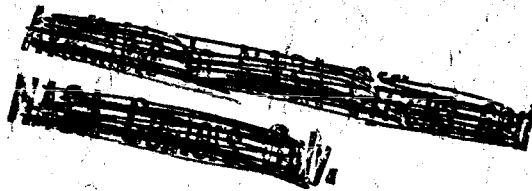


HIG-64-11

SUMMARY REPORT ON ZODIACAL LIGHT, JULY 1964

FACILITY FORM 602	N66-15052	
	ACCIDENT NUMBER	(TITLE)
	21	1
	CP 58323	30
	(CODE)	(CATEGORY)

By
J. L. WEINBERG



GPO PRICE \$ _____

CFSTI PRICE(S) \$ _____

Hard copy (HC) _____

Microfiche (MF) _____

ff 653 July 65

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
UNDER NASA GRANT NsG 676

UNPUBLISHED PRELIMINARY DATA

HAWAII INSTITUTE OF GEOPHYSICS
UNIVERSITY OF HAWAII



REPORTS CONTROL

SUMMARY REPORT ON ZODIACAL LIGHT, JULY 1964

By

J. L. Weinberg

Astrogeophysics Division
Hawaii Institute of Geophysics
University of Hawaii

July 1964

Prepared for

National Aeronautics and Space Administration
Under NASA Grant NsG 676

Approved by Director

George V. Vailland

Date: 3 August 1964

~~Available to NASA Office and
NASA Centers Only~~

Introductory Remarks

A special session of Commission 21 (luminescence du ciel) of the International Astronomical Union will be convened at the XIIth General Assembly (August 1964; Hamburg) to consider the current status of research on the zodiacal light. This summary report was prepared to facilitate a critical review of the zodiacal light problem (with particular emphasis on results during the triennium 1961-1964) by participants in this special session.

Accurate measurement of the Stokes parameters of the night-sky radiation at high ecliptic latitudes is now possible, and careful calibration combined with new techniques for separating the zodiacal light from the airglow and starlight in these regions will contribute greatly to our understanding of the physics of the night-sky radiation in general and the zodiacal light in particular. In view of the considerable disagreement in observational results in the oft-observed bright portions of the zodiacal light and the ensuing difficulty in specifying the nature of the interplanetary matter, we have restricted ourselves to a detailed survey (numerical results, rather than a critique) of those results in the plane of the ecliptic that were available to the author.

This survey is presented in the form of tables and graphs of the surface brightness (radiance) and degree of polarization of the zodiacal light as a function of elongation, ϵ , in the plane of the ecliptic. No distinction is made between morning and evening observations, and, whenever possible, the spectral region or effective wavelength is specified.

Surface brightness of
plane of the ecliptic

Notes (see p. 5)

Color	UV	4060Å	4140	4355	4470	4500	4500
€	B 1955	D-K 1963	D-A 1960	P 1961a	BL-I 1961b	LVR 1937	REG 1955
5°							
10							
15							
20							
25				3150	3080		
30				1660	1641		2335
35			900	1230	1100	2295	1690
40	750*	1140	690	926	785	1691	1270
45	498	690	530		616	1323	
50	400*	535	410	697	491	1063	820
55					407	864	
60	295*	350	300	380	343	719	542
65						622	
70	255*	220	220	292		538	
75						468	
80		150	160	246		414	
85	287					371	
90			110	223		329	
95	186					297	
100			77	191		270	
105							
110	160						
115						255	
120							
125							
130	177						
135							
140							
145	169						
150							
155	127						
160							
165	144						255
170							305
175	93						335
180							

* interpolated value

f the zodiacal light in the
in S_{10} (vis) units (see p. 5).

iv.				iv.	v.		
4630	blue	blue	5220	5280	5300	5300	5300
RO	B	E-S	D-A	RO	RPTD	R-RE	W
1962	1955	1957	1960	1962	1954	1956	1963b
1938	1817			2108	2331		2200
1176	1155*			1275	1594		1525
860	896	700		938	1184		1130
658	700*	500		759	945		900
553		390		637	755		730
488	425*	250		567	601		615
446				506	498		520
412	335*	170		455	426		445
					371		385
377		120		379	329		335
	203				297		300
		91			271		270
	177				247		250
		59			229		230
					211	250	215
	93	20					205
						215	195
							190
	110					195	185
							185
	127					180	190
							195
	118					175	200
182							200
		95				170	205
	144	96					215
206		102				175	220
							230
	118	110				185	240
265		117					245
						218	260

