

High Resolution Coronal Intensity and Polarization Measurements

John L. Streete*

Southwestern at Memphis Memphis, Tennessee

Leon B. Lacey

High Altitude Observatory (HAO), National Center for Atmospheric Research, Boulder, Colorado

(Received August 27, 1980)

Abstract

The total eclipse of February 16, 1980 was successfully photographed with the High Altitude Observatory's coronal camera from a site in Palem, India. The purpose of the experiment was to obtain, with high spatial resolution, polarization and intensity measurements of the corona to about $3.5 R_{\odot}$. The exposures are now processed, raster scanned, digitized and stored on magnetic tape, and we are in the process of obtaining the final photometric calibration of the exposures.

The experiment was designed to record, with high spatial resolution, the total intensity and polarization of the corona from the limb to about $3.5 R_{\odot}$. The intensity, per cent polarization, and polarization direction will ultimately be used in electron density and temperature models. The results will also be available for cross calibration with other measurements such as those obtained with the ground based HAO Mark III K-coronameter instrument at Mauna Loa, Hawaii, the joint Harvard/HAO Lyman-alpha/White Light Coronagraph Rocket Flight and the Naval Research Laboratory's coronagraph on satellite P78-1.

Description: The instrument used in the experiment was the High Altitude Observatory's coronal camera (Newkirk *et al.*, 1970). It was slightly modified during the summer of 1979 by the installation of heat shields to prevent temperature produced changes in focus. The format of the calibration step wedge was also modified. A Goertz 178-cm focal length, $f/16$, objective lens, which forms a coronal image on 70-mm film, is the primary optical element of the instrument. Inserted in the light path directly in front of the film plane is a filter wheel containing the four filters required for the measurement of intensity and polarization and a fifth filter used to obtain a single-exposure photograph of the entire corona. The former four filters consist of three HN-38 polaroid filters sandwiched between a clearcover glass and a Schott OG-5 filter and a fourth, identical filter without a polaroid. The three polaroid filters are oriented at 60° intervals. The fifth filter is a radially graded neutral density filter constructed to compensate for the sharp radial decrease in coronal intensity. The Schott filters and spectral sensitivity of the Kodak Linagraph Shellburst film produce a spectral band-pass of about 1400 \AA centered at 6500 \AA .

On the edge of each frame is focused an image of a 20-step wedge which is illuminated by a stabilized strip filament lamp. These images were standardized to the photosphere by recording exposures through

calibrated opal filters on clear days when the sun was at eclipse elevation. In an attempt to obtain maximum photometric accuracy the exposure times for the calibration exposures were produced with the same program cam as used during the eclipse (Lilliequist, 1977).

In order to determine the sky contribution to the recorded intensity and polarization values, an image from an 8.5° sky field, 10° from the Sun was formed on the edge of appropriate frames. These exposures were also made through three polaroids oriented at 60° intervals.

Summary of Preliminary Results: A total of thirteen exposures, including one radially-graded photograph, three clear filter and nine polaroid exposures were obtained during the 160 seconds of totality. These are now processed and the latter twelve raster scanned and digitized as are all of the calibration exposures. The eclipse photograph recorded through the radially-graded focal plane filter, using an exposure time of 24 seconds, is seen in Figure 1. Presently the calibration data are being analyzed to obtain calibration curves of brightness as a function of density. Once these curves are obtained they will be used to determine, from the eclipse exposures, the positional variations of coronal brightness and polarization.

Location: Palem, India.

References: Newkirk, Jr., G. R. Dupree, E. Schmahl: 1970, *Sol. Phys.* **15**, 15.

Lilliequist, C.: 1977, "Photometry and Polarimetry of the Solar Corona of 30 June 1973", *NCAR Technical Note* 128-STR.

Credit: National Science Foundation, Southwestern at Memphis, Memphis, Tennessee, National Center for Atmospheric Research, which is operated by the University Corporation for Atmospheric Research under contract to the National Science Foundation.

*Currently on leave-of-absence to HAO.

