Coronal Interferogram in 5303 Å Obtained During Total Solar Eclipse of February 16, 1980 and Coronal Temperatures

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Abstract

Coronal interferogram in 5303 Å was obtained during the total solar eclipse of February 16, 1980 using Fabry-Perot etalon. Coronal temperatures determined from the Doppler width of the fringes are reported and compared with similar observations made during earlier eclipses.

During the total eclipse of February 16, 1980, the expedition from the Physical Research Laboratory conducted an experiment from Gadag, India (15° 25'N, 75° 37'E) to determine the temperature distribution in the corona. The corona was photographed in 5303 Å through a Fabry—Perot interferometer to obtain the Doppler broadened fringes of the Fe XIV green line.

The Fabry-Perot etalon was an optically contacted one with air spacing of 300 μ m and a reflective coating of 88% at 5300 Å. The effective finesse was about 20 and the instrumental line width ~ 0.25 Å. The interferometer was used in conjunction with a 15 cm f/15 telescope objective serving as a light collector. A prefilter of 7 Å band width centred at 5303 Å isolated the green line. Four photographs were taken under clear skies during the 2 minutes 46 seconds of totality on 35mm precalibrated Kodak Tri X (400ASA) film with exposure times 4 sec, 10 sec, 30 sec and 90 sec. The fringes were offcentred with respect to the solar centre by ~16 min. of arc in order to get temperature values continuously along radial directions.

Figure 1 shows the coronal interferogram obtained with 90 sec exposure, The profiles corrected for the instrumental broadening have yielded temperatures with most values ranging between 2–4 x 10^6 °K. A few values are as high as 5.8 x 10^6 °K and some as low as 1 x 10^6 °K. The temperatures are estimated to be accurate to within an error of 15%. Figure 2 shows corona in λ 5303 Å for the shape of completeness.

Table 1 summarises the Doppler width temperatures obtained with 5303 Å coronal line width during earlier eclipses and this eclipse.

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TABLE 1

Eclipse Date	Line width Temp. Range (x 10^6 K)	Comments	Reference
June 30, 1954	2.2 — 5.0	Most values close to 2.5 x 10^6 K	Jarett and Von Kluber (1955)
Oct. 12, 1958	1.6 — 3.2	A few cases of high excitation lead to temp. 8 x 10^6 K.	Jarett and Von Kluber (1961)
May. 30, 1965	1.6 — 4.2		Liebenberg et al. (1975)
May. 30, 1965	6.8 — 16	Macroscopic mass motion with velocities upto 23 km/s suggested.	Delone and Makarova (1969)
Sept. 22, 1968	2.5 — 9.4*		*Delone and Makarova (1975)
March 7, 1970	2.5 — 4.7*	6 x 10^6K at the core of active region. 2.5 x 10^6 K at the periphery.	*Hirschberg etal. (1971)
July 10, 1972	1.3	Macroscopic mass motion with velocities ranging from 24 km/s to 34 km/s suggested.	Kim and Nikolsky (1975)
Feb. 16, 1980	1.1 — 4.7	One value of 5.8 x 10^6 K Most values lie between 2 and 4 x 10^6 K	Present work

*Quoted half-widths converted to Doppler temperatures by us.

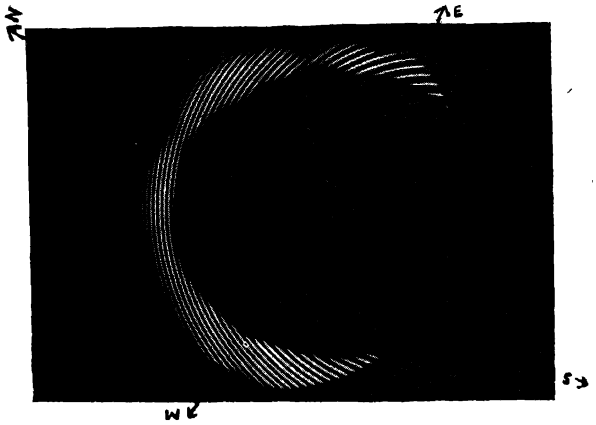

Fig. 1 : Coronal interferogram in 5303 Å (90 sec exposure).

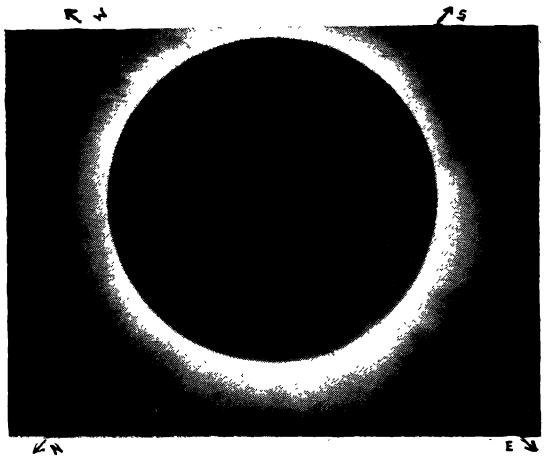

Fig. 2 : The Corona in 5303 Å with Celestron - 8 telescope (15 sec exposure at f/10)

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