ABSTRACTS

7 JUNE 1989
WEDNESDAY

Session 15: Magnetic Fields
Oral Session
8:30 am, Auditorium

15.01
Review of Recent Solar Magnetic Field Observations
D. N. Rust (JHU Applied Physics Laboratory)

After encountering severe difficulties in dealing with
the effects of instrumental polarization in vector
magnetic field measurements, most solar physicists let
many years pass before successful field measurements by
the Huntsville group and by the HAO group at Sacramento
Peak caused them to try again. The current interest in
improving magnetic field observations is yielding some
intriguing results, i.e., flux cancellation, emergence
and rapid segregation of flux ropes in active regions,
etc. An improved theoretical picture of the observational
consequences of the division of magnetic flux into sub-telescopic elements has improved the
research environment, too. This review focuses on recent
observations and on prospects for the future.

15.02
Measuring Sunspot Magnetic Fields with the
Infrared Line Fe I $\lambda$55649
D. M. Rabin, J. E. Graves (NSO)

We have used the NOAO infrared array imager (58 x 62 InSb) and the
vertical spectrograph of the McMath telescope to measure mag-
netic field strengths in and around sunspots using the Zeeman-
sensitive line Fe I $\lambda$55649 ($\Delta$3 $^1D_1-\Delta$5 $^3D_0$, Lande $g = 3.0$). The
magnetic sensitivity of this line (Zeeman splitting in units of
linewidth) is about three times greater than the sensitivity of the
best lines in the visible region. Because the adjacent infrared con-
tinuum is near the 1.63 micron opacity minimum, the line is formed
deep in the photosphere. The relatively low contrast in the infrared
continuum between umbra and photosphere allows the field to be
followed clearly into the umbra. We compare field strengths
inferred from the infrared line with nearly simultaneous spectra in
Fe I $\lambda$5250 and $\lambda$5247.

15.03
Magnetic Fields from Video Spectra-Spectroheliograms:
A Test of the Center of Gravity Method
S.R. Walton, G.A. Chapman (SFO/CSUN)

We have been testing various methods of calculating the mag-
netic field from spectra produced by the SFO Video Spectra-
Spectroheliograph (VS$^3$HG). This instrument, currently under de-
velopment and testing at SFO, allows the simultaneous recording
on videotape of both senses of circular or linear polarization as the
SFO spectroheliograph scans an active region. The VS$^3$HG has
been described in detail elsewhere (Chapman and Walton 1988,
paper presented at the Sac Peak Workshop on High Resolution
Solar Observations, in press).

The VS$^3$HG produces approximately two minutes (500 frames) of
500-line video data per scan of an active region. We average sets of
eight frames together, which still results in several thousand spec-
tra per observation. Therefore, we have been testing various quick
methods of calculation of the magnetic field strength while still
making use of the entire spectrum. One possibility is the "Centre
74, 1).

At present, comparison of the Centre of Gravity method with
Gaussian fits to both the $\sigma$ and $\pi$ profiles in umbral spectra indi-
cates that the CM method underestimates the line splitting; in
one example, we obtain a field of 2700G from the Gaussian fits and
1600G from the CM method. However, proper application of
it to our observations of the $\lambda$6302.5 line of Fe I will require de-
blending of the telluric line at $\lambda$6302.764, which we are currently
attempting with Gaussian fits to that line. This work has been
supported, in part, by NSF Grant No. AST-8603309; the data
reduction has been done using the IRAF system from NOAO.

15.04
The Magnetic Field Strength of Umbrae Dots
B. W. Lites (HAO/NCAR), T. A. Bida (U. of New Mexico),
G. B. Scharmer (Roy. Swedish Acad. Sci.)

The Swedish Vacuum Solar Telescope on La Palma, Canary
Islands (Spain) has been used to obtain extremely high
resolution spectra of umbral dots in a pair of Fe I
lines ($\lambda$30.15 and $\lambda$30.25 nm) and in a Zeeman-sensitive
line of Fe II ($\lambda$614.92 nm). We find that the field
strength does not appear to decrease greatly in umbral
dots relative to the surrounding darker regions of
umbrae. These findings are discussed in terms of models of
the subsurface structure of the magnetic field in
sunspots.

15.05
Large-Scale Motions of Small-Scale Magnetic Fields
J. Harvey, R. Howard, S. Forgach (NSO/NOAO)

Full-disk magnetograms with 1 arc second pixels have been obtained
daily at NSO/Kitt Peak since 1974. We use such observations,
separated by one day, to deduce large scale motions. The method we
use is correlation tracking of small-scale magnetic features outside
active regions. Such features are relatively good indicators of mass
motions over moderate time periods. An example is the well-known
correlation between horizontal supergranule flow fields and small
magnetic features. Previous measurements of the proper motion of
magnetic fields have either been limited to low angular resolution
and hence refer to large-scale patterns of magnetic fields or have
been restricted to small areas and short time intervals.

Each day of a pair of observations is corrected for atmospheric
refraction, image scale and scanning instrumental distortions. The
corrected data are remapped to a latitude and central meridian
distance map with resolution of 0.12 degrees and range of ± 60
degrees. Active regions are masked to remove their effects in
subsequent processing. Areas of 7.68 degrees on a side are
two-dimensionally cross correlated between the two days allowing
for the expected motion due to solar rotation. The result is an array
of more than 200, 2-d, cross-correlation arrays covering lags of ±
0.96 degrees.

Using preliminary correlations from a small data sample, we find a
rotation rate somewhat faster than deduced by Snodgrass (Ap. J.,
270, 228) based on magnetic data of lower angular resolution. We
also find no evidence for systematic meridional flows or giant cell
motions but the noise level is still of the order of 30 m/s. The
correlation functions suggest a random walk diffusion coefficient
of about 400 km $^2$/s but also significant variations with position.