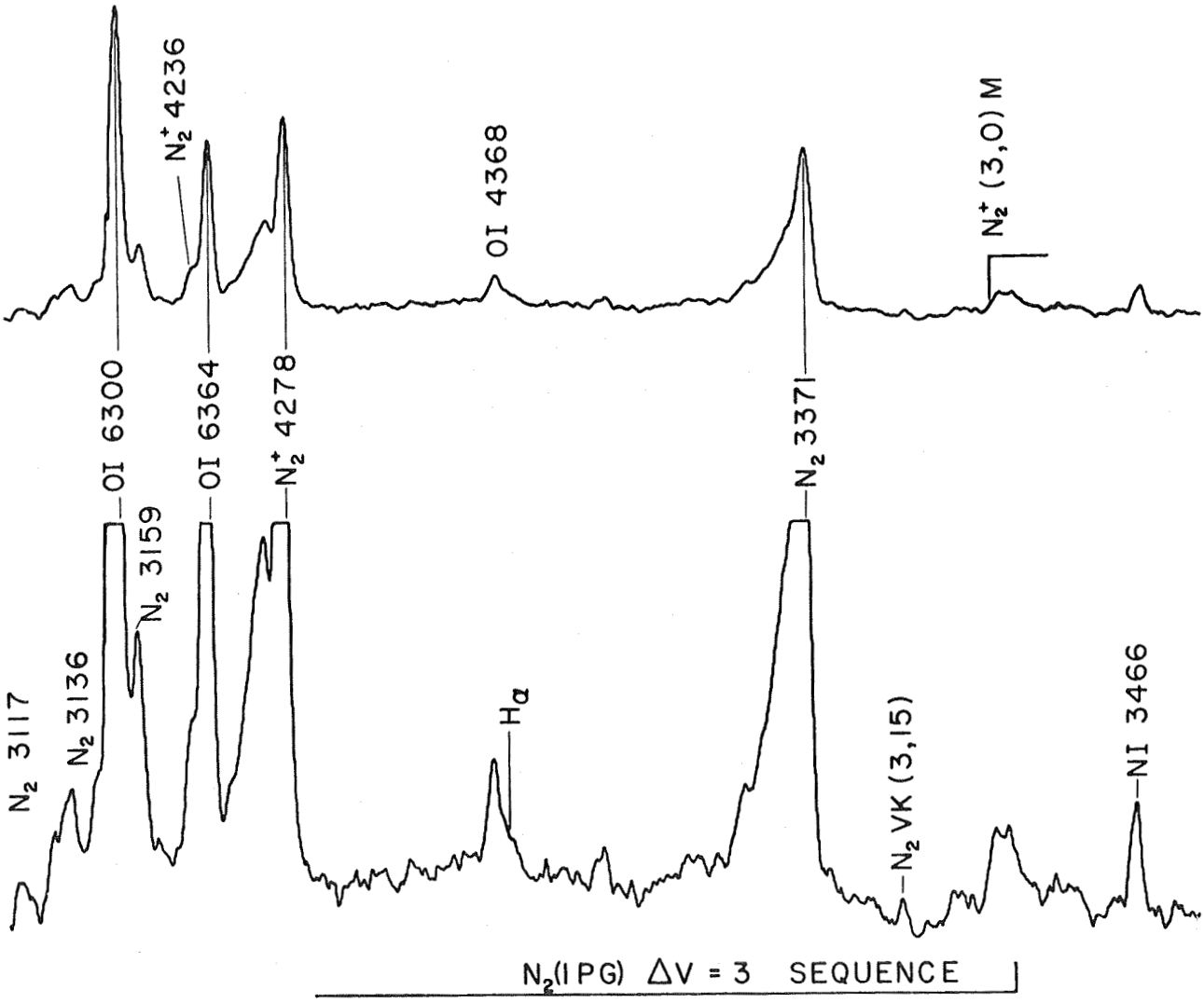

Fig. 1: Summation of 256 spectral scans from Flight 22, slit width 2 mm. The bottom trace has an amplification four times that of the top trace.

consisted of taking three successive voltage readings from each filter at 5-minute intervals, averaging, calculating the intensities, and listing. The results are contained in Appendix I. Also included are the ratios of intensities of the first three features to 3914. Further reduction of photometer data has been carried out for selected times in connection with spectrometer data reduction and will be presented separately. Detailed intensities will be made available to any other experimenters who should have need of them.

As noted above, the spectrometer could be used with or without order sorting filters. In general, the filters were used only during night-sky and low auroral activity conditions. Appendix II gives the times the various filters were used. (Also included are the spectrometer slit width and photomultiplier tube gain setting.) In order to obtain reasonable signal-to-noise values, it was usually necessary to average a number of scans. This was accomplished by playing the analogue magnetic tape records into our Fabri-Tek signal averager.

Figure 1 shows the result of averaging 256 spectral scans early in Flight 22. The slit width was 2 mm. Average 4278 $\mathring{A}$ intensity was $\sim$ 1.3 kR.

Included as Appendix III is a list of all the spectral features identified. It should be noted that many of the weak features are identifiable only on a very small portion of the total scans taken.

REFERENCES

Broadfoot, A. L. and K. R. Kendall, J. Geophys. Res., 73, 426 (1968).

Dick, K. A., G. G. Sivjee, and H. M. Crosswhite, Planet. Space Sci., 18, 887 (1970).

APPENDIX I

PHOTOMETER RESULTS

Notes:

1) These numbers were obtained by reading real-time strip-chart records and manual intensity calculations. Thus, they undoubtedly contain some numerical errors, but the overall trends in intensities will still be apparent. All values are in rayleighs, and some cases are quoted to more significant figures than the accuracy warrants.

2) The following approximations were used in obtaining preliminary calibration values:

   a) The 6704 Å band shape was assumed to be "square," with base ~ 50 Å wide.

   b) Temperature variations in aircraft cabin had no effect on filter characteristics.

   c) The integrated area under each interference filter was 10% higher than the product of peak transmission and half width (full width at half maximum).

   d) No correction was made for atmospheric attenuation.

3) A secondary bandpass in the 3371 filter renders its results questionable; they are not included.

4) Values listed include night-sky spectral contributions to the intensities of 6300, 5577.

5) Flights 1, 24, 25, 26, and 27 are not included due to moonlight or non-zenith applications of the photometer. Flights 2, 4, 6, 7, 12, and 13 are not included because of aircraft problems, daylight ferry flights, or instrumental problems.

6) Filter characteristics:

λ_{max}	T_{max}	Half-Width	Background Subtracted
6708 Å	74 %	51 Å	57 R*
6302	46	13	10
5582	54	10	10
3913	47	33	17 *

*Somewhat different values were used initially based on the known filter characteristics and the night-sky spectrum of Broadfoot and Kendall (1968). The above values were finally chosen to make the average intensities of 3914 and 6704 equal zero for flights 14 and 15. The actual value will of course change with night sky conditions. For example, the correction is obviously too great for 3914 after 0300 hours in flight 5, and not enough for 6704 during the same flight.

FLIGHT 3

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
130	55	76	115	105	0.5238	0.7238	1.0952	1.5132
135	45	60	88	38	1.1842	1.5789	2.3158	1.4667
140	68	87	115	49	1.3878	1.7755	2.3469	1.3218
145	54	78	96	25	2.1600	3.1200	3.8400	1.2308
150	67	100	120	41	1.6341	2.4390	2.9268	1.2000
155	52	83	110	32	1.6250	2.5938	3.4375	1.3253
200	54	88	115	43	1.2558	2.0465	2.6744	1.3068
205	52	89	130	64	0.8125	1.3906	2.0313	1.4607
210	54	103	120	83	0.6506	1.2410	1.4458	1.1650
215	56	99	135	103	0.5437	0.9612	1.3107	1.3636
220	74	120	200	250	0.2960	0.4800	0.8000	1.6667
225	660	335	2980	2500	0.2640	0.1340	1.1920	8.8955
230	200	230	900	830	0.2410	0.2771	1.0843	3.9130
235	180	215	720	660	0.2727	0.3258	1.0909	3.3488
240	105	205	400	310	0.3387	0.6613	1.2903	1.9512
245	130	155	500	480	0.2708	0.3229	1.0417	3.2258
250	140	160	560	560	0.2500	0.2857	1.0000	3.5000
255	0	570	26400	23600		0.0242	1.1186	46.3158
300	460	225	1960	2000	0.2300	0.1125	0.9800	8.7111
305	530	250	2470	2150	0.2465	0.1163	1.1488	9.8800
310	250	340	1130	920	0.2717	0.3696	1.2283	3.3235
315	150	235	615	830	0.1807	0.2831	0.7410	2.6170
320	155	180	630	580	0.2672	0.3103	1.0862	3.5000
325	120	160	380	320	0.3750	0.5000	1.1875	2.3750
330	91	96	185	125	0.7280	0.7680	1.4800	1.9271
335	61	50	115	61	1.0000	0.8197	1.8852	2.3000
340	63	120	190	117	0.5385	1.0256	1.6239	1.5833
345	73	110	180	120	0.6083	0.9167	1.5000	1.6364
350	130	180	390	330	0.3939	0.5455	1.1818	2.1667
355	185	165	720	720	0.2569	0.2292	1.0000	4.3636
400	350	145	1000	850	0.4118	0.1706	1.1765	6.8966
405	890	330	3850	3610	0.2465	0.0914	1.0665	11.6667
410	490	290	2250	2120	0.2311	0.1368	1.0613	7.7586
415	390	245	1100	1020	0.3824	0.2402	1.0784	4.4898
420	480	270	2360	2390	0.2008	0.1130	0.9874	8.7407
425	470	325	2040	1660	0.2831	0.1958	1.2289	6.2769
430	0	0	0	0				
345	760	480	2780	2890	0.2630	0.1661	0.9619	5.7917
440	340	225	1070	1260	0.2698	0.1786	0.8492	4.7556
445	530	670	2500	2480	0.2137	0.2702	1.0081	3.7313
450	335	380	1160	1090	0.3073	0.3486	1.0642	3.0526
455	220	265	625	580	0.3793	0.4569	1.0776	2.3585
500	325	310	1120	970	0.3351	0.3196	1.1546	3.6129
505	220	300	570	510	0.4314	0.5882	1.1176	1.9000
510	440	580	1300	1250	0.3520	0.4640	1.0400	2.2414
515	4100	760	18800	17600	0.2330	0.0432	1.0682	24.7368
520	1520	760	3340	2940	0.5170	0.2585	1.1361	4.3947
525	980	590	5100	5400	0.1815	0.1093	0.9444	8.6441

