ABSTRACTS

7.11 Synthesis and Inversion of the Chromospheric Mg I I-Line Stokes Profiles
G. A. Murphy, D. E. Rees (Univ. of Sydney), B. W. Lites, A. Skumanich (High Altitude Observatory/NCAR)

An analytic solution to the transfer equations for polarized radiation is presented which allows for departures from LTE in the overall excitation of a chromospheric line. The exponential form of the analytic solution is able to mimic the source function dependence on line center optical depth \( \Sigma_0 \) predicted by non-LTE transfer computations in a model sunspot atmosphere. The simple form of the analytic solution permits us to generalize existing least-squares inversion procedures for Stokes profiles to nonlinear \( \Sigma_0 \), allowing recovery of the magnetic field from simulated Stokes profiles if we restrict the fit to the Doppler cores of chromospheric lines, divorce the fit from the observed continuum intensity, fit the Stokes \( I \) profile as well as the polarization profiles, and fit simultaneously two members of a multiplet with different Zeeman splitting patterns.

The method of least-squares inversion is tested on profiles of the Mg I \( \delta \)-lines at \( \lambda = 5772.7 \) and \( \lambda = 5838.6 \) observed in 1975 December with the High Altitude Observatory/Sacramento Peak Observatory Stokes \( I \) polarimeter. This multiplet is shown to be among the most favorable of pairs of chromospheric lines for quantitative analysis of vector magnetic fields. This analysis results in reasonable values for the magnetic field if we adopt a `macroturbulent' profile smearing of 1-2 km/sec, and correct the observed profiles for scattered light.

7.12 The Coronal Temporal of 1988 October 15: A New Look at "Post Flare Loops"
A. J. Hundhausen and D. G. Sime (High Altitude Observatory/NCAR)

The coronal mass ejection (CME) of 1988 October 15 (DOY 288) was observed in detail both by the High Altitude Observatory's Coronagraph/Polarimeter on SMM and by the HAO Coronal Dynamics ground based instruments on Mauna Loa. The event has the appearance of a typical loop-like CME observed in association with an eruptive prominence, and the particularly good observing coverage from the limb (observed in \( H_\alpha \)) to a height of \( 5R_\odot \) in the corona permits the temporal and spatial details of the association to be examined closely.

In this paper we display those observations which show 1) the pre-existence of a well formed prominence which has been active for some hours before the eruption, 2) the ejection of \( H_\alpha \), emitting material into the corona around the time of the CME launch and later also, 3) the temporal and spatial development of the CME in relation to the site of the eruption and the ejected material, including the evolution of the CME from its asymmetrical appearance in the low corona to the nested loops seen higher up.

Taken all together, these observations provide a powerful indication that the event represents the evolution of a magnetic structure which is much larger than the "postflare loops" which remain at the site of the chromospheric activity. This activity is very compact and is clearly located at the base of one leg of the CME loop. This observation is consistent in detail with the 3 part structure for loop like events (prominence-carvity-lobe) suggested earlier and also with the model of Harrison, that the site of chromospheric activity associated with a CME occurs at one side and well displaced from the center of the evolving structure. All of these observed features point away from any interpretation of the mass ejection as the response to a chromospheric event, and towards the CME's being one phase of a prolonged and major change in the large scale magnetic configuration in the corona.

Session 8: Open

Special Presentation

Flare Research at the next Solar Maximum
B.R. Dennis (NASA/Goddard Space Flight Center)

During the planned Max '91 program of flare observations at the next solar maximum, major advances in solar flare physics will be possible through observations of high energy phenomena and the magnetic and thermal context in which they take place. Recent advances in instrumentation technology now make it possible, for the first time, to observe several of the most important processes on their intrinsic spatial, spectral and temporal scales. The Japanese Solar-A spacecraft and the Gamma Ray Observatory will have instruments on board capable of making some of these observations. In addition, advanced hard X-ray, gamma-ray, and optical instrumentation on long-duration balloon flights, and ground-based radio and optical telescopes, are capable of making many types of observations not possible from these spacecraft. It is the purpose of this talk to outline an international Max '91 program of coordinated flare research that should be carried out during the next solar maximum, indicate how the observations might be made in a timely fashion, and ensure that the effort will be coordinated to obtain the maximum scientific return with the limited available resources. It is proposed that this program include a series of observing campaigns during a three-year interval beginning in 1991 to be followed by an analysis program lasting an additional three years. It is hoped that this Max '91 program can be coordinated with the International Space Year that will begin in 1992 and with other international programs to ensure the maximum possible scientific participation.

8.01 The Origin of Rigidly Rotating Solar Magnetic Field Patterns
A.G. Nash*, N.R. Sheeley, Jr., Y.-H. Wang* (NRL)

We use numerical simulations to demonstrate that the rigidly rotating patterns of the large-scale photospheric magnetic field arise from a balance between the meridional component of magnetic flux transport and the shearing effect of differential rotation. These simulations show that the field evolves into large-scale stripes of alternating polarity which rotate rigidly like a barber pole; individual small-scale flux elements rotate at the intrinsic differential rate of the latitudes they are crossing. Supergranular diffusion, possibly assisted by a small poloidal flow, provides the meridional transport of flux and, thus, the progression toward rigid rotation. New sources of flux retard this process and exclude the rigid rotation from the sunspot belts until well into the declining phase of the sunspot cycle. This mechanism accounts for a number of heretofore unexplained phenomena including the observed rigid rotation of coronal holes during the declining phase of the sunspot cycle.

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8.02 The Decay of the Large-Scale Solar Magnetic Field
C. Richard DeVore (NRL)

In the absence of new bipolar sources of flux, the Sun's large-scale magnetic field decays due to differential rotation, meridional flow, and supergranular diffusion. The rotational shear quickly winds up the axisymmetric components of the field, increasing their latitudinal gradients and thus the rates of diffusive cancellation of their flux. This process is particularly effective at mid latitudes, where the shear is greatest, so that eventually only low- and high-latitude remnants of the initial field pattern survive. The transport equation for the magnetic field admits analytical eigenfunction solutions which describe this time-asymptotic behavior. The eigenstates are rigidly rotating, uniformly decaying distributions of flux, wound up by differential rotation and localized near the equator and the poles. I will discuss some properties of these solutions, with a view toward understanding the evolution of the solar magnetic field during times of minimum sunspot activity.

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