Bull. Astr. Soc. India (2003) 31, 295–296

White Light and Emission Line Polarization of Solar Corona during TSE of June 21, 2001

Ashok Ambastha and Sanjay Gosain*
Udaipur Solar Observatory, Physical Research Laboratory, P.O. Box No. 198, Udaipur-313004

Abstract. Coronal intensity and polarization maps have been obtained for the total solar eclipse (TSE) of June 21, 2001, observed from Lusaka, Zambia (location: $28°17.5'E15°24.5'S$, Alt. 1300 mtr) at broadband Hα 6563Å (FWHM 80Å), as well as, around the coronal emission lines 5303Å (FWHM 12Å), and 6374Å (FWHM 12Å). The results are discussed.

Keywords : Solar eclipse, corona, green line polarization

1. Introduction

The main aim of the USO experiment for June 21, 2001 TSE was to obtain the intensity structure, the extent of polarization of the inner white-light corona, and particularly address the rather unresolved issue of the green line 5303 Å polarization. An imaging polarimter developed at USO was used to obtain digital images at 4 positions of polaroid axes, i.e., 0°, 45°, 90°, 135°, as required for the polarization analysis (Billings 1966). These observations were taken using three interference filters centered at H_α 6563Å (80 A FWHM), Fe XIV Green line 5303 Å, Fe X Red line 6374 Å having passband of 12 Å FWHM. In order to subtract the continuum component, one needs to take observations both on and off the line, however, our experiment did not have this provision. The The total green line intensity is given by $I_\lambda = I_E + I_{ph}$, where I_E originates by excitation of FeXIV by electron collisions, and I_{ph} is the contribution by the photo-excitation of the ions due to absorption of the photospheric photons. The linear polarization in λ5303 line is caused by scattering of the photospheric radiation, therefore it is related to I_{ph} component. In the absence of magnetic field, the angular distribution of scattering in the line is analogous to Thomson scattering, so the polarization in the line can be given by $p = a(T)\sigma_{5303}p_{ph}B_{wl}/(\sigma I_\lambda)$ (Badalyan et al. 1999). Here, $a(T)$ is the relative abundance of FeXIV ions, σ and σ_{5303} coefficients of

*e-mail:ambastha@prl.ernet.in

scattering in white light, and green line radiations, and the product $p_{ph}B_{wl}$ represents polarized brightness of the corona. This relation shows an anti-correlation between the degree of polarization p and I_λ. Theoretical calculations show that maximum green line polarization p should be lower than 43%, depending on the contribution of photo-excitation versus electron collisions, and the strength and configuartion of magnetic field (House et al. 1974, House et al. 1982, see also Badalyan and Sykora 1997). On the contrary, the coronagraph observations have usually yielded very low degree of polarization, such as, $\approx$ 1% to a few percent (Arnaud 1982, Querfeld and Smartt 1984). The eclipse observations show a large scatter in the measured values, ranging from $\approx$ 0% (Beckers and Wagner 1971), 5 – 20% (Picat et al. 1979), and $\approx$ 30% (Mogilevsky et al. 1973).

2. Results and Conclusions

Our polarization map in broadband Hα 6563Å essentially shows WL-polarization, having polarization less than 10% at the sites of the cooler chromospheric prominence structures. Linear polarization degree of up to 25-30% is found in both the emission lines Fe XIV 5303Å, and Fe X 6374Å. The shapes of polarized and unpolarized coronae are found to be distinctly different. Intensity images in 5303Å and 6374Å showed good correlation, except at lower intensities. However, the location of maximum intensity and polarization show anti-correlation effect as first reported by Badalyan & Sykora 1997. Decrease of p, caused by the increasing role of electron collisions in the excitation of coronal emission line is the probable reason for this effect. The bright inner coronal emission does not correlate well with outer LASCO structures. Magnetic field in the active latitude belts appears to be an important factor affecting the degree of polarization and intensity of the coronal emission lines. A careful examination of p-maps may allow to infer magnetic field configuration in the corona.

References

Arnaud J. 1982, *Astron. Astrophys*, **112**, 350.
Badalyan O.G., Sykora J.1997, *Astron.Astrophys.*, **319**, 661.
Badalyan O.G., Livshitz M.A., Sykora J. 1999, *Astron. Astrophys.*, **349**, 295.
Beckers J.M., Wagner W.J. 1971, *Solar Phys.*, **21**, 439.
Billings 1966, A Guide to the Solar Corona, Academic Press, New York and London.
House L.L. 1974, *PASP*, **86**, 490.
House L.L, Querfeld Ch.W., Rees D.E. 1982, *Astrophys. J.*, **255**, 753.
Mogilevsky E., Ioshpa B., Obridko V. 1973, *Solar Phys.*, **33**, 169.
Picat J.P., Felenbok P., Fort B.1979, *Astron. Astrophys.*, **75**, 176.
Querfeld Ch. W., Smartt R.N. 1984, *Solar Phys.*, **91**, 299.