FLIGHT 5

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
155	2	52	55	12	0.1667			1.0577
200	5	40	50	55	0.0909	0.7273	0.9091	1.2500
205	12	46	75	28	0.4286	1.6429	2.6786	1.6304
210	2	18	40	4	0.5000			2.2222
215	1	15	38	6	0.1667			2.5333
220	0	19	33	0				
225	2	20	37	-1	-2.0000			1.8500
230	-1	18	40	4	-0.2500			2.2222
235	32	99	175	77	0.4156	1.2857	2.2727	1.7677
240	24	69	145	70	0.3429	0.9857	2.0714	2.1014
245	3	38	50	4	0.7500			1.3158
250	3	25	46	3	1.0000			1.8400
255	2	20	49	2	1.0000			2.4500
300	6	24	53	1	6.0000			2.2083
305	4	21	45	-1	-4.0000			2.1429
310	10	20	57	-2	-5.0000			2.8500
315	10	20	57	-3	-3.3333			2.8500
320	12	20	60	-2	-6.0000			3.0000
325	13	20	54	-1	-13.0000			2.7000
330	16	17	59	-5	-3.2000			3.4706
335	18	23	58	-3	-6.0000			2.5217
340	22	22	65	-4	-5.5000			2.9545
345	8	19	50	-8	-1.0000			2.6316
350	13	13	50	-9	-1.4444			3.8462
355	38	23	60	-7	-5.4286			2.6087
400	61	30	73	-8	-7.6250			2.4333
405	62	30	70	-6	-10.3333			2.3333
410	61	28	63	-9	-6.7778			2.2500
415	61	26	62	-8	-7.6250			2.3846
420	66	29	62	-8	-8.2500			2.1379
425	71	31	60	-8	-8.8750			1.9355
430	86	32	64	-6	-14.3333			2.0000
435	84	34	69	-7	-12.0000			2.0294
440	79	33	68	-8	-9.8750			2.0606
445	100	34	71	-16	-6.2500			2.0882
450	79	23	68	-16	-4.9375			2.9565
455	79	23	68	-16	-4.9375			2.9565
500	83	28	71	-16	-5.1875			2.5357

FLIGHT 8

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
420	1270	300	3390	3750	0.3387	0.0800	0.9040	11.3000
425	1000	560	3510	4190	0.2387	0.1337	0.8377	6.2679
430	65	57	107	150	0.4333	0.3800	0.7133	1.8772
435	68	61	92	120	0.5667	0.5083	0.7667	1.5082
440	85	86	140	107	0.7944	0.8037	1.3084	1.6279
445	65	97	130	140	0.4643	0.6929	0.9286	1.3402
450	77	96	145	230	0.3348	0.4174	0.6304	1.5104
455	66	82	135	205	0.3220	0.4000	0.6585	1.6463
500	71	86	165	370	0.1919	0.2324	0.4459	1.9186
505	125	155	370	0				
510	112	105	315	830	0.1349	0.1265	0.3795	3.0000
515	130	115	400	1100	0.1182	0.1045	0.3636	3.4783
520	130	135	400	1040	0.1250	0.1298	0.3846	2.9630
525	0	0	0	0				
530	0	0	0	0				
535	660	355	2410	3260	0.2025	0.1089	0.7393	6.7887
540	275	285	835	1900	0.1447	0.1500	0.4395	2.9298
545	520	370	1820	2670	0.1948	0.1386	0.6816	4.9189
550	980	540	3990	5090	0.1925	0.1061	0.7839	7.3889
555	640	400	2090	2810	0.2278	0.1423	0.7438	5.2250
600	650	370	2430	2670	0.2434	0.1386	0.9101	6.5676
605	9800	2880	6980	9110	1.0757	0.3161	0.7662	2.4236
610	430	290	1540	2090	0.2057	0.1388	0.7368	5.3103
615	300	265	1070	1410	0.2128	0.1879	0.7589	4.0377
620	1410	1220	3870	5100	0.2765	0.2392	0.7588	3.1721
625	440	265	1200	1730	0.2543	0.1532	0.6936	4.5283
630	39	365	275	330	0.1182	1.1061	0.8333	0.7534
635	380	260	960	1040	0.3654	0.2500	0.9231	3.6923
640	220	240	690	790	0.2785	0.3038	0.8734	2.8750
645	210	210	660	720	0.2917	0.2917	0.9167	3.1429
650	540	375	550	490	1.1020	0.7653	1.1224	1.4667
655	160	165	430	500	0.3200	0.3300	0.8600	2.6061

FLIGHT 9

TIME	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
340	112	82	340	220	0.5091	0.3727	1.5455	4.1463
345	120	87	370	260	0.4615	0.3346	1.4231	4.2529
350	130	113	465	295	0.4407	0.3831	1.5763	4.1150
355	135	120	415	260	0.5192	0.4615	1.5962	3.4583
400	135	140	510	340	0.3971	0.4118	1.5000	3.6429
405	130	97	420	240	0.5417	0.4042	1.7500	4.3299
410	125	99	400	260	0.4808	0.3808	1.5385	4.0404
415	125	82	355	230	0.5435	0.3565	1.5435	4.3293
420	135	113	415	280	0.4821	0.4036	1.4821	3.6726
425	98	110	325	215	0.4558	0.5116	1.5116	2.9545
430	135	140	485	230	0.5870	0.6087	2.1087	3.4643
435	150	155	320	260	0.5769	0.5962	1.2308	2.0645
440	260	440	510	785	0.3312	0.5605	0.6497	1.1591
445	60	102	150	190	0.3158	0.5368	0.7895	1.4706
450	50	76	150	200	0.2500	0.3800	0.7500	1.9737
455	49	75	135	170	0.2882	0.4412	0.7941	1.8000
500	57	96	135	240	0.2375	0.4000	0.5625	1.4063
505	40	88	118	135	0.2963	0.6519	0.8741	1.3409
510	36	87	106	130	0.2769	0.6692	0.8154	1.2184
515	39	105	155	200	0.1950	0.5250	0.7750	1.4762
520	39	100	125	140	0.2786	0.7143	0.8929	1.2500
525	48	105	160	210	0.2286	0.5000	0.7619	1.5238
530	54	130	180	180	0.3000	0.7222	1.0000	1.3846
535	62	160	215	225	0.2756	0.7111	0.9556	1.3438
540	97	240	385	385	0.2519	0.6234	1.0000	1.6042
545	210	475	810	610	0.3443	0.7787	1.3279	1.7053
550	185	540	820	565	0.3274	0.9558	1.4513	1.5185
555	0	0	0	0				
600	0	0	0	0				
605	0	0	0	0				
610	1240	505	4830	4930	0.2515	0.1024	0.9797	9.5644
615	740	340	2900	3320	0.2229	0.1024	0.8735	8.5294
620	665	315	2960	3130	0.2125	0.1006	0.9457	9.3968
625	560	250	1980	2210	0.2534	0.1131	0.8959	7.9200
630	500	430	2590	1520	0.3289	0.2829	1.7039	6.0233
635	350	300	1430	1850	0.1892	0.1622	0.7730	4.7667
640	480	410	2180	2590	0.1853	0.1583	0.8417	5.3171
645	225	285	970	1740	0.1293	0.1638	0.5575	3.4035
650	550	410	1900	1960	0.2806	0.2092	0.9694	4.6341
655	780	450	3500	2900	0.2690	0.1552	1.2069	7.7778
700	290	400	2350	1520	0.1908	0.2632	1.5461	5.8750
705	320	290	1320	1300	0.2462	0.2231	1.0154	4.5517
710	250	240	1000	990	0.2525	0.2424	1.0101	4.1667
715	265	255	1020	950	0.2789	0.2684	1.0737	4.0000
720	560	380	1910	1490	0.3758	0.2550	1.2819	5.0263
725	295	300	1040	950	0.3105	0.3158	1.0947	3.4667
730	365	350	1070	880	0.4148	0.3977	1.2159	3.0571

