THE TOTAL BRIGHTNESS OF THE SOLAR CORONA DURING THE ECLIPSE JUNE 21ST 2001

Pintér,T.[1], Klocok,Ľ.[2], Minarovjech,M.[2] and Rybanský,M.[2]

[1]Slovak Central Observatory, PO Box 42, 947 01Hurbanovo, pinter@suh.sk

[2] Astronomical Institute, Slovak Academy of Sciences, 059 60 Tatranská Lomnica, klocok@ta3.sk, milanmin@ta3.sk, rybansky@ta3.sk

ABSTRACT.

The total brightness of the white-light corona in the standart region (1.03 – 6.00 R_o) alter during the solar activity cycle in relation 1:3 [3]. We have used for its determination during the 2001 solar eclipse a calibrated photographic observation. We obtained a value $1.15x10^{-6}$ of the total blightness of the Sun in the same spectral region.

1. INTRODUCTION

The problems of the coronal heating and its mass dynamics is still not solved, atthough scientists have been studying these problems intensively in recent decades. The state of the corona is characterised by many observed parameters. Among basic ones have belonged the total mass, which can be determined from its total brightness.

In this contribution, the total brightness of the solar corona has been determined in the optical range of the spectrum as observed during the total solar eclipse of June 21, 2001, in the standart zone $1,03 \leq \rho \leq 6,00$. [5] claims that this brightness fluctuates in the course of the solar activity cycle between 0.5×10^{-6} and 1.0×10^{-6} of the mean brightness of the solar disk. The measures of the state of the corona, are, therefore, closely related to the state of other parts of the solar atmosphere and are apparently bound by a mechanism of solar activity.

2. THE OBSERVATION, PHOTOMETRY AND METHOD OF COMPUTATION

The total solar eclipse of June 21, 2001 was observed by expedition of Solar Central Observatory and Astronomical Institute of the Slovak Academy of Sciences near of city Sumbe in Angola Republic, (φ =11°07' S, λ =13°56' E), photographicaly, using the mirror telescope: d/f = 110/1000 mm with expositions 1/500 – 1s. The calibrated photo was made with exposition time 1/60 s (Fig. 1). The calibration was made to the centre of the solar disk, using the set of reduction diaphragmes and neutral density filter. The photometry was made with film scaner Nikon 8000 ED.

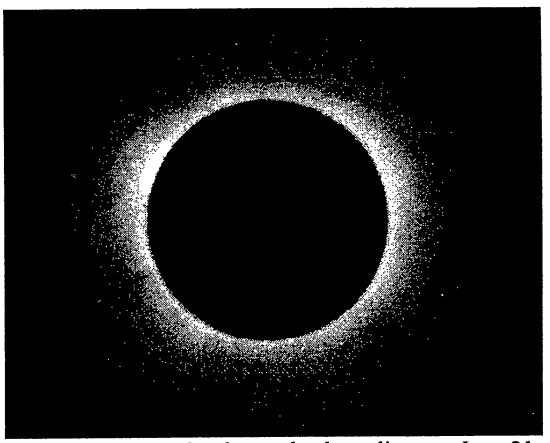

Fig.1. K+F corona by the total solar eclipse on June 21, 2001.

Proc. ISCS 2003 Symposium, 'Solar Variability as an Input to the Earth's Environment', Tatranská Lomnica, Slovakia, 23-28 June 2003 (ESA SP-535, September 2003)