Notes (see p. 5)	Surface brightness of the of the ecliptic in S_{10} (vis							
	5410Å	5425	5430	5430	vi.	vii.	viii.	vi
Color	D-A	P	BE-S	D-K	F	F	D	1930
€	1960	1961a	1953	1963	1947	1947	1952	
5°								
10								
15								
20								
25		2570						
30		1820					690	3
35		1150	855			1.29	560	
40	740	875	725	880	480-550	1.00	430	2
45	570		615	680				
50	450	558	515	520	300-350	.55	220	1
55			450					
60	280	392	395	320		.33	140	
65			360					
70	180	320	325	200		.22	100	
75			290					
80	120	254	255	150		.15	70	
85			225					
90	74	232	200					
95								
100	65	211						
105								
110								
115								
120								
125								
130								
135								
140								
145								
150								
155								
160								
165								
170								
175								
180								

zodiacal light in the plane
 units, cont'd. (see p. 5).

			ix.			iv.		x.	
visual	visual	visual	visual	visual	yellow	6165	6200	6300	6380
H	E	KA	DUM	F	E-S	RO	BL-I	BL	P
,1932	1958	1961	1962,1963a	1964b	1957	1962	1961b	1956	1961a
							5170		
							3036		
22	1230			2700			1945	1206	2020
80	630	350-450		1330		1970	1340	856	1290
			($\epsilon=43^\circ$)	770		1320	972	638	1010
52	420	220		605		996	730	499	
						786	568	400	645
64	270		($\epsilon=57^\circ$)	462	355	650	449		
						545	365		432
44	180			327	226	476	301		
			($\epsilon=72^\circ$)	334		434	253		327
40	130			170					278
62	110					356			
									237
96									202
30									
88									
54									
76									
20				166					
64						170			
96				166		175			
						177			
18						192			
				200		207	273		

		Degree of polarization the plane				
Notes (see p.6)	xii.		xiii.		xiv.	xv.
Color	?	blue	5220Å	5300	5410	5410
€	DU 1925	P 1961a	D-A 1960	W 1963b	D-A 1960	D-A 1960
5°						
10						
15						
20						
25						
30	.125			.148	.15	
35				.159	.16	
40	.125		.16	.171	.17	
45			.19	.183	.18	.17
50	.130		.21	.197	.19	.21
55			.21	.208	.20	.25
60	.150	.22	.22	.218	.19	.26
65			.22	.225	.18	.26
70	.130		.22	.229	.16	.26
75	.10	.17	.22	.226	.15	.25
80	.06			.217	.13	.23
85	.04			.204	.11	.22
90	.025	.15		.186		
95				.168		
100				.151		
105		.13		.135		
110				.120		
115				.107		
120		.12		.095		
125				.085		
130				.077		
135		.12		.069		
140				.058		
145				.042		
150				.027		
155				.016		
160				.006		
165						
170						
175						
180				.00		

ion of the zodiacal light in
e of the ecliptic.

xvi.			xvii.	xviii.			xix.
5430	visual	visual	visual		?	green	6200
D-A 1960	BE-S 1953	E 1958	RO 1962	HU 1951	T Y,1939	P 1961a	BL-I 1961b
							.100
.15		.20					.152
.16	.234		.10				.217
.17	.230	.29	.13	.15			.268
.18	.220		.14				.292
.20	.223	.31	.16	.20			.306
.22	.207						.314
.22	.190	.33	.19	.21	.15	.23	.320
.22	.172						.32
.21	.145	.36	.22	.19			.32
.20	.131					.21	
.18	.122	.35		.17			
.16	.116						
	.108	.36		.12		.20	
						.165	
						.16	
						.15	

Notes

Table 1a:

- i. These results were taken from a logarithmic plot and were converted from brightnesses in units of the integrated solar disk to $S_{10}(\text{vis})$ units using the solar spectral irradiance data of Johnson (1954).
- ii. The original paper does not include average results--only 4 sets of isophotes which differ with season. The results given here for $35^\circ \leq \epsilon \leq 100^\circ$ are an average of those isophotes as given by Roach, et al. (1954). The results for $\epsilon > 100^\circ$ were taken from Roach and Rees (1956).
- iii. As given by Peterson (1961). 4500\AA is the effective wavelength for this set of white-light observations.
- iv. To maintain internal consistency in Robley's work, we have used his conversion factors to express his results in $S_{10}(\text{vis})$ units.
- v. Roach, et al.'s (1954) Approximation III.

Table 1b:

- vi. As given by Karyagina (1961).
- vii. Distribution relative to the value at 40° elongation; as given by Divari (1952).
- viii. The spectral region was not given, nor was it stated whether the results are in photographic or visual units.
- ix. In the spectral region $4900\text{--}5500\text{\AA}$.
- x. "One morning observation only".

