ABSTRACTS

7.5 "Effects of Magnetic Fields on the Asymmetry of Photospheric Line Profiles"
S. L. Kell (AFGL/PHS)
Changes in the shape of photospheric line profiles are observed between regions of quiet sun and regions showing various degrees of magnetic activity and structure. We simultaneously record profiles for FeI 4065, 5434 and 6302A. Spatially averaged profiles are generated separately for regions showing strong CaII K-line emission (plage) and for regions where no K-line emission is apparent (no plage). The 6302 line is used to determine the magnetic flux present in the observed regions. Both regions of emerging and disappearing flux were observed periodically over periods of several days. Our results indicate that the relative shift between plage and no-plage profiles depends strongly on the type of region being observed and the amount of magnetic flux. Plage profiles tend to have a small core blueshift and a strong wingshift with respect to no-plage profiles. Discrepancies between previous observations can be explained by differences in the regions observed and by inadequacy of the shifts introduced by the solar 5 minute oscillations.

7.6 3-D Behavior of Buoyant Magnetic Flux Tubes in Granules and Supergranules
G.W. Simon (AFGL), H.U. Schmidt (Max Planck Institut fuer Astrophysik), N.O. Weiss (University of Cambridge) (work performed at National Solar Observatory, NOAA, Sunspot, NM 88349)
A simple model is used to study the interaction of isolated magnetic flux tubes with convection in the Sun. Convective motion in granules and supergranules is represented by prescribed flows in three-dimensional cells with square cross-sections, and thin flux tubes move under the action of magnetic buoyancy, Lorentz curvature forces and aerodynamic drag. Inflow at the base of a cell competes with outflow at its upper surface; small flux tubes tend to be swept to the cell boundaries while larger, more buoyant tubes are dragged to the axis of the cell. These results are compared with recent observations of small scale granular and intergranular magnetic fields.

7.7 The Magnetic Equilibrium of Vertical, Thick Flux Tubes Near the Solar Surface
V. J. Pizzo (HAO/NCAR)*
We investigate the equilibrium structure of vertically-oriented flux tubes near the solar surface without making the thin flux tube approximation. We use an iterative numerical technique that permits solution of the nonlinear boundary value problem associated with two-dimensional magnetostatic equilibrium in great generality. It is based on the formalism of Low (1975), in which the hydrostatic atmosphere along each fieldline is arbitrarily specified in terms of self-consistent treatment of the energy balance. We find the shape of the magnetic configuration depends upon five major factors: the magnetic field strength, the radius of the tube, the net internal-external pressure deficit and temperature difference, and the thickness of the layer in which the pressure deficit deviates significantly from lateral total pressure balance. A scaling relation involving these factors indicates the magnetic topology will experience significant constriction in the Wilson depression. It is demonstrated that the fieldlines near the center of a large spot will most likely assume a configuration very close to that of a potential, free expansion. The equilibrium force balance in small spots and pores appears to be quite sensitive to relatively modest changes in the presumed thermodynamic structure near (and just below) the visible surface of the umbra. Hence, whether flux tubes of small horizontal scale assume a narrow tubular ("thin") shape or a highly divergent one remains an open question. We suggest that observations of the magnetic field strength in small structures, like pores and magnetic knots, may have been misinterpreted.

7.8 Numerical Simulations of the Mean Solar Magnetic Field During the Sunspot Cycle
N.R. Sheeley, Jr., C.R. DeVore (NRL)
We describe results of numerical simulations of the Sun's large-scale magnetic field during sunspot cycle 21. The new flux eroding in magnetic regions evolves in response to the diffusion, differential rotation, and meridional flow at the photosphere. By integrating the line-of-sight component of the computed radial field over the Earthward visible disk, we obtain the mean magnetic field of the Sun. We find that the calculated daily values of the mean field are in reasonably good agreement with the observed values over the same interval of time (1976-1984). By altering the input to the calculation, specifically the parameters of the transport model and the properties of the sources of new flux, we explore the changes induced in the strength and polarity patterns of the mean field. In particular, we find that the mean field originates in a small fraction of relatively large magnetic regions, and is insensitive to the presence or absence of the multitude of small regions.

7.9 A Stochastic Model for the Mean Solar Magnetic Field During the Sunspot Cycle
C.R. DeVore and N.R. Sheeley, Jr. (NRL)
The classical Langevin equation describes the dynamics of a particle undergoing Brownian motion, in which the particle is subject to deceleration by viscous drag and to acceleration by a time-dependent stochastic force representing molecular collisions. We associate the mean solar magnetic field with the projection of the Sun's magnetic moment onto the ecliptic plane. This two-dimensional vector, represented by a complex number, is analogous to the velocity of the Brownian particle. It decays due to the effects of diffusion, differential rotation, and meridional flow (analogous to the viscous drag), and it is restored by the continual eruption of new magnetic regions (analogous to the stochastic force). The solution to the modified Langevin equation is used to derive statistical information about the magnetic moment in terms of the timescales for decay and the statistical properties of the magnetic regions. This model provides a simple, intuitive framework for understanding aspects of our detailed numerical results for the mean solar magnetic field during sunspot cycle 21.

7.10 A Fabry-Perot Etalon for Differential Spectral Imaging
D.M. Rust (JHU/APL), C. Burton, R. Abell (CSIRO)
In response to requirements for a stable, compact, rugged and tunable filter for precision measurements of Zeeman and Doppler shifts in solar spectral lines, the Commonwealth (of Australia) Scientific and Industrial Research Organization's National Measurement Laboratory and the Johns Hopkins University Applied Physics Laboratory have fabricated several 20-mm diameter solid Fabry-Perot etalons of lithium niobate. LiN03(sub3) is a highly transparent, high-index, artificially-grown crystalline material which exhibits the Pockels effect. The high refractive index allows construction of a filter with 1/5th the bandwidth of an air-spaced Fabry-Perot for the same acceptance angle. Application of ±100 volts to conductive coatings on the polished faces will allow modulation of the passband from one wing to the other in narrow (0.1 Å) photospheric lines. We have designed around the filter a compact telescope that will form a 1.06 Å (spectral bandwidth) image of the whole solar disk on a single CCD array detector, at two arcsecond resolution. Our goal is to produce a Doppler and Zeeman imager that does not require that the solar image be scanned or the filter be tuned in the course of normal full-disk measurements. The instrument has applications to helioseismology and magnetometry. We will discuss fabrication techniques, bandpass stability, dynamic range and the selection of spectral lines that

© American Astronomical Society • Provided by the NASA Astrophysics Data System