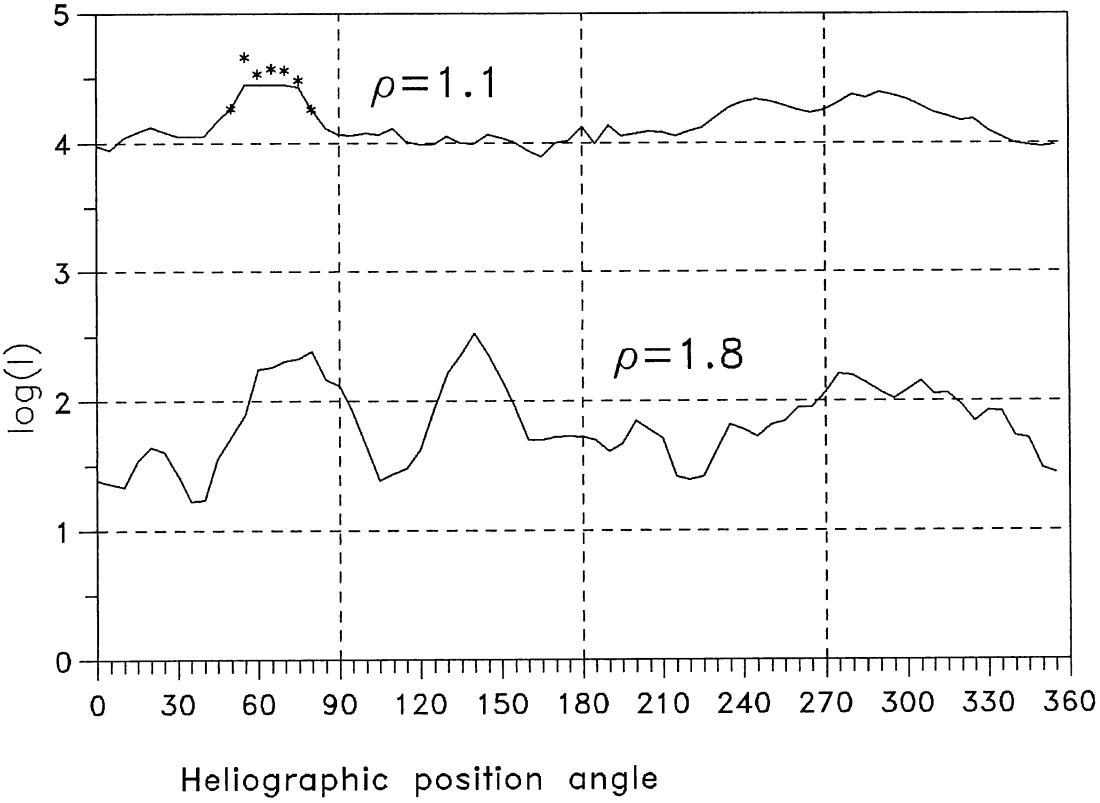

Fig. 2. The distribution of total brightness of the solar corona for different height interval. The asterisk markes the prominence intensity.

The subsequent procedure of computing the total brightness of corona is identical with used the total brightness from the eclipse of June 30, 1973 [2] and of February 16, 1980 [4].

The total brightness of the corona is expressed in terms of the total brightness of the solar disk, which we have determinet from equation

$$(1) \qquad J_D = \iint \rho I(\rho) d\varphi d\rho,$$

for effective wavelength 550 nm. I(ρ) is determined by [1] taking into account the limb darkening, according to the formula

$$(2) \qquad I(\mu) = \sum C_i \mu^i,$$

where $\mu = \cos\theta$ and $\sin\theta = \rho$, $i = 0 \div 5$.

If we define the brightness of the solar disk center by value 10^{10}, we arrives for total brightness of the solar disk : $J_D = 2{,}524.10^{10}$. The total brightness of the corona in interval between 1.1 and 1.8 we determine directli, multiplying intensities by pixel area (in solar radius). The brightness in iterval 1.03 – 1.1 and in interval 1.8 – 6.0 we were computed by extrapolation, using the Baumbach formula. After computings by method of [2] we have got for 5° -sector in interval 1.03 – 1.1 the contribution to total brightness: 0,00962 I(1.1) and analogous for interval 1.8- – 6.0 : 0,1248 I(1.8). The values I(1.1) and I(1.8) are shown in Fig. 2.

The corresponding contributions to total brightness are: 18011, 10239 a 774 for intervals 1.1 – 1.8; 1.03 – 1.1; a 1.8 – 6.0. After adding and dividing we have got for total brightness of corona value :

$$\underline{J = 1{,}15 \times 10^{-6} J_D},$$

which correspond to the maximum phase of solar cycle by [3].

3. ACKNOWLEDGEMENTS

The authors would like to extend their gratitude to Ministry of Culture of the Slovak Republic, to Ministry of Science and Technology Republic Angola and to Grant Agency VEGA for financial support (Grant 1164/01) and to SLOVTEPMONT a.s.,Partizánske, for granting the film scanner Nikon 800 ED.

4. REFERENCES

1. Pierce,A.K. and Slaughter,C.D. , *Solar Physics* Vol. 51, 25, 1977.

2. Rybanský,M., and Rušin,V., *Bull. Astron. Inst. Czechosl.* Vol. 26, 206, 1975.

3. Rušin,V. and Rybanský,M., *Bull. Astron. Inst. Czechosl. Vol.* 36, 73, 1985.

4. Rybanský,M., and Rušin,V., *Bull. Astron. Inst. Czechosl., Vol. 36*, 77, 1985.

5. Waldmeier,M., *The Solar Corona*, ed. J.W. Evans, Acad. Press, NY, 129,1963.