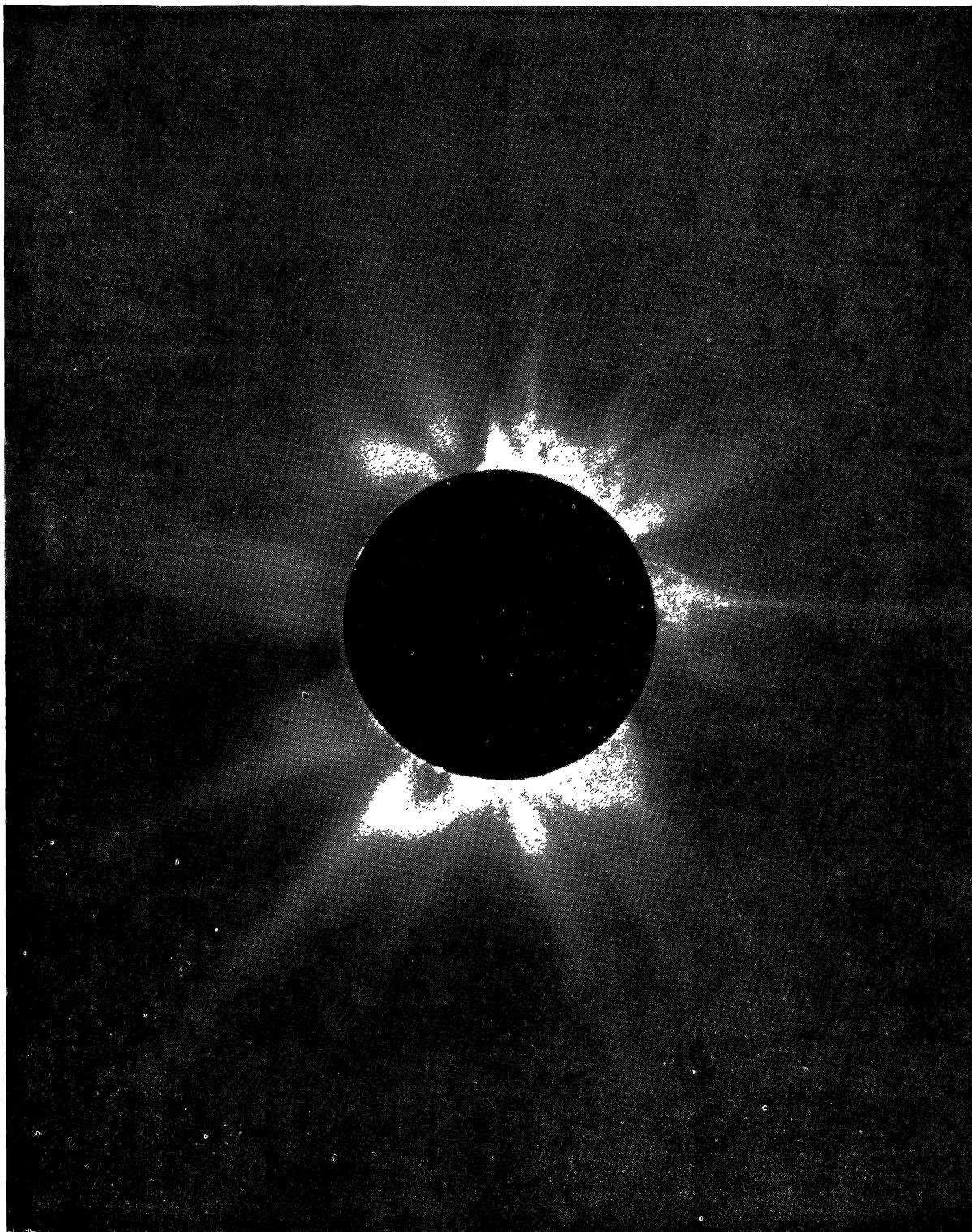


Figure 1. The solar corona of 16 February 1980 photographed through a radially-graded, focal plane filter with an exposure time of 24^s