Notes (Continued)

Table 2:

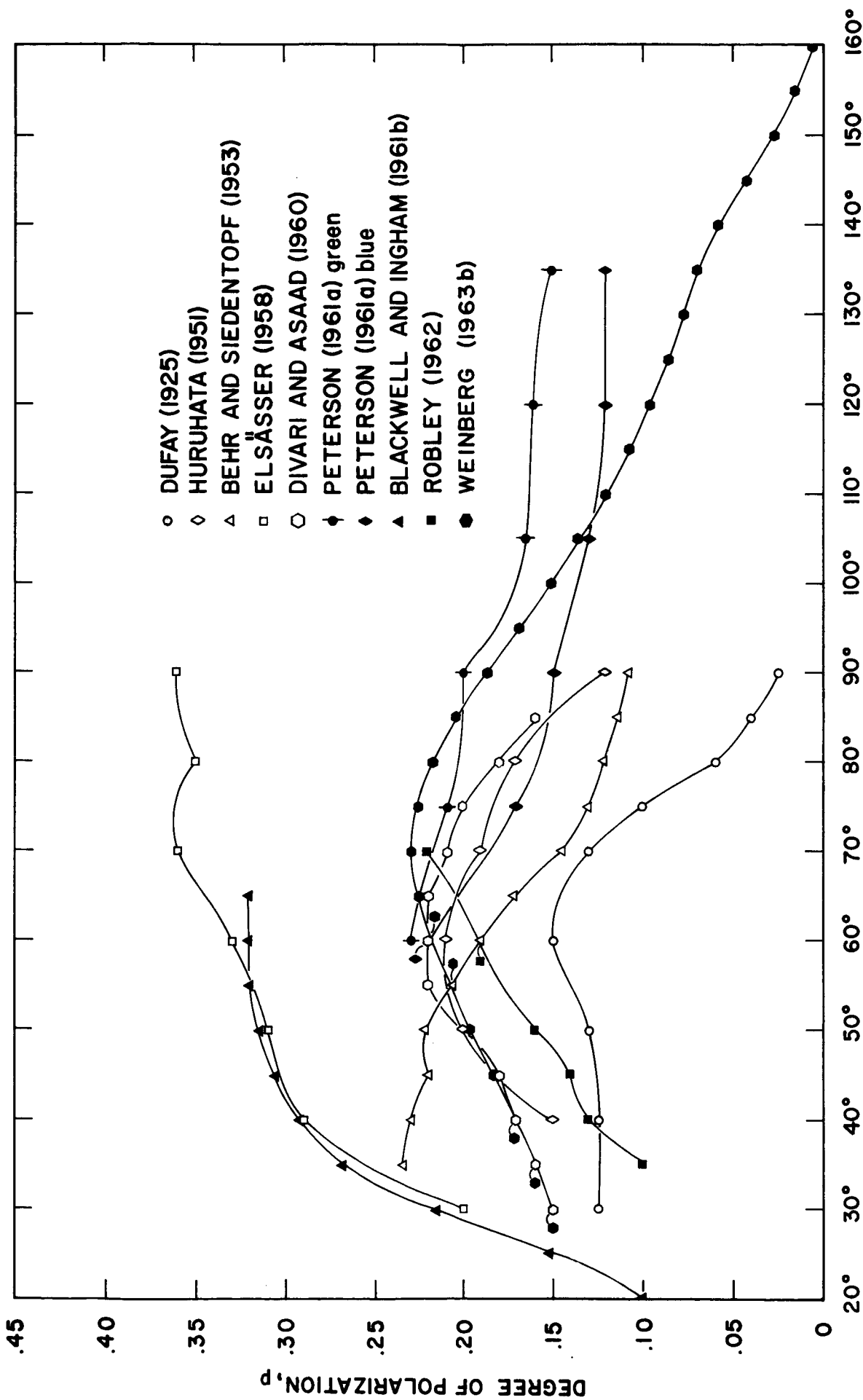
- xii. This first quantitative determination of the polarization of zodiacal light was based on a photographic study of the night-sky radiation.
- xiii. One night's observation (26 October 1957).
- xiv. One night's observation (27 October 1957).
- xv. One night's observation (28 October 1957).
- xvi. Average of 3 nights and 2 colors.
- xvii. Average of results in blue and in green.
- xviii. Mean values from morning and evening results in 1945, 1948, and 1949. These results were obtained with 2 broad-band photoelectric units having maximum sensitivities in the visible (4500Å) and near infrared (7200Å).
- xix. Unsmoothed results of polarization measurements at 4470Å were also given (but are not shown here), and they appear to be slightly higher than the results at 6200Å.

Figure 1:

In Figure 1 we have plotted representative post-1950 results for the surface brightness of the zodiacal light as a function of elongation, ϵ , in the plane of the ecliptic. To more clearly indicate the disagreement in zodiacal light photometry, we have plotted results only in the visible spectral region ($\sim 5200\text{--}5600\text{\AA}$). The unit of brightness is 10th magnitude (visual) G0 stars per square degree ($S_{10}(\text{vis})$ units).

Figure 2:

In Figure 2 we have plotted the distributions of polarization which are listed in Table 2. Polarization measurements in the region $160^\circ < \epsilon < 180^\circ$ are still being analyzed, but the author was unable to detect any polarization at the anti-solar point (Weinberg, 1964a).



