1.1.2

HELIOS ZODIACAL LIGHT EXPERIMENT

Pitz,E., Leinert,C., Link,H. and Salm,N.
Max Planck Institut für Astronomie

D 6900 Heidelberg, Königstuhl, F.R.G.

The Z.L. experiment consists of 3 photometers which are mounted rigidly into the s/c with orientations of about 15^0, 30^0 and 90^0 south of the s/c - XY - plane, which coincides in orbit with the ecliptic plane (see Fig.1). Helios is spinning with 1 Hz, and the integration time of the experiment is 513 revolutions. The 90^0 - photometer always looks to the south ecliptic pole and one

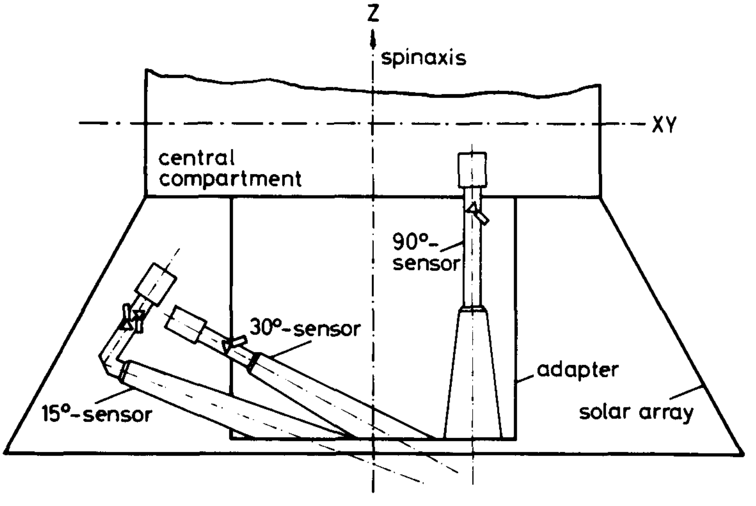

Fig.1: Schematic view of the southern s/c - cone with the mounting positions of the Z.L. - photometers.

revolution of the s/c is divided into 8 sectors to get information on the polarization of Z.L. The polarization is measured by a fixed polaroid foil within the photometer which is rotated by the s/c. In the other two photometers one revolution is split into 32 sectors with different angular resolution. Near the antisun where the gradient in Z.L. intensity is small, the sector length

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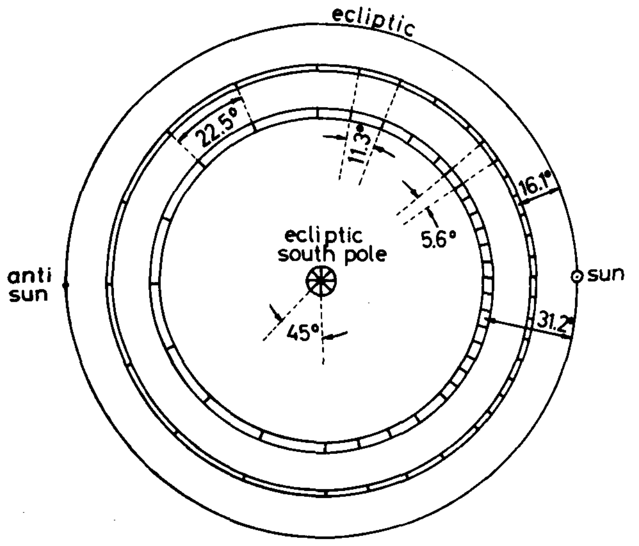

Fig.2: Sectoring of the photometer scans on the sky.

is 4 times the length near the sun (see Fig.2). In these 2 photometers the polarization is obtained by 3 differently oriented polarization foils moved by stepping motors. Intensity and polarization of Z.L. is measured in 3 different colors, which are near the international UBV - system (Ažusienis and Straižys 1969), the effective wavelength shifted by about 100 Å to the blue end.

To obtain the intensity of Z.L., we have to multiply the recorded counting rates by a calibration factor and we have then to subtract darc current, star background and possible stray light contribution.

Calibration of broad band photometers is not trivial and has been done on ground several times very carefully. The method is discribed by Leinert et. al. (1974). Inflight calibration by means of bright star crossing is used to check the ground based calibration. The stability of the sensors is monitored during the mission by means of internal lamps which are switched on from time to time to give a reference signal. In the upper curve of Fig.3 this signal is shown versus time after launch for the 30^{o} sensor. The lower curve is the temperature near the sensor unit and it can be seen that the variation of the signal by $\pm$ 3% is mainly a temperature effect. The dark current of the sensor is about a factor 3 higher than on ground, due to cosmic radiation effects, but still less than