FLIGHT 10

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
555	135	180	710	64	2.1094	2.8125	11.0938	3.9444
600	53	125	200	37	1.4324	3.3784	5.4054	1.6000
605	53	59	120	19	2.7895			2.0339
610	55	46	128	26	2.1154	1.7692	4.9231	2.7826
615	69	50	135	14	4.9286			2.7000
620	63	44	95	20	3.1500			2.1591
625	62	95	100	19	3.2632			1.0526
630	69	69	100	20	3.4500			1.4493
635	52	50	78	13	4.0000			1.5600
640	63	85	105	24	2.6250	3.5417	4.3750	1.2353
645	49	54	78	30	1.6333	1.8000	2.6000	1.4444
650	57	49	73	27	2.1111	1.8148	2.7037	1.4898
655	58	48	70	11	5.2727			1.4583
700	61	47	75	12	5.0833			1.5957
705	52	50	69	16	3.2500			1.3800
710	57	52	81	8	7.1250			1.5577
715	67	55	90	21	3.1905	2.6190	4.2857	1.6364
720	55	55	76	19	2.8947			1.3818
725	46	56	67	5	9.2000			1.1964
730	45	45	67	8	5.6250			1.4889
735	45	54	75	9	5.0000			1.3889
740	42	52	72	12	3.5000			1.3846
745	47	37	54	11	4.2727			1.4595
750	41	36	44	11	3.7273			1.2222
755	40	36	48	3	13.3333			1.3333
800	42	26	60	7	6.0000			2.3077
805	46	32	44	9	5.1111			1.3750
810	45	33	47	8	5.6250			1.4242
815	46	37	51	19	2.4211			1.3784
820	45	32	50	11	4.0909			1.5625
825	53	48	64	12	4.4167			1.3333
830	52	51	59	15	3.4667			1.1569
835	55	40	57	12	4.5833			1.4250
840	52	36	57	8	6.5000			1.5833
845	54	52	56	7	7.7143			1.0769
850	52	46	64	4	13.0000			1.3913
855	85	100	210	29	2.9310	3.4483	7.2414	2.1000
900	44	40	56	9	4.8889			1.4000
905	44	41	57	13	3.3846			1.3902
910	45	32	51	4	11.2500			1.5938
915	42	46	57	4	10.5000			1.2391
920	46	46	64	7	6.5714			1.3913
925	63	72	120	17	3.7059			1.6667
930	83	210	250	31	2.6774	6.7742	8.0645	1.1905
935	68	120	150	19	3.5789			1.2500
940	81	110	170	17	4.7647			1.5455
945	74	110	145	21	3.5238	5.2381	6.9048	1.3182
950	63	100	115	17	3.7059			1.1500
955	74	115	125	19	3.8947			1.0870
1000	85	120	210	34	2.5000	3.5294	6.1765	1.7500

FLIGHT 10

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
1010	72	120	180	25	2.8800	4.8000	7.2000	1.5000
1015	58	83	110	23	2.5217	3.6087	4.7826	1.3253
1020	55	64	97	24	2.2917	2.6667	4.0417	1.5156
1025	49	62	110	24	2.0417	2.5833	4.5833	1.7742
1030	50	81	120	31	1.6129	2.6129	3.8710	1.4815
1035	48	125	155	44	1.0909	2.8409	3.5227	1.2400
1040	56	81	125	28	2.0000	2.8929	4.4643	1.5432
1045	50	81	125	37	1.3514	2.1892	3.3784	1.5432
1050	48	85	140	45	1.0667	1.8889	3.1111	1.6471
1055	47	120	160	57	0.8246	2.1053	2.8070	1.3333
1100	53	89	160	61	0.8689	1.4590	2.6230	1.7978
1105	49	84	180	74	0.6622	1.1351	2.4324	2.1429

FLIGHT 11

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
715	-12	43	51	45	-0.2667	0.9556	1.1333	1.1860
720	11	61	100	82	0.1341	0.7439	1.2195	1.6393
725	9	17	32	11	0.8182			1.8824
730	5	7	16	3	1.6667			2.2857
735	6	15	15	-5	-1.2000			1.0000
740	19	15	18	-5	-3.8000			1.2000
745	21	23	25	4	5.2500			1.0870
750	21	27	37	5	4.2000			1.3704
755	10	19	43	11	0.9091			2.2632
800	11	16	37	17	0.6471			2.3125
805	16	15	47	21	0.7619	0.7143	2.2381	3.1333
810	22	30	59	34	0.6471	0.8824	1.7353	1.9667
815	15	71	81	69	0.2174	1.0290	1.1739	1.1408
820	21	105	165	85	0.2471	1.2353	1.9412	1.5714
825	64	87	340	260	0.2462	0.3346	1.3077	3.9080
830	27	53	100	73	0.3699	0.7260	1.3699	1.8868
835	-9	45	85	52	-0.1731	0.8654	1.6346	1.8889
840	18	44	120	73	0.2466	0.6027	1.6438	2.7273
845	81	100	500	365	0.2219	0.2740	1.3699	5.0000
850	83	105	450	290	0.2862	0.3621	1.5517	4.2857
855	54	63	320	200	0.2700	0.3150	1.6000	5.0794
900	19	38	145	82	0.2317	0.4634	1.7683	3.8158
905	11	32	91	37	0.2973	0.8649	2.4595	2.8438
910	6	25	67	19	0.3158			2.6800
915	6	20	45	7	0.8571			2.2500
920	7	19	54	4	1.7500			2.8421
925	5	17	31	8	0.6250			1.8235
930	2	16	37	-4	-0.5000			2.3125
935	-4	12	23	-8	0.5000			1.9167
940	-4	14	22	-5	0.8000			1.5714
945	-1	11	23	-2	0.5000			2.0909
950	14	14	31	4	3.5000			2.2143
955	-4	13	24	-3	1.3333			1.8462
1000	-5	12	23	-3	1.6667			1.9167
1005	-5	13	28	-1	5.0000			2.1538
1010	-4	16	28	1	-4.0000			1.7500
1015	-2	19	29	4	-0.5000			1.5263
1020	-3	19	36	14	-0.2143			1.8947
1025	1	24	45	18	0.0556			1.8750
1030	11	33	58	33	0.3333	1.0000	1.7576	1.7576
1035	-5	38	79	56	-0.0893	0.6786	1.4107	2.0789
1040	31	43	150	105	0.2952	0.4095	1.4286	3.4884
1045	34	42	150	83	0.4096	0.5060	1.8072	3.5714

FLIGHT 14

TIME	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
625	18	34	85	20	0.9000			2.5000
630	28	26	55	-1	-28.0000			2.1154
635	6	23	54	6	1.0000			2.3478
640	1	14	34	-5	-0.2000			2.4286
645	1	14	39	-1	-1.0000			2.7857
650	6	18	44	1	6.0000			2.4444
655	3	15	41	-4	-0.7500			2.7333
700	0	0	0	0				
705	-6	19	48	0				
710	-6	15	45	-2	3.0000			3.0000
715	-5	15	46	-1	5.0000			3.0667
720	-6	12	52	21	-0.2857	0.5714	2.4762	4.3333
725	-7	13	47	-1	7.0000			3.6154
730	-6	14	45	1	-6.0000			3.2143
735	-7	14	46	-1	7.0000			3.2857
740	0	0	0	0				
745	0	13	51	-1				3.9231
750	0	13	51	1				3.9231
755	3	13	52	1	3.0000			4.0000
800	1	12	53	-4	-0.2500			4.4167
805	1	16	51	0				
810	0	12	50	-4				4.1667
815	0	14	54	-1				3.8571
820	1	14	52	0				
825	1	14	50	2	0.5000			3.5714
830	2	15	55	-1	-2.0000			3.6667
835	-1	13	49	-4	0.2500			3.7692
840	0	16	50	-1				3.1250
845	-2	13	48	-1	2.0000			3.6923
850	-1	13	46	-1	1.0000			3.5385
855	-5	12	41	-3	1.6667			3.4167
900	0	14	49	-2				3.5000
905	0	14	62	0				
910	-4	14	63	3	-1.3333			4.5000
915	-5	14	61	1	-5.0000			4.3571
920	-1	14	59	1	-1.0000			4.2143
925	-2	15	62	0				
930	-3	15	61	4	-0.7500			4.0667
935	-3	14	57	4	-0.7500			4.0714
940	-2	14	61	1	-2.0000			4.3571
945	-1	15	61	3	-0.3333			4.0667
950	0	17	64	8				3.7647
955	-2	13	63	40	-0.0500	0.3250	1.5750	4.8462
1000	4	15	69	11	0.3636			4.6000
1005	2	16	65	8	0.2500			4.0625
1010	2	15	65	5	0.4000			4.3333
1015	-2	14	63	6	-0.3333			4.5000
1020	-1	12	62	6	-0.1667			5.1667
1025	-2	13	61	4	-0.5000			4.6923
1030	2	14	59	3	0.6667			4.2143