ELONGATION, ϵ (IN DEGREES)

FIGURE 1. Representative post-1950 results for the surface brightness of the zodiacal light in the plane of the ecliptic (see p. 6).

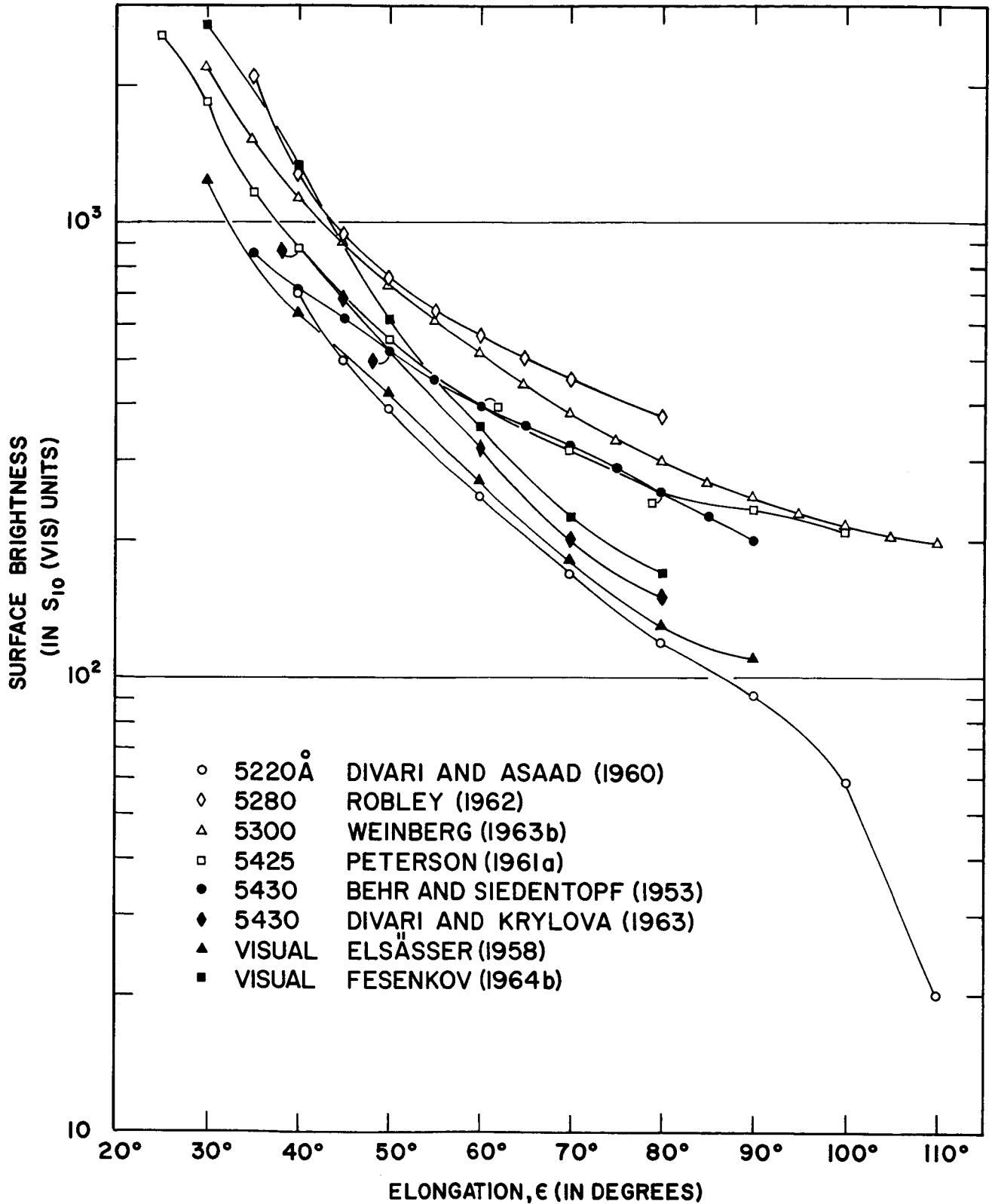


FIGURE 2. The degree of polarization of the zodiacal light in the plane of the ecliptic (see p. 6)

Author Legend

B	1955	Barbier
BE-S	1953	Behr and Siedentopf
BL	1956	Blackwell
BL-I	1961b	Blackwell and Ingham
D	1952	Divari
D-A	1960	Divari and Asaad
D-K	1963	Divari and Krylova
DU	1925	Dufay
DUM	1962, 1963a	Dumont
E	1958	Elsässer
E-S	1957	Elsässer and Siedentopf
F	1947, 1964b	Fesenkov
H	1930, 1932	Hoffmeister
HU	1951	Huruhata
KA	1961	Karyagina
LVR	1937	Elvey and Roach
P	1961	Peterson
REG	1955	Regener
RO	1962	Robley
RPTD	1954	Roach, Pettit, Tandberg-Hanssen, and Davis
R-RE	1956	Roach and Rees
T		Take-uchi
W	1963b	Weinberg
Y	1939	Yamamoto

Pre-1961 References Used in the Text

Barbier, D., 1955, Sur les variations d'intensité de la lumière zodiacale, Mém. Soc. Roy. Sci. Liège, 15, 55-71.

