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Interfermetric study of Coronal Emissions during Total Solar Eclipse

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Abstract
Ground based interfermetric study of coronal emission in high resolution spectroscopy laser was used during the total solar eclipse of August 11, 1999 in Iran. The emission of green and red lines from sun which were selected in optical instrument with half width 4ºA. The photographs taken by He-Ne laser source with 0.35mm thick PFPI.

Keywords: Coronal, Solar eclipse, He-Ne laser, PFPI.

INTRODUCTION

The solar corona prominently emits wave length 5303º*A* green line and 6374º*A* red line and these have been studied for the first time by Jarret (1954,58). The half width of the green line at 5303º*A* as measured by Jarret nearly 1A. It was essential to have minimum from spectral range of order 2º*A* (1). For sake of concenience we choose the free spectral rang nearly 3º*A*.

Observation

The optical instrument arrangement was fabricated to get the image of the sun to an appropriate size from the terrace of Iranian Meteorology Organization at Esfahan during eclipse timing (2). A green glass plate of diameter 10″ and thickness 1″ was used.

Instrumentations

The solar coronal prominently emits wavelength 5303º*A* green and 6374º*A* red lines with half width of the green line 3º*A*. A 25cm diameter plane concave lens L1 was fabricated with focal length of 335 CM with thickness 1 (3). An another lens L2 of short focus 27cm a diameter 7cm was made and before the PFPI to image the sun on it by parallel light. Lens L2 was kept at a distance of 362cm from the object lens. Lens L3 of focus 5cm is place after the PFPI to focus the fringes on the screen. This lens was of the photographic camera and a layer focus lens is better to get a larger solar image fig1. The PFPI are prepared as parallel plates.

The surfaces are highly polished and the wadge angle was kept minimum possible. A larger wedge angle would have reduced the intensity due to walk off effect and the resolving power also would have been affected. The dielectric coatings were adopted due to their absorption properties. The surfaces are highly polished and the wadge angle was kept minimum possible. A larger wedge angle would have reduced intensity due to walk off effect and the resolving power also would have been affected. The dielectric coatings were adopted due to their absorption properties.

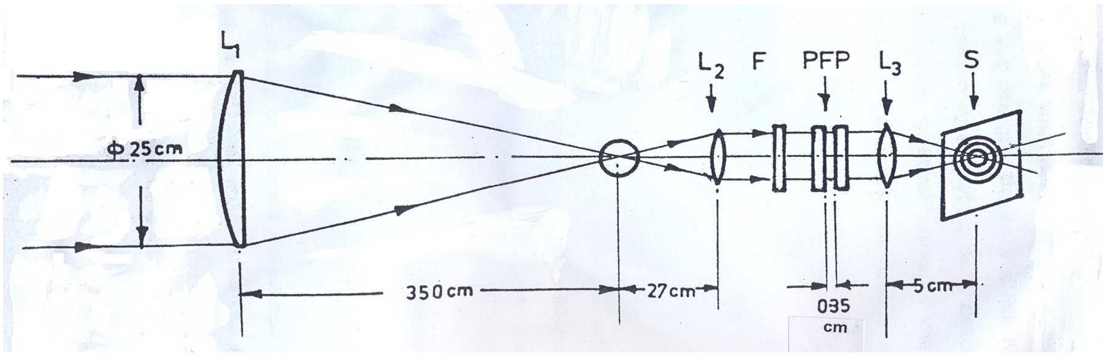

Fig.1 Optical arrangements for Solar eclipse experiment

The PFPI of diameters 20cm and 15mm were mounted in a brass cell which could be pushed into a cylindrical housing and the hot water was passed from a Geiser. The housing and the optical arrangement is shown in the fig 2 (4).

Calculation

The required spacers were decided by using the usual formula

$$\Delta\lambda = \frac{\lambda^2}{2r}$$

Substituting the value of $\Delta\lambda$ = 3°*A* and λ = 5303 °*A*, then r $\cong$ 0.3mm. The order of interference can be calculated by the formula