FLIGHT 14

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
1040	-1	12	59	0				
1045	-3	13	56	0				
1050	-3	13	53	0				
1055	-3	14	47	-3	1.0000			3.3571
1100	0	16	53	-4				3.3125

FLIGHT 15

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
520	350	100	128	79	4.4304	1.2658	1.6203	1.2800
525	56	67	93	37	1.5135	1.8108	2.5135	1.3881
530	28	61	80	23	1.2174	2.6522	3.4783	1.3115
535	17	58	73	21	0.8095	2.7619	3.4762	1.2586
540	18	55	75	19	0.9474			1.3636
545	24	55	71	8	3.0000			1.2909
550	23	50	55	1	23.0000			1.1000
555	18	47	66	-1	-18.0000			1.4043
600	0	0	0	0				
605	28	45	55	2	14.0000			1.2222
610	35	34	57	9	3.8889			1.6765
615	35	33	52	7	5.0000			1.5758
620	31	29	52	4	7.7500			1.7931
625	28	28	54	1	28.0000			1.9286
630	29	28	57	3	9.6667			2.0357
635	14	26	57	1	14.0000			2.1923
640	11	28	65	5	2.2000			2.3214
645	11	28	79	6	1.8333			2.8214
650	11	27	83	3	3.6667			3.0741
655	10	25	81	5	2.0000			3.2400
700	9	23	80	7	1.2857			3.4783
705	7	22	72	6	1.1667			3.2727
710	0	0	0	0				
715	0	0	0	0				
720	0	0	0	0				
725	-4	15	50	-2	2.0000			3.3333
730	-4	13	46	-3	1.3333			3.5385
735	-5	10	47	-4	1.2500			4.7000
740	-9	11	55	-2	4.5000			5.0000
745	-5	9	62	-2	2.5000			6.8889
750	-9	9	62	-2	4.5000			6.8889
755	-11	9	64	-1	11.0000			7.1111
800	-9	9	63	-2	4.5000			7.0000
805	-7	8	59	-3	2.3333			7.3750
810	-12	9	50	-4	3.0000			5.5556
815	-12	9	39	-5	2.4000			4.3333
820	-13	7	38	-6	2.1667			5.4286
825	-14	8	48	-2	7.0000			6.0000
830	-15	6	42	-5	3.0000			7.0000
835	-13	7	41	-5	2.6000			5.8571
840	-16	5	37	-6	2.6667			7.4000
845	-16	5	40	-3	5.3333			8.0000
850	-15	6	43	-4	3.7500			7.1667
855	-15	5	50	-3	5.0000			10.0000
900	-14	5	50	-1	14.0000			10.0000
905	-12	5	65	1	-12.0000			13.0000
910	-10	4	67	-3	3.3333			16.7500
915	-10	5	79	-1	10.0000			15.8000
920	-10	6	77	-1	10.0000			12.8333
925	-11	6	74	-3	3.6667			12.3333

FLIGHT 15

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
935	-10	9	72	1	-10.0000			8.0000
940	-10	9	70	1	-10.0000			7.7778
945	-10	8	62	5	-2.0000			7.7500
950	-7	12	72	11	-0.6364			6.0000
955	-7	10	67	11	-0.6364			6.7000
1000	-7	11	69	20	-0.3500			6.2727
1005	-5	21	75	29	-0.1724	0.7241	2.5862	3.5714
1010	67	140	320	250	0.2680	0.5600	1.2800	2.2857
1015	140	155	660	560	0.2500	0.2768	1.1786	4.2581
1020	310	175	1120	1220	0.2541	0.1434	0.9180	6.4000

FLIGHT 16

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
910	30	62	150	160	0.1875	0.3875	0.9375	2.4194
915	39	57	117	90	0.4333	0.6333	1.3000	2.0526
920	27	57	64	15	1.8000			1.1228
925	26	31	41	-6	-4.3333			1.3226
930	28	40	64	1	28.0000			1.6000
935	29	41	51	0				
940	28	40	48	1	28.0000			1.2000
945	35	43	73	0				
950	13	40	71	0				
955	42	75	100	0				
1000	50	105	115	0				
1005	34	64	125	0				
1010	40	62	93	0				
1015	56	84	175	0				
1020	38	69	110	0				
1025	38	68	103	0				
1030	0	0	0	0				
1035	54	70	120	0				
1040	60	89	145	0				
1045	53	61	108	0				
1050	0	0	0	0				
1055	0	0	0	0				
1100	59	75	115	78	0.7564	0.9615	1.4744	1.5333
1105	66	71	123	77	0.8571	0.9221	1.5974	1.7324
1110	67	68	112	71	0.9437	0.9577	1.5775	1.6471
1115	59	63	113	77	0.7662	0.8182	1.4675	1.7937
1120	56	66	113	79	0.7089	0.8354	1.4304	1.7121
1125	66	77	140	70	0.9429	1.1000	2.0000	1.8182
1130	58	87	130	160	0.3625	0.5437	0.8125	1.4943
1135	55	91	135	130	0.4231	0.7000	1.0385	1.4835
1140	58	96	160	215	0.2698	0.4465	0.7442	1.6667
1145	96	155	295	305	0.3148	0.5082	0.9672	1.9032
1150	50	120	145	230	0.2174	0.5217	0.6304	1.2083
1155	64	123	175	400	0.1600	0.3075	0.4375	1.4228
1200	67	165	150	380	0.1763	0.4342	0.3947	0.9091
1205	180	325	470	260	0.6923	1.2500	1.8077	1.4462
1210	125	200	160	395	0.3165	0.5063	0.4051	0.8000
1215	225	135	180	615	0.3659	0.2195	0.2927	1.3333
1220	495	215	440	1030	0.4806	0.2087	0.4272	2.0465
1225	200	410	1250	800	0.2500	0.5125	1.5625	3.0488
1230	380	285	1950	1760	0.2159	0.1619	1.1080	6.8421
1235	830	355	2440	2940	0.2823	0.1207	0.8299	6.8732

FLIGHT 17

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
155	85	79	305	125	0.6800	0.6320	2.4400	3.8608
200	74	82	270	113	0.6549	0.7257	2.3894	3.2927
205	83	170	320	145	0.5724	1.1724	2.2069	1.8824
210	49	125	155	28	1.7500	4.4643	5.5357	1.2400
215	46	102	170	53	0.8679	1.9245	3.2075	1.6667
220	37	97	140	28	1.3214	3.4643	5.0000	1.4433
225	34	80	135	48	0.7083	1.6667	2.8125	1.6875
230	27	75	115	43	0.6279	1.7442	2.6744	1.5333
235	30	79	135	38	0.7895	2.0789	3.5526	1.7089
240	31	79	140	28	1.1071	2.8214	5.0000	1.7722
245	32	78	165	27	1.1852	2.8889	6.1111	2.1154
250	37	74	160	40	0.9250	1.8500	4.0000	2.1622
255	0	0	0	0				
300	31	64	165	27	1.1481	2.3704	6.1111	2.5781
305	30	51	160	26	1.1538	1.9615	6.1538	3.1373
310	30	47	145	26	1.1538	1.8077	5.5769	3.0851
315	0	0	0	0				
320	24	46	135	23	1.0435	2.0000	5.8696	2.9348
325	37	40	135	32	1.1563	1.2500	4.2188	3.3750
330	28	48	140	55	0.5091	0.8727	2.5455	2.9167
335	122	190	580	445	0.2742	0.4270	1.3034	3.0526
340	97	243	390	285	0.3404	0.8526	1.3684	1.6049
345	61	76	340	230	0.2652	0.3304	1.4783	4.4737
350	0	0	0	0				
355	63	185	325	380	0.1658	0.4868	0.8553	1.7568
400	210	260	900	750	0.2800	0.3467	1.2000	3.4615
405	135	260	625	480	0.2813	0.5417	1.3021	2.4038
410	210	305	1030	740	0.2838	0.4122	1.3919	3.3770
410	270	305	1030	740	0.3649	0.4122	1.3919	3.3770
415	235	113	1120	1010	0.2327	0.1119	1.1089	9.9115
420	0	50	170	125		0.4000	1.3600	3.4000
425	63	88	230	170	0.3706	0.5176	1.3529	2.6136
430	63	109	315	250	0.2520	0.4360	1.2600	2.8899
435	49	100	245	105	0.4667	0.9524	2.3333	2.4500
440	61	150	290	180	0.3389	0.8333	1.6111	1.9333
445	48	113	245	140	0.3429	0.8071	1.7500	2.1681
450	62	185	325	180	0.3444	1.0278	1.8056	1.7568
455	62	165	300	165	0.3758	1.0000	1.8182	1.8182
500	46	125	250	84	0.5476	1.4881	2.9762	2.0000
505	54	160	315	105	0.5143	1.5238	3.0000	1.9688
510	43	122	255	88	0.4886	1.3864	2.8977	2.0902
515	56	140	300	125	0.4480	1.1200	2.4000	2.1429