Behr, A. and H. Siedentopf, 1953, Untersuchungen über Zodiakallicht und Gegenschein nach lichtelektrischen Messungen auf dem Jungfrauoch, Zeits. f. Astrophys., 32, 19-50.

Blackwell, D. E., 1956, Observations from an aircraft of the zodiacal light at small elongations, Mon. Not. Roy. Astron. Soc., 116, 365-379.

Divari, N. B., 1952, Photometric study of the zodiacal light (translated title), Ast. Zhur., 29, 49-56, and 1958, The Zodiacal Twilight, Defence Res. Board, Canada, Pub. T245R, 29-35.

- Divari, N. B. and A. S. Asaad, 1960, Photoelectric observations of the zodiacal light in Egypt, Soviet Astron.-AJ, 3, 832-838, translation of 1959, Ast. Zhur., 36, 856-862.
- Dufay, J., 1925, La polarisation de la lumière zodiacale, Compt. Rend., 181, 399.
- Elsässer, H., 1958, Neue Helligkeits- und Polarisationsmessungen am Zodiakallight und ihre Interpretation, Die Sterne, 9-10, 166-169.
- Elsässer, H. and H. Siedentopf, 1957, Die Helligkeit des Gegenscheins nach lichtelektrischen Messungen an der Boyden-Station, Zeits. f. Astrophys., 43, 132-143.
- Elvey, C. T. and F. E. Roach, 1937, A photoelectric study of the light from the night sky, Astrophys. J., 85, 213-241.
- Fesenkov, V. G., 1947, in Meteoric Matter in Interplanetary Space (Moscow: Academy of Sciences Press).
- Hoffmeister, C., 1930, Beitrag zur Photometrie der südlichen Milchstrasse und des Zodiakallichts, Veröff. Univ.-Sternw. Berlin-Babelsberg, VIII, H. 2, 63pp.
- Hoffmeister, C., 1932, Untersuchungen über das Zodiakallight, Veröff. Univ.-Sternw. Berlin-Babelsberg, X, H. 1, 111pp.
- Huruhata, M., 1951, Photoelectric study of the zodiacal light, Publ. Astron. Soc. Japan, 2, 156-171.
- Johnson, F. S., 1954, The solar constant, J. Meteorology, 11, 431-439.
- Regener, V. H., 1955, Recordings of the zodiacal light, Astrophys. J., 122, 520-529.
- Roach, F. E., H. B. Pettit, E. Tandberg-Hanssen, and D. N. Davis, 1954, Observations of the zodiacal light, Astrophys. J., 119, 253-273.
- Roach, F. E. and M. H. Rees, 1956, The absolute photometry of the gegenschein, in The Airglow and the Aurorae (E. B. Armstrong and A. Dalgarno, eds.), 142-155, (London and New York: Pergamon Press).
- Yamamoto, I., 1939, Report of the sub-commission on zodiacal light, Trans. Int. Astron. Union (Stockholm, 1938), VI, 172-175.

A Bibliography on Zodiacal Light and Gegenschein during the
Triennium 1961-1964

This non-annotated bibliography is a compilation of zodiacal light and gegenschein references during the period January 1961 through June 1964 which were available to or known of by the author. Also included are papers on closely related problems which make use of zodiacal light results. It was not our intent to provide another bibliography on the closely-related topic of interplanetary matter, but we have included several references on this and other related subjects on the basis of our bias as to what should be included in such a bibliography.

References

- _____, 1964, Brief description of Ney's and Regener's IQSY zodiacal light programs, Preprint of the U. S. program for IQSY, 39-40, May.
- Alexander, W. M., C. W. McCracken, L. Secretan, and O. E. Berg, 1962, Rocket, satellite, and space-probe measurements of interplanetary dust, IGY Bull., no. 61, 7-16, July; 1962, in Trans. Amer. Geophys. Union, 43, 351-360; 1963, published as "Review of Direct Measurements of Interplanetary Dust from Satellites and Probes", in Space Research III (W. Priester, ed.), 891-917, (New York: Interscience).
- Beggs, D. W., D. E. Blackwell, D. W. Dewhirst, and R. D. Wolsten-croft, 1964a, Further observations of the zodiacal light from a high altitude station and investigation of the interplanetary plasma: I. Introductory survey and photoelectric measurements of brightness, Mon. Not. Roy. Astron. Soc., 127, 319-328.

