THE MEAN MAGNETIC FIELD OF THE SUN:
OBSERVATIONS AT STANFORD

PHILIP H. SCHERRER, JOHN M. WILCOX, LEIF SVALGAARD,
THOMAS L. DUVALL, JR., PHIL H. DITTMER, and ERIC K. GUSTAFSON
Institute for Plasma Research, Stanford University, Stanford, Calif., U.S.A.

(Received 29 April, 1977)

Abstract. A solar telescope has been built at Stanford University to study the organization and evolution of large-scale solar magnetic fields and velocities. The observations are made using a Babcock-type magnetograph which is connected to a 22.9 m vertical Littrow spectrograph. Sun-as-a-star integrated light measurements of the mean solar magnetic field have been made daily since May 1975. The typical mean field magnitude has been about 0.15 G with typical measurement error less than 0.05 G. The mean field polarity pattern is essentially identical to the interplanetary magnetic field sector structure (see near the Earth with a 4 day lag). The differences in the observed structures can be understood in terms of a 'warped current sheet' model.

1. Introduction

A solar telescope has been built at Stanford University to study the organization and evolution of large-scale solar magnetic fields and velocities. The primary objective of building the new observatory is to permit dedicated synoptic observations of the large-scale structures. The main observing program to date has been sun-as-a-star integrated light observations of the mean solar magnetic field. The instrument and mean field observations will be described in this paper.

2. The Instrument

The need for a solar observing instrument designed specifically to study large-scale structure of magnetic fields and velocities has been clear for several years. For such observations an instrument should be able to measure the average magnetic field and velocity over large regions (arc-minutes to full disk resolution) with negligible magnetic zero level errors and sensitivity which does not vary for many rotations. The design emphasis should be for precision rather than spatial resolution and for stability rather than temporal resolution. The instrument at Stanford was designed with these goals in mind. The goal for magnetic observations was (for a several minute observation) and error of less than 0.1 G. The goal for velocity observations was a sensitivity in the m s$^{-1}$ range. To achieve these goals mechanical and electrical stability was considered to be of greatest importance.

The preliminary design of the instrument was begun in the summer of 1972 with the detailed design and construction beginning in 1973. The installation of the telescope was complete in the fall of 1974 and the daily observing program commenced May 16, 1975. The instrument was designed and built by the authors.
and the Special Projects Group led by Jack Franck at the Lawrence Berkeley Laboratory of the University of California at Berkeley. The solar telescope and magnetograph is currently installed at the Stanford Solar Observatory which is located in the foothills about 2 km south of the Stanford University campus center.

A schematic layout of the optics is shown in Figure 1. The sunlight is directed into the telescope by 33 cm coelostat and 25 cm second flat mirrors. There are two objective lens positions. The north one is presently used to produce an image for a guiding system which controls the second flat angle. There is a choice of two lenses which can be mounted at the south position depending on the observation to be