FLIGHT 18

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
150	125	175	565	375	0.3333	0.4667	1.5067	3.2286
155	90	170	400	140	0.6429	1.2143	2.8571	2.3529
200	165	420	725	420	0.3929	1.0000	1.7262	1.7262
205	72	165	340	160	0.4500	1.0313	2.1250	2.0606
210	65	93	300	44	1.4773	2.1136	6.8182	3.2258
215	67	99	285	55	1.2182	1.8000	5.1818	2.8788
220	65	105	270	51	1.2745	2.0588	5.2941	2.5714
225	0	0	0	0				
230	54	84	200	33	1.6364	2.5455	6.0606	2.3810
235	54	120	220	65	0.8308	1.8462	3.3846	1.8333
240	45	71	170	23	1.9565	3.0870	7.3913	2.3944
245	41	46	150	21	1.9524	2.1905	7.1429	3.2609
250	43	42	150	17	2.5294			3.5714
255	95	140	345	24	3.9583	5.8333	14.3750	2.4643
300	48	130	165	27	1.7778	4.8148	6.1111	1.2692
305	52	80	170	41	1.2683	1.9512	4.1463	2.1250
310	41	52	135	17	2.4118			2.5962
315	43	87	135	18	2.3889			1.5517
320	0	0	0	0				
325	0	0	0	0				
330	0	0	0	0				
335	53	64	165	36	1.4722	1.7778	4.5833	2.5781
340	52	67	160	42	1.2381	1.5952	3.8095	2.3881
345	28	62	81	42	0.6667	1.4762	1.9286	1.3065
350	48	81	165	42	1.1429	1.9286	3.9286	2.0370
355	50	69	165	40	1.2500	1.7250	4.1250	2.3913
400	46	64	170	38	1.2105	1.6842	4.4737	2.6563
405	44	64	175	30	1.4667	2.1333	5.8333	2.7344
410	49	70	180	30	1.6333	2.3333	6.0000	2.5714
415	52	73	180	28	1.8571	2.6071	6.4286	2.4658
420	66	74	210	28	2.3571	2.6429	7.5000	2.8378
425	46	62	180	26	1.7692	2.3846	6.9231	2.9032
430	46	56	180	21	2.1905	2.6667	8.5714	3.2143
435	43	57	150	20	2.1500			2.6316
440	43	61	150	15	2.8667			2.4590
445	39	62	150	11	3.5455			2.4194
450	32	57	170	16	2.0000			2.9825
455	36	57	140	12	3.0000			2.4561
500	36	54	150	9	4.0000			2.7778
505	35	55	140	15	2.3333			2.5455
510	33	56	140	15	2.2000			2.5000
515	33	55	135	17	1.9412			2.4545
520	33	61	140	17	1.9412			2.2951
525	35	55	145	18	1.9444			2.6364
530	36	56	140	16	2.2500			2.5000
535	36	52	130	17	2.1176			2.5000
540	35	40	145	20	1.7500			3.6250
545	35	54	170	18	1.9444			3.1481
550	36	51	140	19	1.8947			2.7451
555	36	52	120	16	2.2500			2.3077

FLIGHT 18

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
605	36	53	145	21	1.7143	2.5238	6.9048	2.7358
610	36	64	165	30	1.2000	2.1333	5.5000	2.5781
615	44	62	165	21	2.0952	2.9524	7.8571	2.6613
620	48	65	165	24	2.0000	2.7083	6.8750	2.5385
625	49	64	165	26	1.8846	2.4615	6.3462	2.5781
630	45	60	180	31	1.4516	1.9355	5.8065	3.0000
635	50	63	175	42	1.1905	1.5000	4.1667	2.7778
640	52	64	195	49	1.0612	1.3061	3.9796	3.0469
645	56	68	200	55	1.0182	1.2364	3.6364	2.9412
650	102	180	340	185	0.5514	0.9730	1.8378	1.8889

FLIGHT 19

TIME	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
305	40	52	195	160	0.2500	0.3250	1.2188	3.7500
310	44	53	285	135	0.3259	0.3926	2.1111	5.3774
315	32	56	235	113	0.2832	0.4956	2.0796	4.1964
320	29	55	195	90	0.3222	0.6111	2.1667	3.5455
325	35	69	230	97	0.3608	0.7113	2.3711	3.3333
330	22	57	175	38	0.5789	1.5000	4.6053	3.0702
335	20	51	170	25	0.8000	2.0400	6.8000	3.3333
340	26	58	160	26	1.0000	2.2308	6.1538	2.7586
345	36	61	190	40	0.9000	1.5250	4.7500	3.1148
350	31	60	190	42	0.7381	1.4286	4.5238	3.1667
355	48	61	265	127	0.3780	0.4803	2.0866	4.3443
400	60	68	345	165	0.3636	0.4121	2.0909	5.0735
405	104	91	520	390	0.2667	0.2333	1.3333	5.7143
410	275	375	1155	1070	0.2570	0.3505	1.0794	3.0800
415	73	132	330	240	0.3042	0.5500	1.3750	2.5000
420	37	108	280	113	0.3274	0.9558	2.4779	2.5926
425	93	232	865	730	0.1274	0.3178	1.1849	3.7284
430	27	65	185	70	0.3857	0.9286	2.6429	2.8462
435	25	86	180	61	0.4098	1.4098	2.9508	2.0930
440	38	175	225	61	0.6230	2.8689	3.6885	1.2857
445	17	74	165	48	0.3542	1.5417	3.4375	2.2297
450	16	84	150	50	0.3200	1.6800	3.0000	1.7857
455	22	96	190	145	0.1517	0.6621	1.3103	1.9792
500	31	109	220	160	0.1937	0.6812	1.3750	2.0183
505	155	190	835	460	0.3370	0.4130	1.8152	4.3947
510	525	375	2280	1620	0.3241	0.2315	1.4074	6.0800
515	245	265	990	920	0.2663	0.2880	1.0761	3.7358
520	165	230	860	550	0.3000	0.4182	1.5636	3.7391
525	69	100	400	260	0.2654	0.3846	1.5385	4.0000
530	43	64	280	150	0.2867	0.4267	1.8667	4.3750
535	33	59	235	108	0.3056	0.5463	2.1759	3.9831
540	22	46	200	75	0.2933	0.6133	2.6667	4.3478
545	27	60	215	93	0.2903	0.6452	2.3118	3.5833
550	40	74	285	200	0.2000	0.3700	1.4250	3.8514
555	105	135	560	425	0.2471	0.3176	1.3176	4.1481
600	295	185	1410	800	0.3687	0.2312	1.7625	7.6216
605	440	330	2050	1670	0.2635	0.1976	1.2275	6.2121
610	515	225	2480	2240	0.2299	0.1004	1.1071	11.0222
615	455	245	2020	1560	0.2917	0.1571	1.2949	8.2449
620	500	460	2000	1740	0.2874	0.2644	1.1494	4.3478
625	215	235	960	970	0.2216	0.2423	0.9897	4.0851
630	365	400	1510	1400	0.2607	0.2857	1.0786	3.7750
635	305	365	1380	1220	0.2500	0.2992	1.1311	3.7808
640	790	405	3420	2810	0.2811	0.1441	1.2171	8.4444
645	665	710	1790	2730	0.2436	0.2601	0.6557	2.5211
650	395	345	1720	1470	0.2687	0.2347	1.1701	4.9855
655	145	210	640	430	0.3372	0.4884	1.4884	3.0476
700	74	215	350	230	0.3217	0.9348	1.5217	1.6279
705	76	210	370	450	0.1689	0.4667	0.8222	1.7619
710	109	240	440	315	0.3460	0.7619	1.3968	1.8333

FLIGHT 19

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
720	320	380	1200	950	0.3368	0.4000	1.2632	3.1579
725	99	250	480	330	0.3000	0.7576	1.4545	1.9200