- Beggs, D. W., D. E. Blackwell, D. W. Dewhirst, and R. D. Wolstencroft, 1964b, Further observations of the zodiacal light from a high altitude station and investigation of the interplanetary plasma: II. Spectrophotometric observations and the electron density in interplanetary space, Mon. Not. Roy. Astron. Soc., 127, 329-340.
- Blackwell, D. E., 1962, The zodiacal light, Science Survey, 3, 117.
- Blackwell, D. E., 1963, Remarks on the limitations of optical methods for measuring electron densities in the corona and interplanetary space, Space Science Reviews, 1, 612-614.
- Blackwell, D. E. and M. F. Ingham, 1961a, Preliminary results of zodiacal light observations from a very high altitude station, Observatory, 81, 1-3.
- Blackwell, D. E. and M. F. Ingham, 1961b, Observations of the zodiacal light from a very high altitude station: I. The average zodiacal light, Mon. Not. Roy. Astron. Soc., 122, 113-127.
- Blackwell, D. E. and M. F. Ingham, 1961c, Observations of the zodiacal light from a very high altitude station: II. Electron densities in interplanetary space, Mon. Not. Roy. Astron. Soc., 122, 129-141.
- Blackwell, D. E. and M. F. Ingham, 1961d, Observations of the zodiacal light from a very high altitude station: III. The disturbed zodiacal light and corpuscular radiation, Mon. Not. Roy. Astron. Soc., 122, 143-155.
- Brandt, J. C. and P. W. Hodge, 1961, Lunar dust and the gegenschein, Nature, 192, 957.
- Briggs, R. E., 1962, Steady-state space distribution of meteoric particles under the operation of the Poynting-Robertson effect, Astron. J., 67, 710-723.
- Chuvaev, K. K., 1962, A separation of the light from the night sky into its components, Soviet Astron.-AJ, 5, 526-535, translation of 1961, Ast. Zhur., 38, 692-705.
- Dewhirst, D. W., 1963, Further observations of the zodiacal light from a high altitude station and investigation of the interplanetary plasma, account of papers by Beggs, Blackwell, Dewhirst, and Wolstencroft (1964), Observatory, 83, 232-233.

- Divari, N. B., 1964, Lunar effects on zodiacal brightness, Soviet Astron.-AJ, 7, 547-548, translation of 1963, Ast. Zhur., 40, 717-718.
- Divari, N. B. and S. N. Krylova, 1963, Photoelectric observations of zodiacal light from a high-altitude observatory, Soviet Astron.-AJ, 7, 391-398, translation of 1963, Ast. Zhur., 40, 514-522.
- Dumont, R., 1962, L'elimination de la luminescence atmosphérique dans la photométrie photoélectrique de la lumière zodiacale, Compt. Rend., 254, 4428-4430.
- Dumont, R., 1963a, Séparation des composantes extraterrestre et atmosphérique de la lumière du ciel nocturne au pôle et en différents points du ciel, Compt. Rend., 256, 1447-1449.
- Dumont, R., 1963b, Mesures photométriques de la lumière zodiacale et du gegenschein corrigés de la luminescence atmosphérique, Compt. Rend., 257, 2242-2245.
- Elsässer, H., 1963, The zodiacal light, Planetary Space Sci., 11, 1015-1033.
- Fesenkov, V. G., 1961a, On the observation conditions of zodiacal light during a solar eclipse (translated title), in Izv. Akad. Nauk Kazakh. S.S.R., 12, 15-20.
- Fesenkov, V. G., 1961b, Zodiacal light (translated title), Priroda, no. 3, 5-8.
- Fesenkov, V. G., 1961c, The polarization of emission lines in the spectrum of the night sky, Soviet Astron.-AJ, 4, 749-753, translation of 1960, Ast. Zhur., 37, 794-798.
- Fesenkov, V. G., 1962, On the density of meteoric matter in interplanetary space in the light of the possible existence of a dust cloud around the earth, Soviet Astron.-AJ, 5, 775-778, translation of 1961, Ast. Zhur., 38, 1009-1015.
- Fesenkov, V. G., 1963a, Conditions of disintegration of asteroids from observations of the properties of the zodiacal light (translated title), A.I.A.A. J., 1, no. 5, 1250-1253, May, translation of 1959, Izvest. Astrofiz. Inst. Akad. Nauk Kazakh. S.S.R., 8, 3-12; see also Reviewer's Comment, by D. E. Blackwell, 1254.

