From the detailed analysis of the simulation, the characteristics of solar granulation in shallow regions have been parameterized and compared with that of Chan and Sofia’s deep, efficient convection simulations (Chan and Sofia 1989). Furthermore, the validity of the mixing length approximation for these shallow regions has been studied, which this talk will focus on.

This research was supported in part by NASA grant NAGW-2531 to Yale University.

59.02
Recent array-detector Observations of the solar CO Fundamental vibration-rotation Transitions at 4.67 μm
H. Ultenbrock, R. W. Noyes (CIA), D. Rahin (NOAO)

We present recent observations of lines of the fundamental vibration-rotation transitions of carbon monoxide (CO) in the solar atmosphere obtained with the 256 element array detector at the McMath telescope on Kitt Peak. Standard, plane parallel, solar models have these lines form in LTE around the temperature minimum region; they should be indicative of electron temperatures there. However, matching observed line profiles in a standard solar model requires temperatures as low as 3700 K which are not confirmed by any other spectral diagnostic. We investigate whether this discrepancy can be solved by invoking spatial inhomogeneities or temporal variations or a combination of both. To this end we obtained series of spectra-spectrohelograms at different positions on the disk as well as time series of slit-spectra at a single position. The former type of observations allow us to study spatial inhomogeneities in stronger and weaker lines and the IR continuum at 160 cm⁻¹ and to distinguish between variations due to the 5-minute oscillations and the more steady patterns due to magnetic fields by comparing helograms taken several minutes apart.

We also obtained spectra with the slit crossing the limb giving us a more rigid registration of the intensity variations above the limb as compared to previous single-detector measurements. Early analysis shows that high and low excitation lines behave differently at the limb which may bear information on the temperature structure of the atmosphere just above the minimum.

59.03
Current Sheet Formation in Complex Solar Coronal Fields

Steve G. Benka and Spiro K. Antiochos (NRL)

We discuss the formation of current singularities and reconnection in magnetic fields with complex 3D topology. First, we argue that since the photospheric field is observed to consist of a complicated mixture of positive and negative polarity regions, the coronal magnetic field must, in general, contain a large number of separatrix surfaces and null points. Using numerical simulations, we calculate the effect of photospheric stressing on such a field. As initial conditions in the numerical model, we assume a cylindrically-symmetric potential field consisting of a small dipole field imbedded in a background larger dipole; hence, there are three polarity regions on the photosphere. In the corona the field has a hemispherical separatrix surface with a null point at the apex of this surface.

The initial field is then stressed by footpoint motions at the photosphere that have the form of a vortical flow of finite width. Results are discussed for two different photospheric locations of this flow, one in which the flow is centered on the symmetry axis so that the system retains its cylindrical symmetry, and one in which the flow is offset from the symmetry axis. The results of these simulations are discussed, in particular, the nature of reconnection in a true 3D geometry. We find that in both cases current sheets form at the separatrix. We argue that this mechanism for current sheet formation may play a central role in coronal heating.

59.04
Nonlinear Evolution of Coronal Heating by the Resonant Absorption of Alfvén Waves

L. Ofman* (NASA/GSFC), J.M. Davila (NASA/GSFC), R.S. Steinolfson (SwRI)

The nonlinear 3-D MHD equations for a fully compressible, low-beta, visco-resistive plasma are solved numerically using the Lax-Wendroff integration scheme (the explicit integration scheme was found to converge considerably faster in terms of physical time per CPU time than the Alternating Direction Implicit method). The calculations are initiated with the solutions of the linearized version of the MHD equations (Ofman, Davila, and Steinolfson 1994, ApJ., in press), with inhomogeneous background density, and a constant magnetic field. The numerical simulations demonstrate that the narrow dissipation layer is affected by the self-consistent velocity shear: i.e., the regions of high ohmic heating are carried around by the flow. Consequently, the topology of the perpendicular magnetic field and the ohmic heating regions differs significantly from the linear case. Additional harmonics of the driver frequency appear in the temporal oscillations with the dominant frequency of double the driver frequency. When the Lundquist number is $S = 10^7$ the average width of the resistive dissipation layer is 0.46c (where c is the density gradient length scale) and consistent with the linear results. When the driver amplitude is small compared to the average Alfvén speed the dissipation layer appears to be stable and the ohmic heating rate is enhanced by about 15% over the linear heating rate. When the driver amplitude is comparable to the average Alfvén speed the nonlinear effects dominate the evolution and the resonant heating phase may become unstable. A parametric study of the instability is presented. The effect of the self-consistent velocity on the instability is considered by generalizing the linear theory (Davila 1987) to include shear flow and solving the linearized dispersion relation of the resonant absorption with the background shear flow.

*NASA Resident Research Associate.

59.05
Heating Constraints on the Solar Corona Determined from SERTS Observations

D.A. Falconer (University of Maryland, NASA/GSFC), J.M. Davila, R.J. Thomas (NASA/GSFC), W.T. Thompson* (NASA/GSFC)

EUV emission above the quiet solar limb up to 1.2$R_S$ was studied using observations made from two different flights of the Goddard Solar EUV Rocket Telescope and Spectrograph (SERTS) covering three different spatial locations.

The spectral line intensities from a number of EUV spectral lines as a function of height were analyzed. Ratio of iron line intensities from Fe XIII, Fe XIV, Fe XV and Fe XVI were used to determine the electron temperature. The emission measure was determined from the iron line intensities and the electron temperature. Since in all three cases the line ratio temperature increased with height, a source of heating is required at some location above the maximum observed height, which was 1.15$R_S$ for two locations and 1.2$R_S$ for the third location.

The maximum divergence of heat flux was determined from the variation of temperature versus radius. The total radiative power was obtained from the emission measurement and temperature. By comparing the divergence of heat flux and the total radiative power, heating was also shown to be necessary for two of the three cases throughout the region below 1.15$R_S$.

*ARC

59.06
Spartan 201 H I Lyman-Alpha Observations of a Polar Coronal Region

J.L. Kohl, L.D. Gardner, D.M. Hasler, L. Strachen (CFA)

Measurements of H I Lyman-alpha spectral line profiles were made during the Spartan 201-1 Mission on 11 April 1993. The spectral resolution elements were 0.025 nm and the spatial elements were 0.5 arc min. by 2.5 arc min. Observations were made between 1.35 and 3.5 solar radii from sun-center. The