FLIGHT 20

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
345	145	390	615	790	0.1835	0.4937	0.7785	1.5769
350	110	345	435	620	0.1774	0.5565	0.7016	1.2609
355	530	690	1980	1910	0.2775	0.3613	1.0366	2.8696
400	310	510	1010	1180	0.2627	0.4322	0.8559	1.9804
405	160	265	630	500	0.3200	0.5300	1.2600	2.3774
410	255	310	975	1030	0.2476	0.3010	0.9466	3.1452
415	345	450	2020	2100	0.1643	0.2143	0.9619	4.4889
420	255	265	985	1070	0.2383	0.2477	0.9206	3.7170
425	255	230	865	920	0.2772	0.2500	0.9402	3.7609
430	205	290	760	810	0.2531	0.3580	0.9383	2.6207
435	170	265	635	680	0.2500	0.3897	0.9338	2.3962
440	145	330	530	460	0.3152	0.7174	1.1522	1.6061
445	195	370	690	745	0.2617	0.4966	0.9262	1.8649
450	415	395	1410	1500	0.2767	0.2633	0.9400	3.5696
455	435	730	1140	1410	0.3085	0.5177	0.8085	1.5616
500	1130	1060	3900	3900	0.2897	0.2718	1.0000	3.6792
505	200	570	640	740	0.2703	0.7703	0.8649	1.1228
510	345	490	1250	1366	0.2526	0.3587	0.9151	2.5510
515	410	410	1480	1580	0.2595	0.2595	0.9367	3.6098
520	290	380	1050	1070	0.2710	0.3551	0.9813	2.7632
525	285	430	1060	1140	0.2500	0.3772	0.9298	2.4651
530	180	430	625	725	0.2483	0.5931	0.8621	1.4535
535	335	650	1130	410	0.8171	1.5854	2.7561	1.7385
540	250	525	1060	1460	0.1712	0.3596	0.7260	2.0190
545	410	545	1600	2080	0.1971	0.2620	0.7692	2.9358
550	150	465	600	765	0.1961	0.6078	0.7843	1.2903
555	610	675	2320	2050	0.2976	0.3293	1.1317	3.4370
600	50	280	190	300	0.1667	0.9333	0.6333	0.6786
605	45	215	140	140	0.3214	1.5357	1.0000	0.6512
610	19	70	150	150	0.1267	0.4667	1.0000	2.1429
615	24	82	140	150	0.1600	0.5467	0.9333	1.7073
620	29	84	127	170	0.1706	0.4941	0.7471	1.5119
625	45	140	285	250	0.1800	0.5600	1.1400	2.0357
630	24	89	130	215	0.1116	0.4140	0.6047	1.4607
635	110	210	470	675	0.1630	0.3111	0.6963	2.2381
640	3440	790	13300	13900	0.2475	0.0568	0.9568	16.8354
645	1340	660	5540	4800	0.2792	0.1375	1.1542	8.3939
650	1090	570	3570	3280	0.3323	0.1738	1.0884	6.2632
655	350	90	185	185	1.8919	0.4865	1.0000	2.0556
700	23	53	120	120	0.1917	0.4417	1.0000	2.2642
705	42	79	145	125	0.3360	0.6320	1.1600	1.8354
710	33	60	110	110	0.3000	0.5455	1.0000	1.8333
715	40	62	140	210	0.1905	0.2952	0.6667	2.2581
720	100	130	340	1150	0.0870	0.1130	0.2957	2.6154
725	825	1030	3260	3430	0.2405	0.3003	0.9504	3.1650
730	755	220	3200	3400	0.2221	0.0647	0.9412	14.5455
735	33	83	175	270	0.1222	0.3074	0.6481	2.1084
740	3170	1030	12200	13100	0.2420	0.0786	0.9313	11.8447
745	755	690	3740	3850	0.1961	0.1792	0.9714	5.4203
750	1270	800	4600	4900	0.2592	0.1633	0.9388	5.7500

FLIGHT 20

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
800	1290	730	4500	4980	0.2590	0.1466	0.9036	6.1644
805	655	560	2190	2400	0.2729	0.2333	0.9125	3.9107

FLIGHT 21

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
535	350	330	180	395	0.8861	0.8354	0.4557	0.5455
540	80	190	350	530	0.1509	0.3585	0.6604	1.8421
545	220	330	1000	840	0.2619	0.3929	1.1905	3.0303
550	125	300	585	470	0.2660	0.6383	1.2447	1.9500
555	67	130	210	210	0.3190	0.6190	1.0000	1.6154
600	82	150	330	350	0.2343	0.4286	0.9429	2.2000
605	65	130	215	255	0.2549	0.5098	0.8431	1.6538
610	185	175	735	550	0.3364	0.3182	1.3364	4.2000
615	65	125	255	245	0.2653	0.5102	1.0408	2.0400
620	72	160	280	270	0.2667	0.5926	1.0370	1.7500
625	62	155	260	380	0.1632	0.4079	0.6842	1.6774
630	93	170	380	540	0.1722	0.3148	0.7037	2.2353
635	110	185	485	615	0.1789	0.3008	0.7886	2.6216
640	225	270	280	280	0.8036	0.9643	1.0000	1.0370
645	650	310	2850	2650	0.2453	0.1170	1.0755	9.1935
650	1130	320	4580	4290	0.2634	0.0746	1.0676	14.3125
655	590	245	2580	2370	0.2489	0.1034	1.0886	10.5306
700	270	215	1200	1010	0.2673	0.2129	1.1881	5.5814
705	295	220	300	265	1.1132	0.8302	1.1321	1.3636
710	765	320	345	820	0.9329	0.3902	0.4207	1.0781
715	13600	2360	36800	47900	0.2839	0.0493	0.7683	15.5932
720	445	395	1690	2240	0.1987	0.1763	0.7545	4.2785
725	2430	1340	10300	12700	0.1913	0.1055	0.8110	7.6866
730	135	250	590	875	0.1543	0.2857	0.6743	2.3600
735	250	290	940	250	1.0000	1.1600	3.7600	3.2414
740	670	345	2560	2600	0.2577	0.1327	0.9846	7.4203
745	2130	510	7920	8030	0.2653	0.0635	0.9863	15.5294
750	1540	370	5760	6320	0.2437	0.0585	0.9114	15.5676
755	1040	290	3780	4150	0.2506	0.0699	0.9108	13.0345
800	1170	280	4270	5070	0.2308	0.0552	0.8422	15.2500
805	920	260	3330	4020	0.2289	0.0647	0.8284	12.8077
810	950	245	3330	4020	0.2363	0.0609	0.8284	13.5918
815	1230	270	4000	4800	0.2562	0.0562	0.8333	14.8148
820	860	250	3050	3480	0.2471	0.0718	0.8764	12.2000
825	830	365	3600	4100	0.2024	0.0890	0.8780	9.8630
830	800	300	3050	3180	0.2516	0.0943	0.9591	10.1667
835	400	275	2250	2320	0.1724	0.1185	0.9698	8.1818
840	255	235	1840	1870	0.1364	0.1257	0.9840	7.8298
845	495	215	1970	1990	0.2487	0.1080	0.9899	9.1628
850	390	225	1400	1660	0.2349	0.1355	0.8434	6.2222
855	505	275	1980	1990	0.2538	0.1382	0.9950	7.2000
900	295	215	1260	1190	0.2479	0.1807	1.0588	5.8605
905	395	225	375	340	1.1618	0.6618	1.1029	1.6667
910	370	215	350	330	1.1212	0.6515	1.0606	1.6279
915	68	220	420	400	0.1700	0.5500	1.0500	1.9091
920	80	240	490	455	0.1758	0.5275	1.0769	2.0417
925	630	235	2430	2460	0.2561	0.0955	0.9878	10.3404
930	920	245	2860	3590	0.2563	0.0682	0.7967	11.6735
935	370	215	1640	1410	0.2624	0.1525	1.1631	7.6279
940	180	160	720	590	0.3051	0.2712	1.2203	4.5000

FLIGHT 21

TIME	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
950	70	91	225	135	0.5185	0.6741	1.6667	2.4725
955	53	75	200	105	0.5048	0.7143	1.9048	2.6667
1000	47	67	195	105	0.4476	0.6381	1.8571	2.9104
1005	57	105	240	160	0.3562	0.6563	1.5000	2.2857
1010	60	88	325	260	0.2308	0.3385	1.2500	3.6932
1015	225	270	965	950	0.2368	0.2842	1.0158	3.5741
1020	390	510	1710	1740	0.2241	0.2931	0.9828	3.3529