- Fesenkov, V. G., 1963b, Correction of photometric observations of the zodiacal light for tropospheric scattering, Soviet Astron.-AJ, 7, 23-27, translation of 1963, Ast. Zhur., 40, 31-37.
- Fesenkov, V. G., 1964a, A table for the reduction of photometric observations of the zodiacal light for the effect of tropospheric scattering, Soviet Astron.-AJ, 7, 670-676, translation of 1963, Ast. Zhur., 40, 882-888.
- Fesenkov, V. G., 1964b, Isophotes of zodiacal light from observations made in Egypt during the autumn of 1957, Soviet Astron.-AJ, 7, 829-834, translation of 1963, Ast. Zhur., 40, 1085-1094.
- Giese, R. H., 1961, Streuung elektronmagnetischer Wellen an absorbierenden und dielektrischen kugelförmigen Einzelteilchen und an Gemischen solcher Teilchen, Zeits. f. Astrophys., 51, 119-147.
- Giese, R. H., 1963, Light scattering by small particles and models of interplanetary matter derived from the zodiacal light, Space Science Reviews, 1, 589-611.
- Giese, R. H. and H. Siedentopf, 1962, Optische Eigenschaften von Modellen der interplanetaren Materie, Zeits. f. Astrophys., 54, 200-216.
- Gillett, F. C., E. P. Ney, and W. A. Stein, 1963, Outer corona and zodiacal light measurements, Proceedings of Project APEQS Symposium, December, and 1964, Douglas Aircraft Co. Rept. No. G-36443, 59, March.
- Gindilis, L. M., 1962, Absolute spectrophotometry of the continuous spectrum of the counter glow, Soviet Astron.-AJ, 6, 67-76, translation of 1962, Ast. Zhur., 39, 93-106.
- Gindilis, L. M., 1963, The gegenschein as an effect produced by the scattering of light from particles of interplanetary dust, Soviet Astron.-AJ, 6, 540-548, translation of 1962, Ast. Zhur., 39, 689-701.
- Gindilis, L. M. and Z. V. Karyagina, 1964, Energy distribution in the counter glow spectrum in the region $\lambda\lambda$ 3900-6500 Å (translated title), Ast. Zhur., 41, 116-121.
- Gindilis, L. M. and N. N. Pariiskii, 1961, The intensity of the principal emission lines of the night sky in the region of the gegenschein, Soviet Astron.-AJ, 5, 72-77, translation of 1961, Ast. Zhur., 38, 99-106.

- Harrison, E. R., 1961, Solar wind and the gegenschein, Nature, 189, 993-994.
- Harrison, E. R., 1962, The earth's distant magnetic field, Geophys. J., 6, 479-492.
- Harwit, M., 1963a, Origins of the zodiacal dust cloud, J. Geophys. Res., 68, 2171-2180.
- Harwit, M., 1963b, Infrared appearance of different zodiacal cloud models, Paper presented at the 12th International Colloquium of the Astrophysical Institute, Liège, 24-26 June.
- Hope, E. R., 1961, Confirmation of outer atmospheric asymmetry postulated to explain the false zodiacal light, Nature, 192, 742.
- Huruhata, M., 1964, Photoelectric observations of the photometric axis of the zodiacal light, Tokyo Astronomical Observatory, unpublished manuscript.
- Ingham, M. F., 1961, Observations of the zodiacal light from a very high altitude station: IV. The nature and distribution of the interplanetary dust, Mon. Not. Roy. Astron. Soc., 122, 157-176.
- Ingham, M. F., 1962a, The nightglow spectrum: I. $\lambda\lambda$ 3700-4650 A, Mon. Not. Roy. Astron. Soc., 124, 505-522.
- Ingham, M. F., 1962b, The nightglow spectrum: II. $H\alpha$ radiation in the night sky, Mon. Not. Roy. Astron. Soc., 124, 523-532.
- Ingham, M. F., 1963a, The profile of an absorption line in the spectrum of the zodiacal light, Mon. Not. Roy. Astron. Soc., 126, 377-380.
- Ingham, M. F., 1963b, Interplanetary matter, Space Science Reviews, 1, 576-588.
- James, J. F., 1963, The zodiacal light, New Scientist, 17, 135-137.
- Karyagina, Z. V., 1961, The energy distribution in the spectrum of zodiacal light, Soviet Astron.-AJ, 4, 828-832, translation of 1960, Ast. Zhur., 37, 882-887.
- Little, S., B. J. O'Mara, and L. H. Aller, 1964, Light scattering by small particles in the zodiacal light, Paper presented at 116th AAS meeting, Flagstaff, Arizona, 24-27 June.

