that the magnetic field is line tied at the discontinuous photospheric boundary. On the Sun, however, the interface between the photosphere and chromosphere has finite width, and hence line tying is invalid there. The present work extends our earlier theoretical and numerical studies of the symmetric case (Karpyn et al. 1990) to a system with an asymmetric shear. Using a 2.5-dimensional numerical simulation, we have investigated the results of an asymmetric shear imposed on a potential, quadrupolar magnetic field under two sets of atmospheric and boundary conditions: (1) A low-$\beta$ plasma with line tying at the base, similar to the analytic model described above; and (2) a hydrostatic-equilibrium atmosphere with solar gravity, typical of the observed photosphere-chromosphere interface. The low-$\beta$ simulation confirms the crucial role of the line-tying assumption in producing current sheets. As before, we find that current sheets do not form in the corona when a more realistic atmospheric model is considered.

*Work supported by NASA and ONR.

47.05
The Thermodynamic Stability of Current Sheets Formed in the Solar Atmosphere
T.N. LaRosa (UAH)

Current sheets can be formed when two independent magnetic flux systems are mechanically driven together. The thermodynamic structures of current sheets formed by (i) a new magnetic flux system emerging from the photosphere and encountering a pre-existing overlying coronal flux system and (ii) when neighboring coronal magnetic flux systems are pressed together, are examined. In the case of emerging flux, the current sheet forms in a low temperature (T < 10^4 K) region. Thus, to maintain pressure balance across the sheet, the particle density in the sheet must be extremely large (n > 10^{10} - 10^{16} cm^{-3}). It can be demonstrated that with such a large density the radiative energy loss exceeds both the internal Joule heating and energy input from the surrounding medium in the form of convection and thermal conduction. Therefore as the current sheet rises from the photosphere into the corona the sheet temperature in contradiction to previous analyses, remains constant. Alternatively, current sheets generated by coronal flux systems driven together are formed in a high temperature (T > 10^6 K) region. At such a temperature the internal Joule heating can be easily balanced by parallel thermal conduction. Thus the sheet temperature will merely adjust to the temperature of the surrounding corona. These results indicate that current sheets formed in the solar atmosphere are intrinsically thermally stable.

47.06
Coronal Evolution Due to Shear Motion
R. S. Stenflonson (SwRI)

The slow evolution of the solar corona in response to photospheric motion of the magnetic field footpoints is simulated using numerical solutions of the compressible and dissipative MHD equations in the meridional plane of a spherical coordinate system. An initial dipole magnetic configuration in a static, exponential atmosphere is sheared by azimuthal motions in opposite directions on each side of the equatorial plane. In contrast to earlier simulations, a continuous iterative feedback between the instantaneous coronal magnetic field and the field line footpoints forces the field to move with the solar motion so there is no "resistive slippage". Simulations have been completed for values of plasma beta from 0.1 - 0.5, maximum shear velocities from 1.6 - 10.3 km s^{-1}, and with various amounts of resistive and viscous dissipation. In all cases the evolution proceeds in two qualitatively different stages. In the earlier stage the field evolves gradually with the field lines expanding outward at a velocity not unlike the shear velocity. During the second stage the field begins to expand much more rapidly until it reaches velocities exceeding the local Alfvén velocity. For a representative case with beta = 0.2, maximum shear velocity = 2.6 km s^{-1} and no explicit dissipation, the eruptive behavior occurs after the field has been sheared by a maximum total distance of 0.6 solar radii from footpoint to footpoint over a period of 21 hours. Inclusion of the thermodynamics and compressibility has only a quantitative effect on the eruptive phase. The increase in thermal energy is always negligible compared to the nonpotential magnetic energy, and the kinetic energy only becomes appreciable during the eruptive phase. If the above feedback procedure is not implemented and the sheared magnetic field component is at the surface is computed as in earlier simulations, the eruptive behavior does not occur most likely as a result of the resistive slippage. Research supported by NASA Grant NAGW-1324, and NSF Grant ATM 89-96317.

47.07 (Dissertation)
The Large and Small Scale Density Structure in the Solar Corona
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In this thesis we have investigated the three-dimensional distribution of the polarization brightness product (pB) and then inferred electron density distribution with respect to the heliographic current sheet during the declining phase of the solar cycle 20 (from 1973 through 1976). This is the first model of the electron density of the quiet corona and its large-scales variation based on its association with the neutral line. Synoptic pB data from the K coronameter and the White Light Coronagraph aboard Skylab were used to locate the current sheet, taken as the center of the 'band of coronal streamers', during years of low and intermediate solar activity. Polarization brightness scans were analyzed as a function of minimum distance from the current sheet (R0p) between 1.13 and 5.0 R0. The electron density was obtained from the pB data and the following conclusions were drawn: (1) unlike the Munro and Jackson model (1977) we concluded that for a given solar distance r, the electron density inside the polar coronal hole remained constant with respect to the magnetic latitude (theta0) and longitude (phi0), (2) the electron density was maximal at the current sheet and not the solar equatorial plane, and (3) the electron density Np for the entire corona up to a height of 6 R0 can be expressed by the formula

\[ N(r, \theta_0, \phi_0) = N_0 + (N_{max}(r) - N_0) e^{-r/2H}, \]  

where

- \( N(r, \theta_0, \phi_0) \) number of free electrons / cm²,
- \( N_0(r) \) electron density at the current sheet,
- \( N_{max}(r) \) electron density at the pole,  
- \( H(\theta, \phi) \) half width of the distribution.

We used the XUV data and the white-light eclipse data of March 17th-18th, 1988, to study the small-scale density structure in the inner corona. Two coronal regions were sampled, the north and the south pole, and the irregularity factor X was found to be greater than 1. This result confirms the earlier observations made by Withbroe 1971, 1972, after correcting the pB data), Allen (1975) and Orrall et al., (1990).

47.08
Interacting Coronal Loops
R. N. Smartt (NSO/Sacramento Peak) and Z. Zhang (U/Nanjing)

Approximately ninety interacting post-flare loop events as recorded in coronal images of Fe XIV (5303 Å) and Fe X (6374 Å), and associated images in H+ have been analysed. Events in 3303 Å emission consist of a gradual increase in brightness to a marked maximum, and then fading, with a total lifetime of the order of 30 minutes. Such enhancements occur at the projected intersection of some loops. Each green-line event is followed by a corresponding red-line event, on average about 9 minutes later.