PHOTOGRAPHIC OBSERVATIONS OF THE INNER ZODIACAL LIGHT ABOARD SALIOUT 7.

G. Nikolsky[1], S. Koutchmy [2], P.L. Lamy[3]
I.A. Nesmjanovich [4]
(1) Izmiran, Moscow
(2) Institut d'Astrophysique, Paris
(3) Laboratoire d'Astronomie Spatiale, Marseille
(4) Kiev University, Kiev

ABSTRACT. Color photographs of the inner Zodiacal Light were obtained aboard Saliout 7 with Kodak Ekta 400. Absolute calibrations were performed in-Flight with attenuated Sun light. The photometric analysis was carried out in three colors and corrections were introduced for the OI emission of the F layers. The brightness of the Zodiacal Light along the ecliptic is found in good agreement with published data while its color is found slightly redder than the Sun. Its out-of-ecliptic variation coincides neither with the fan nor the ellipsoidal model; the photometric axis is found near the projection of the orbital plane of Venus.

1 - INTRODUCTION AND OBSERVATION.

As part of a continuying program to study the inner Zodiacal Light which remains poorly known, we present here the results of an observation obtained during the joint french-soviet flight in June 1982, aboard the Saliout 7 orbital station. The so-called PCN (Photographie du Ciel Nocturne) experiment consist in a Nikon 35mm camera with a 58mm f/1.2 Nikkor lense (Belmahdi and Koutchmy, 1982). Three improvements were introduced in comparison with our past observations, (Gretchko et al.,1982, Lamy et al., 1980):

i) a two-axis mount allows to perform manual corrections by visually tracking a star in the field of an auxilliary finder and thus, to offset any linear displacement; however, the rotation of the field cannot be corrected with the device;

ii) a new sensitometer whose key component is a square matrix of 6x6 densities ranging from 0 to 3.5, which can be mounted directly in front of the film and is directly illuminated by attenuated (10^{-8}) solar light (Koutchmy,1981); problems of color correction are therefore enterely avoided and each film is routinely calibrated;

iii) the kodak Ektachrome 400 ASA color film has been selected as the a-posteriori photometric analysis in three colors is now well mastered (Koutchmy, 1978; Lamy and Koutchmy, 1982).

The present photograph, see Koutchmy and Nikolsky, 1983, was taken by Cosmonaut V.A. Djanibekov on June 30, 1982 at 16h U.T. (before sunrise)

R. H. Giese and P. Lamy (eds.), Properties and Interactions of Interplanetary Dust, 7–10.

the solar depression being - 19°. It is a two minutes exposure which unfortunately shows the rich star field - down to a magnitude of 8.5 - of the Hyades and Pleiades regions. The ecliptic plane was well oriented, making a 70° angle with the local horizon and the Zodiacal Light is conspicuously seen in the elongation interval 23 to 35°. The planet Mercury is burried in the bright atmospheric arc while Venus saturates a large disk at the center of the field. Most part of this region could not be observed by the Helios probe (Leinert et al., 1981) because of its pointing 16° away from the ecliptic plane, even when it reached 0.3 AU. The resolution of 2 to 10 min of arc of the present photographic observation represents also an improvement in comparison with the 1° resolution of Helios.

2 - PROCESSING.

The results presented here are based on seven photometric scans having a resolution of 0.1° and judiciously choosen so as to reveal the most interesting features of the Zodiacal Light (Nesmjanowich, 1984). Densities were successively recorded through the three filters (blue, green and red) of the Kodak color separation system. Relative photometry was carried out in the three bandpass which were further corrected for the differences with the Johnson system with a final accuracy of ± 1.5%. Absolute photometry was performed in the green bandpass using 38 stars of the Hyades cluster. It offers a well-established photometric sequence which resulted in a ± 20% accuracy for the absolute photometry of the Zodiacal Light. The background of unresolved stars (V>8.5) was substracteed using the tables of Roach and Gordon (1973) and represents a contribution of less than 10%. No correction was introduced for the galactic component but this will be done in the final processing. However the more intense OI emission from the F-layers at 200-250 km height was carefully studied via its green line (5577 Å) and mainly its red lines (6300 and 6364 Å) which altogether are four times more intense than the green line. Their measured contributions of 40 S10 for the former and 160 S10 for the latter are non-negligible and may introduce an error in the determination of the color of the Zodiacal Light if they are not accounted for.