- McCracken, C. W. and W. M. Alexander, 1961, The distribution of small interplanetary dust particles in the vicinity of the earth, in Proceedings of the Symposium on the Astronomy and Physics of Meteors, held at Cambridge, Mass.; 1962, Geophys. Res. Paper No. 75, AFCRL-62-497, 314 pp., May; 1962, NASA Technical Note D-1349, NASA N62-14090, July; and 1963, Smithson. Contrib. Astrophys., 7.
- Ney, E. P., 1962a, Eclipse observations of the zodiacal light, Sky and Telescope, 23, 267-271.
- Ney, E. P., 1962b, Summary Report, Atmospheric Physics, University of Minnesota, January-September.
- Ney, E. P., W. F. Huch, and R. Maas, 1961, Zodiacal light measurements from balloons, Paper presented at 109th AAS meeting, Denver, December; abstract published in Astron. J., 67, 120, 1962.
- Nikolskii, G. M., 1961, Photoelectric observations of zodiacal light at Alma-Ata (translated title), Geomagnetizm i aeronomiya, 1, 354-358.
- Peterson, A. W., 1961a, Three-color photometry of the zodiacal light, Astrophys. J., 133, 668-674.
- Peterson, A. W., 1961b, Preliminary investigation of the infrared thermal emission from the zodiacal dust cloud, GD Report ERR-FW-100, 1 September.
- Peterson, A. W., 1961c, The zodiacal light problem, GD Report ERR-FW-102, 1 October.
- Peterson, A. W., 1963a, An investigation of the thermal radiation from the interplanetary medium, GD Report ERR-FW-180, 15 January.
- Peterson, A. W., 1963b, Thermal radiation from interplanetary dust, Astrophys. J., 138, 1218-1230.
- Peterson, A. W., 1963c, Thermal radiation from interplanetary dust - II, Paper presented at the "Conference on Cosmic Dust" sponsored by the New York Academy of Sciences, 22-23 November.
- Piddington, J. H., 1962, The cis-lunar magnetic field, Planetary Space Sci., 9, 305-318.

- Pskovskii, Yu. P., 1962, Dusty material in the vicinity of the earth (translated title), Priroda, No. 12, 68-73.
- Redman, R. O., 1962, Zodiacal light and night sky, in "Reports from Observatories", Quart. J. Roy. Astron. Soc., 3, 115.
- Redman, R. O., 1963, Zodiacal light and night sky, in "Proceedings of Observatories", Quart. J. Roy. Astron. Soc., 4, 95.
- Richter, N. B., 1962, The photometric properties of interplanetary matter, Quart. J. Roy. Astron. Soc., 3, 179-186.
- Roach, F. E., 1964a, The light of the night sky: astronomical, interplanetary and geophysical, Submitted to Space Science Reviews, May.
- Roach, F. E., 1964b, An isophotal map of the zodiacal light, Paper presented at 116th AAS meeting, Flagstaff, Arizona, 24-27 June.
- Roach, F. E. and L. L. Smith, 1964, Absolute photometry of the light of the night sky, NBS Technical Note, No. 214, 29 June.
- Robley, R., 1962, Photométrie des lumières zodiacale et anti-solaire, Ann. de Geophys., 18, 341-350.
- Saito, K., 1961, The gegenschein and coronal streamers of the sun, Publ. Astron. Soc. Japan, 13, 376-383.
- Schmidt, T. and H. Elsässer, 1962, Interplanetare Elektronendichte und Zodiakallichtspektrum, Zeits. f. Astrophys., 56, 31-42.
- Smiley, C. H., 1963, Observation of the zodiacal light from an F-104, Proceedings of Project APEQS Symposium, December, and 1964, Douglas Aircraft Co. Rept. No. G-36443, 55, March.
- Southworth, R. B., 1963, On S. H. Dole's paper "The Gravitational Concentration of Particles in Space Near the Earth", Planetary Space Sci., 11, 499-503.
- Tanabe, H., 1961, A photoelectric study of the gegenschein, Tokyo Astronomical Observatory, unpublished manuscript.
- Tanabe, H., 1964a, Photoelectric observations of the gegenschein, Tokyo Astronomical Observatory, unpublished manuscript.

- Tanabe, H., 1964b, Zodiacal light and airglow components at 5300 Å, Tokyo Astronomical Observatory, unpublished manuscript.
- Tanabe, H., 1964c, An evidence of the existence of an airglow radiation near 5300 Å independent of 5577 Å line, Tokyo Astronomical Observatory, unpublished manuscript.
- Weinberg, J. L., 1963a, White-light versus narrow-band observations of the polarization of the zodiacal light, Nature, 198, 842-844.
- Weinberg, J. L., 1963b, Photoelectric polarimetry of the zodiacal light at λ5300, Ph.D. Dissertation, University of Colorado, 206 pp.
- Weinberg, J. L., 1964a, The zodiacal light at 5300 Å, Ann. d'Astrophys., (in press).
- Weinberg, J. L., 1964b, The Agung eruption, atmospheric extinction, and zodiacal light, Hawaii Institute of Geophysics, unpublished manuscript.

Acknowledgements

The author wishes to thank Miss Sharon Miki for typing the manuscript and for assisting in the compilation of the bibliography. This research was supported by the National Aeronautics and Space Administration under NASA grant NsG 676.

Note added 3 August 1964: The following paper has just come to our attention, and it should be added to the bibliography.

- Gillett, F. C., W. A. Stein, and E. P. Ney, 1964, Observations of the solar corona from the limb of the sun to the zodiacal light, July 20, 1963, Astrophys. J., (in press).