$$n = \frac{2r}{\lambda} = 1302$$

Finesse can be calculated by

$$F = \frac{\pi\sqrt{R}}{1-R} = 30$$

The resolving power given as

$$R.P. = \frac{2rF}{\lambda} = 3.9\times10^4$$

The increase in contrast due to surfaces of reflectivity

$$C = \frac{1-R^2}{(1-R)^2} = 19$$

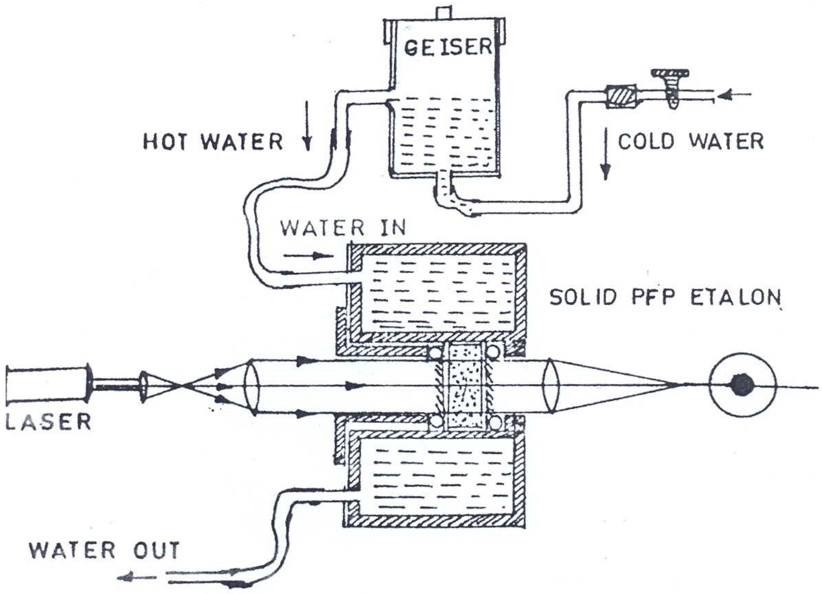

Fig.2 PFPI

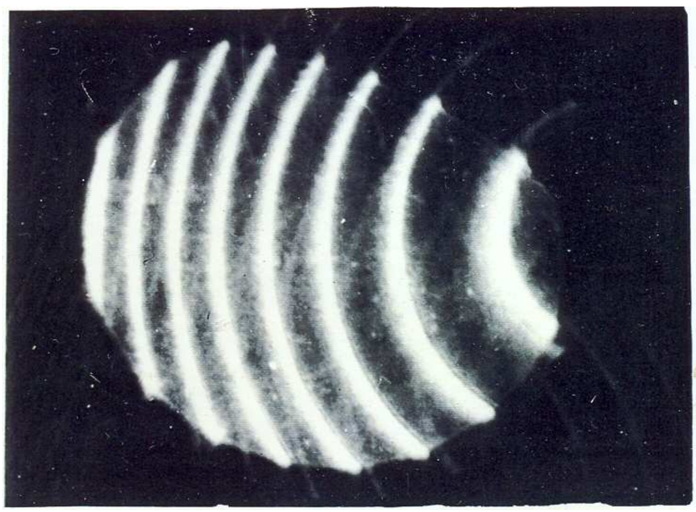

Fig.3 The Solar eclipse image

RESULTS AND CONCLUSION

To use the PFPI at both radiations green and red. We coated the flats by aluminum to give reflectivity of 90%. The optical flats were made from fused silica substrates of diameter 30mm a thickness 5mm to an accuracy better than λ/20. The ratio of 5303°*A* line intensity to the background continuum was first measure by Grotian (1929) which was the solar maximum year. The ratio was found to be 27:1. This eclipse also being in the solar maximum year same value was expected and we accept for the ratio as slightly lower values, say 20:1. Thus increase in contrast due to surfaces of reflectivity 0.90 is 19.

The bandwidth of filter 20^o*A* and the free spectral range taken 3^o*A*, thus decrease in contrast $20/4 = 5$.

Filters don't have a constant peak contrast and a further decrease in contrast nearly 2 takes place. We may estimate the instrumental width say 0.2^o*A*. Since the 5303^o*A* coronal line is much broader nearly 1^o*A* and it has a Doppler width (5). Further decrease in contrast nearly 6. Thus the final contrast of the line to background is estimated 6:1.

We fabricated two 25 cm diameter optically flat mirrors to the accuracy of λ/2. These were fabricated on an ordinary table glass plate of thickness 10mm only due to cost and time factors involved in fabricating a higher accuracy flat on good optical glass. The front surface was coated by thick aluminum by vacuum evaporation.

One mirror was mounted on coeliostat and the smooth tracking of the mirror from east to west with the sun was tried. Another mirror was mounted on a frame and used to turn the image of the sun towards north in a closed room with window (6). Diameter of the sun is known to have the value of 13.92×10^{10} cm. Next the distance of the sun from the Earth is 144×10^{11}cm image size is 3.3cm. Thus the size of the solar image at the focus of the lens is approximately 3.3cm. The size of image with 5cm focus lens is given.

$$size\,of\ image = \frac{3.3\times5}{27} \cong 6mm$$

The photographs taken by He – Ne laser sour and He – source with green filter are shown in fig 3.

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