FLIGHT 22

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
600	255	230	1000	770	0.3312	0.2987	1.2987	4.3478
605	165	290	670	490	0.3367	0.5918	1.3673	2.3103
610	210	220	790	650	0.3231	0.3385	1.2154	3.5909
615	185	200	700	610	0.3033	0.3279	1.1475	3.5000
620	390	420	1600	1350	0.2889	0.3111	1.1852	3.8095
625	220	200	860	780	0.2821	0.2564	1.1026	4.3000
630	220	350	890	770	0.2857	0.4545	1.1558	2.5429
635	200	310	740	670	0.2985	0.4627	1.1045	2.3871
640	215	235	820	750	0.2867	0.3133	1.0933	3.4894
645	190	210	770	650	0.2923	0.3231	1.1846	3.6667
650	130	140	450	415	0.3133	0.3373	1.0843	3.2143
655	240	270	930	770	0.3117	0.3506	1.2078	3.4444
700	100	150	280	250	0.4000	0.6000	1.1200	1.8667
705	88	175	240	200	0.4400	0.8750	1.2000	1.3714
710	120	210	380	340	0.3529	0.6176	1.1176	1.8095
715	115	180	390	375	0.3067	0.4800	1.0400	2.1667
920	360	245	1660	1330	0.2707	0.1842	1.2481	6.7755
725	80	115	270	270	0.2963	0.4259	1.0000	2.3478
730	51	64	110	145	0.3517	0.4414	0.7586	1.7188
735	52	65	130	190	0.2737	0.3421	0.6842	2.0000
740	79	56	145	290	0.2724	0.1931	0.5000	2.5893
745	72	56	165	325	0.2215	0.1723	0.5077	2.9464
750	102	170	460	1000	0.1020	0.1700	0.4600	2.7059
755	195	225	770	1050	0.1857	0.2143	0.7333	3.4222
800	2720	1170	7150	5350	0.5084	0.2187	1.3364	6.1111
805	255	620	890	835	0.3054	0.7425	1.0659	1.4355
810	350	650	1240	1150	0.3043	0.5652	1.0783	1.9077
815	345	800	1430	1550	0.2226	0.5161	0.9226	1.7875
820	1120	800	4800	5100	0.2196	0.1569	0.9412	6.0000
825	270	370	1070	1050	0.2571	0.3524	1.0190	2.8919
830	860	480	3500	3250	0.2646	0.1477	1.0769	7.2917
835	310	340	1060	1060	0.2925	0.3208	1.0000	3.1176
840	700	280	3080	3000	0.2333	0.0933	1.0267	11.0000
845	180	280	610	610	0.2951	0.4590	1.0000	2.1786
850	450	355	1740	1680	0.2679	0.2113	1.0357	4.9014
855	190	280	900	570	0.3333	0.4912	1.5789	3.2143
900	190	355	620	710	0.2676	0.5000	0.8732	1.7465
905	100	240	310	370	0.2703	0.6486	0.8378	1.2917
910	265	310	1170	1400	0.1893	0.2214	0.8357	3.7742
915	125	150	450	475	0.2632	0.3158	0.9474	3.0000
920	1230	1330	0	0				
925	775	665	3300	3050	0.2541	0.2180	1.0820	4.9624
930	480	360	2000	2020	0.2376	0.1782	0.9901	5.5556
935	310	240	1200	1250	0.2480	0.1920	0.9600	5.0000
940	170	180	650	690	0.2464	0.2609	0.9420	3.6111
945	575	340	2100	2320	0.2478	0.1466	0.9052	6.1765
950	1040	565	3750	3670	0.2834	0.1540	1.0218	6.6372
955	1070	500	3810	4020	0.2662	0.1244	0.9478	7.6200
1000	265	180	830	1000	0.2650	0.1800	0.8300	4.6111
1005	0	0	0	0				

FLIGHT 22

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
1015	470	250	1470	2050	0.2293	0.1220	0.7171	5.8800
1020	440	330	1540	1710	0.2573	0.1930	0.9006	4.6667

FLIGHT 23

	BRIGHTNESS IN RAYLEIGHS				RATIOS OF OBSERVED INTENSITIES			
TIME	6685	6300	5577	3914	6685/ 3914	6300/ 3914	5577/ 3914	5577/ 6300
600	920	270	3400	3160	0.2911	0.0854	1.0759	12.5926
605	485	230	1870	1730	0.2803	0.1329	1.0809	8.1304
610	3400	520	13600	17400	0.1954	0.0299	0.7816	26.1538
615	920	295	4080	4700	0.1957	0.0628	0.8681	13.8305
620	625	245	2380	2080	0.3005	0.1178	1.1442	9.7143
625	850	255	3530	3540	0.2401	0.0720	0.9972	13.8431
630	120	170	340	380	0.3158	0.4474	0.8947	2.0000
635	66	77	110	105	0.6286	0.7333	1.0476	1.4286
640	67	42	104	78	0.8590	0.5385	1.3333	2.4762
645	65	65	103	65	1.0000	1.0000	1.5846	1.5846
650	70	59	98	76	0.9211	0.7763	1.2895	1.6610
655	125	63	106	71	1.7606	0.8873	1.4930	1.6825
700	75	50	95	56	1.3393	0.8929	1.6964	1.9000
705	82	54	106	52	1.5769	1.0385	2.0385	1.9630
710	79	52	100	54	1.4630	0.9630	1.8519	1.9231
715	74	46	106	37	2.0000	1.2432	2.8649	2.3043
720	61	42	92	23	2.6522	1.8261	4.0000	2.1905
725	60	42	89	22	2.7273	1.9091	4.0455	2.1190
730	52	48	93	48	1.0833	1.0000	1.9375	1.9375
735	48	45	99	103	0.4660	0.4369	0.9612	2.2000
740	1210	630	3000	2750	0.4400	0.2291	1.0909	4.7619
745	380	265	1410	1720	0.2209	0.1541	0.8198	5.3208
750	410	245	1370	2250	0.1822	0.1089	0.6089	5.5918
755	400	185	1370	1600	0.2500	0.1156	0.8562	7.4054
800	760	390	2370	3020	0.2517	0.1291	0.7848	6.0769
805	385	180	1340	1520	0.2533	0.1184	0.8816	7.4444
810	350	200	1060	1230	0.2846	0.1626	0.8618	5.3000
815	395	180	1270	1470	0.2687	0.1224	0.8639	7.0556
820	490	120	1480	1610	0.3043	0.0745	0.9193	12.3333
825	550	195	1750	1980	0.2778	0.0985	0.8838	8.9744
830	610	225	2130	2400	0.2542	0.0938	0.8875	9.4667
835	395	190	1310	1340	0.2948	0.1418	0.9776	6.8947
840	260	165	860	880	0.2955	0.1875	0.9773	5.2121
845	60	115	240	285	0.2105	0.4035	0.8421	2.0870
850	46	86	105	106	0.4340	0.8113	0.9906	1.2209
855	41	96	104	99	0.4141	0.9697	1.0505	1.0833
900	31	64	62	50	0.6200	1.2800	1.2400	0.9688
905	52	82	110	180	0.2889	0.4556	0.6111	1.3415
910	75	96	270	280	0.2679	0.3429	0.9643	2.8125
915	100	108	370	350	0.2857	0.3086	1.0571	3.4259
920	290	175	1210	1350	0.2148	0.1296	0.8963	6.9143
925	300	175	1350	2180	0.1376	0.0803	0.6193	7.7143
930	290	180	1500	2210	0.1312	0.0814	0.6787	8.3333
935	290	170	1620	2050	0.1415	0.0829	0.7902	9.5294
940	480	155	1680	1570	0.3057	0.0987	1.0701	10.8387
945	410	135	1860	2560	0.1602	0.0527	0.7266	13.7778
950	390	135	1020	1040	0.3750	0.1298	0.9808	7.5556
955	330	135	1040	1160	0.2845	0.1164	0.8966	7.7037

$IBSYS
$RESTORE 896

********** 137800 **********
********** 137800 **********

APPENDIX II

SPECTROMETER CONDITIONS

Unless otherwise noted, the spectral range was ~ 12,400 - 14,000 Å.

Flight 6

UT	Filter (order)	Slit Width	P. M. Tube Gain Setting*	Comments
1944	None	10.0 mm	10	
2034			3	
2037		1.0	4	
2041			5	
2042		0.4	4, 6, 8	
2103			6	Sunrise

Flight 7

0315	Second	2.0 mm	10	
0342				Last Scan

Flight 9

0340	None	0.6 mm	10	
0403		1.0		
0732				Last Scan

Flight 10

0548	None	10.0 mm	10	
0552		4.0		
0656	Second	10.0		
0733	None			
0804	Third			

*See end of this appendix

Flight 10 (cont.)

UT	Filter (order)	Slit Width	P. M. Tube Gain Setting	Comments
0816	Fourth			
0854	None			
0930		4.0 mm		
1105				Last Scan

Flight 11
(Wavelength range to cover 3914 in third order)

0703	Third	1.0 mm	10	
0724		2.0		
0818		1.0		
0849		0.6		
1051				Last Scan

Flight 12
(3914, third order)

0552	Third	0.6 mm	10	
0648		1.0		
0652			3	
0656			10	
1018				Last Scan

Flight 14

0618	None	1.0 mm	10	
0629	Fourth			
0652	Second			
0702		6.0		
0755	Fourth			
0835	Second			

Flight 14 (cont.)