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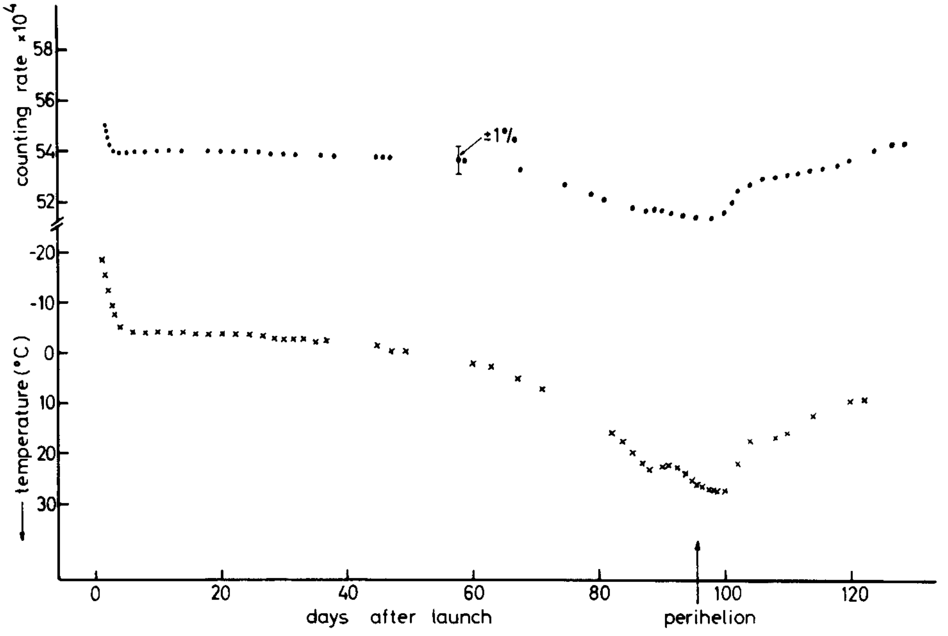

Fig.3: Signal of internal lamp and temperature of the 30^o sensor versus time after launch.

1% of the average signal.

As an interplanetary probe is always exposed to sunlight which is 13 orders of magnitude brighter than the average Z.L., extreme care has to be taken to avoid unwanted stray light. Fig.4 shows the concept of stray light suppression. We call it a 4 step reduction system. For details see Leinert and Klüppelberg (1974).

Step 1: The photometer openings are mounted in the shadow of the s/c solar array.

Step 2: Reflected sunlight from the inner s/c walls is catched in the first

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baffle room of the extended baffle system associated with each photometer.

Step 3: Light from the first baffle room cannot reach the first optical element.

Step 4: Threefold attenuated stray light reaching the optical elements comes from outside the field of view and is therefore imaged onto the field stop.

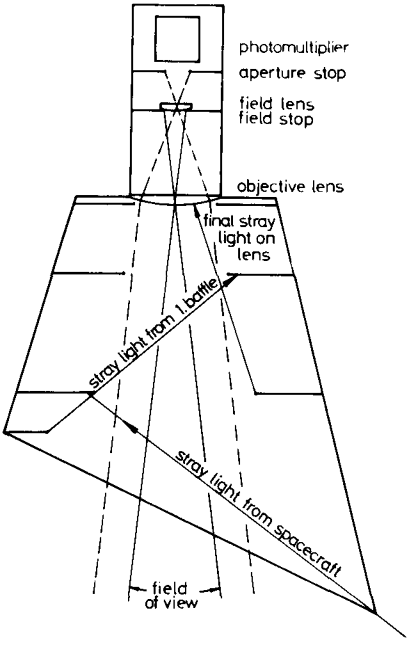

Fig.4: Principle of optical system and stray light suppression.

The worst condition with respect to stray light contamination is in the 15^{o} - photometer observing the anti-solar region. Fig.5 shows data of this region, measured during two different attitudes of the s/c. In the insert the position of the sun with respect to the southern s/c rim is shown. The "dashed" position means that no sunlight enters the s/c cone and therefore no stray light contribution is expected. In the "solid" position the inner s/c wall is partly illuminated and stray light may contaminate the data. Changing the attitude of the s/c has a measurable effect in the star background as can be seen in the milky way regions. The bright star α CMi has left the field of view after the attitude maneuver. Outside these regions no stray light effects can be seen and we conclude that stray light is less than 1% in our signal.

Star background correction will be the most difficult part of recuction and we hope to get some assistance from Pioneer 10 and 11 observations which are made now in the absence of Z.L.

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Up to now, the experiment works perfectly and so far no anomalies can be reported.

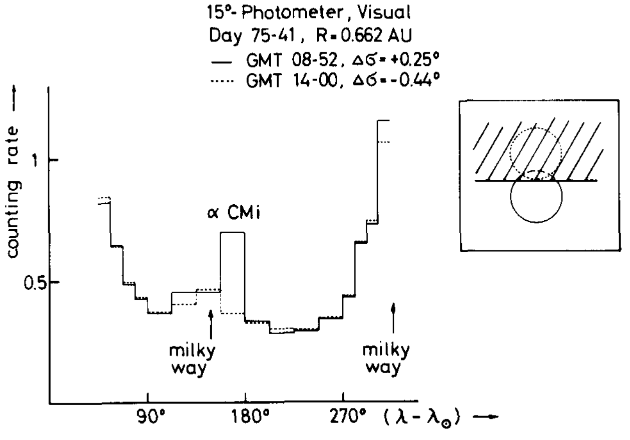

Fig.5: Antisolar data of the 15^{o} - photometer during two different s/c attitudes.

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