3 - RESULTS

The intensities of the Zodiacal Light in the plane of maximum brightness for the B, V and R bandpass are given in Fig. 1.

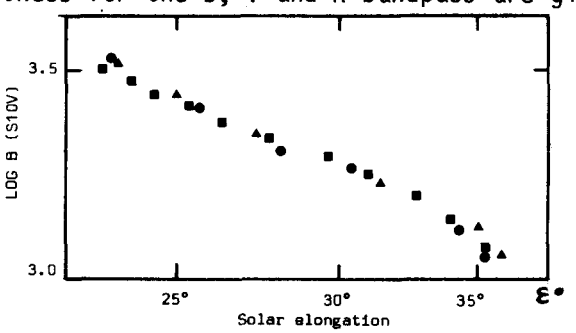

Fig. 1: Brightness of the Zodiacal Light for the B(■), the V(▲) and the R(●) bandpass.

https://doi.org/10.1017/S0252921100084232 Published online by Cambridge University Press

and are in satisfactory agreement with published results (e.g., Leinert, 1975). The slope in the log-log scale is - 2.04 ± 0.1 somewhat smaller than the value of - 2.30 of the model of Koutchmy and Lamy (this volume) in this range of elongation. The color is slightly redder than the Sun, the color index being:

$$\frac{B(4500}{B(5500)} = \frac{B(5500)}{B(6300)} = 0.94 \pm 0.1$$

in agreement with a now classical result (see Weinberg, this volume). Fig. 2 shows calibrated isophotes which illustrate the two-dimensional aspect of the Zodiacal cloud. The out-of-ecliptic variation is specifically illustrated in Fig.3 and is shown to agree neither with the fan nor the ellipsoidal models.

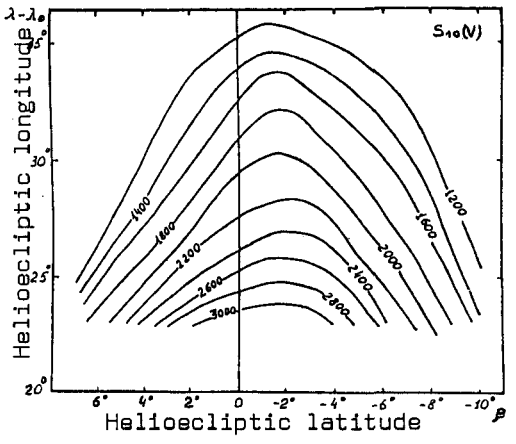

Fig. 2: The isophote in heliocliptic coordinates in units of S_{10} (V)

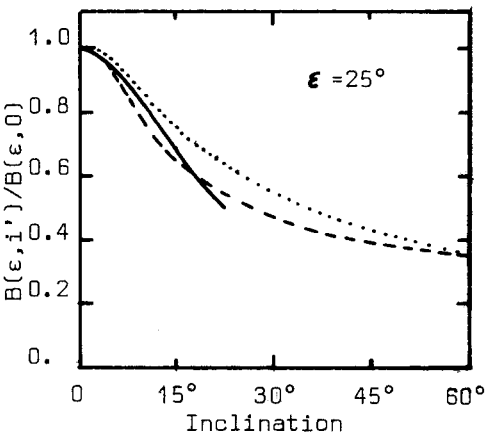

Fig. 3: The out-of-ecliptic variation of the zodiacal light at ε = 25° (solid line) to be compared with the fan (dotted line) and the ellipsoidal (broken line) models.

Finally, the axis of symmetry of the isophotes was found not to coincide exactly with the projection of the orbital plane of Venus, a result which may refine the observation of Misconi and Weinberg (1978).

AKNOWLEDGEMENTS: The PCN experiment was carried out in the frame of French-Soviet cooperation for space research by CNES, France and Inter-Cosmos, USSR involving the participation of many researchers and technicians whose collaboration is acknowledged.

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