UT	Filter (order)	Slit Width	P. M. Tube Gain Setting	Comments
0914	Fourth			
0949	Second			
1008	Fourth			
1047	Second			
1110				Last Scan

Flight 15

38	Second	6.0 mm	10	
540		2.0, 4.0		
0552	Fourth			
0613	Second	6.0		
0625	Fourth			
0643	Second			
0702	Fourth			
0720	None			
0743	Fourth			Problem with curtain until here
0805	Second			
0822	Fourth			
0840	Second			
0858	Fourth			
0916	Second			
0936	Fourth			
0954	Second			
1011	None			
1012		2.0		
1018		1.0		
1025				Last Scan

Flight 16

UT	Filter (order)	Slit Width	P. M. Tube Gain Setting	Comments
0904	Second	2.0 mm	10	
0919		4.0		
0941		6.0		
1001	Fourth			
1020	Second			
1040	Fourth			
1051	None			
1158		2.0		
1235				Last Scan

Flight 17

0150	Second	6.0 mm	10	
0155		2.0		
0218	None			
0357		0.6		
0400	Second			
0400	None			

Flight 18

0145	None	6.0 mm	10	
0150		2.0		
0221	Fourth	6.0		
0237		4.0		
0247	Second	6.0		
0306	Fourth			
0324	Second			

Flight 18 (cont.)

UT	Filter (order)	Slit Width	P. M. Tube Gain Setting	Comments
0343	Fourth			
0401	Second			
0421	Fourth			
0439	Second			
0456	Fourth			
0514	Second			
0532	Fourth			
0551	Second			
0609	Fourth			
0626	Second			
0644	None			
0650				Last Scan

Flight 19

0308	Second	6.0 mm	10	
0414	None			
0434		2.0		
0504		1.0		
0513		2.0		
0618		1.0		
0700		6.0		
0717	Second			
0718	None			
0721		4.0		
0726				Last Scan

Flight 20

UT	Filter (order)	Slit Width	Gain Setting	Comments
0301	None	4.0 mm	10	
0412		2.0		
0459		1.0		
0507		2.0		
0639		0.6		
0649		1.0		
0650			9	
0651			10	
0734			9	
0735			10	
0742			9	
0744			10	
0805				Last Scan

Flight 21

0531	None	2.0 mm	10	
0536		1.0		
0600		2.0		
0604			9	
0644		1.0		
0645			10	
0714			9	
0715			8	
0716		0.6	9	
0717			10	
0722		1.0		

Flight 21 (cont.)

UT	Filter (order)	Slit Width	P. M. Tube Gain Setting	Comments
0724		0.6 mm	9	
0725			10	
0727		1.0		
0741			9	
0758			10	
0858		2.0		
0918		1.0 2.0	9	
0937			10	
1019			9	
1020			10	
1023				Last Scan

Flight 22

0555	None	2.0 mm	10	
0603		1.0 2.0		
0719		1.0		
0730		2.0		
0758		1.0		
0759			9	
0818		0.6 1.0		
0828		2.0		
0831		1.0		
0836		2.0		
0840		1.0		

Flight 22 (cont.)

UT	Filter (order)	Slit Width	P. M. Tube Gain Setting	Comments
0852		2.0 mm		
0921		1.0		
0934		2.0		
0947		1.0		
0957		2.0		
1005		1.0		
1016		2.0		
1025		1.0		
1036				Last Scan

Flight 23

0558	None	2.0 mm	10	
0559		1.0	9	
0601			10	
0602		2.0		
0607		1.0		
0614		2.0		
0638		4.0		
0640	Second			
0645		6.0		
0739	None	2.0		
0740		1.0		
0744		2.0		
0748		1.0		
0749		2.0		
0848		4.0		

Flight 23 (cont.)

UT	Filter (order)	Slit Width	P. M. Tube Gain Setting	Comments
0911		2.0 mm		
0940		1.0		
0942		2.0		
1035				Last Scan

Flight 24

0529	None	2.0 mm	10	
0530		4.0		
0538		6.0		
0559	Second			
0620-34				Calibration
0634	Second	4.0	10	
0653	Fourth			
0714	Second			
0731	Fourth			
0750	Second			
0819	Fourth			
0835	Second			
0855	Fourth			
0923	Second			
1010				Last Scan

Flight 25

0604	None	2.0 mm	10	
0630	Second			
0632		4.0		

Flight 25 (cont.)

UT	Filter (order)	Slit Width	P. M. Tube Gain Setting	Comments
0648		6.0 mm		
0854		4.0		
1020				Last Scan

Flight 26

0906	Second	6.0 mm	10	
0930	Fourth			
0950	Second			
1027	Fourth			
1101	Second			
1136	Fourth			
1217	Second			
1256	Fourth			
1331	Second			
1406	Fourth			
1441	Second			
1502				Last Scan

Flight 27

1000	Second	4.0 mm	10	
1425				Last Scan

P. M. Gain Setting:	3	4	5	6
Actual P. M. Gain:	1.1×10^4	9.6×10^4	2.5×10^5	7.2×10^5
P. M. Gain Setting:	7	8	9	10
Actual P. M. Gain:	1.1×10^6	1.8×10^6	3×10^6	5×10^6

APPENDIX III

Spectral features identified from the spectrometer records.

n λ (Å)		Identification	Order	λ (Å)
12416	N_2	2 PG (4, 3)	4	3104.0
12454	N I	$3s\ ^4P_{2\ 1/2} - 4p\ ^4S^o_{1\ 1/2}$	3	4151.5
12467	N_2	2 PG (3, 2)	4	3116.7
12500	N_2^+	1 NG (3, 4)	3	4166.8
12528	N II	$3d\ ^1D_2{}^o - 4f\ ^1F_3$	3	4176
12544	N_2	2 PG (2, 1)	4	3136.0
12597	N_2^+	1 NG (2, 3)	3	4199.1
12601	O I	$^3P - ^1D$	2	6300.3
12637	N_2	2 PG (1, 0)	4	3159.3
12669	N I	$3s\ ^4P_{2\ 1/2} - 4p\ ^4P^o_{2\ 1/2}$	3	4223
12710	N_2^+	1 NG (1, 2)	3	4236.5
12728	O I	$^3P - ^1D$	2	6363.8
12834	N_2^+	I NG (0, 1)	3	4278.1
12910	O I	$^3P\ ^5P - 5s\ ^5S^o_2$	2	6455
12937	N_2	1 PG (8, 5)	2	6468.5
12951	O II	$3s\ ^4P_{1/2} - 3p\ ^4P^o_{1\ 1/2}$	3	4317.1
12959	O II	$3s\ ^4P_{1\ 1/2} - 3p\ ^4P^o_{2\ 1/2}$	3	4319.6
12960	N_2	V K (1, 13)	3	4320

APPENDIX III (Cont'd)

n λ (Å)		Identification	Order	λ (Å)
12964	N II	$3s\ ^1P^o_1 - 3p\ ^1P_1$	2	6482.0
13031	N_2	2 PG (0, 4)	3	4343.6
13090	N_2	1 PG (7, 4)	2	6544.8
13105	O I	$3s\ ^3S^o_1 - 4p\ ^3P$	3	4368.3
13108	O II	$3p\ ^2D^o_{1\ 1/2} - 3d\ ^2D_{1\ 1/2}$	3	4369.3
13126	H	Balmer α	2	6562.8
13141	N_2	2 PG (3, 3)	4	3285.3
13247	N_2	1 PG (6, 3)	2	6623.6
13275	N_2	V K (2, 14)	3	4425
13297	N_2	G K (0, 10)	3	4432.3
13356	N_2	2 PG (1, 1)	4	3339
13410	N_2	1 PG (5, 2)	2	6704.8
13485	N_2	2 PG (0, 0)	4	3371.3
13577	N_2	1 PG (4, 1)	2	6788.6
13602	N_2	V K (3, 15)	3	4534
13706	N_2^+	Meinel (3, 0)	2	6853.0
13750	N_2	1 PG (3, 0)	2	6875.2
13789	O II	$3s'\ ^2D_{2\ 1/2} - 3p'\ ^2F^o_{3\ 1/2}$	3	4596.2
13866	N I	$2p^3\ ^4S^o_{1\ 1/2} - 2p^3\ ^2P^o$	4	3466.4
13876	N_2	2 PG (3, 4)	4	3469

APPENDIX III (Cont'd)

n λ (Å)		Identification	Order	λ (Å)
13892	N II	$3s\ ^3P^o_2 - 3p\ ^3P_2$	3	4630.5
13917	O II	$3s\ ^4P_{1/2} - 3p\ ^4D^o_{1\ 1/2}$	3	4638.9
13925	O II	$3s\ ^4P_{1\ 1/2} - 3p\ ^4D^o_{2\ 1/2}$	3	4641.8
13947	O II	$3s\ ^4P_{2\ 1/2}\ 3p\ ^4D^o_{3\ 1/2}$	3	4649.1
13952	O II	$3s\ ^4P_{1/2} - 3p\ ^4D^o_{1/2}$	3	4650.8
13955	N_2^+	1 NG (1 3)	3	4651.8