Session 22: Solar Structures
2:30-4:40 (Mohave Room, Convention Center)

22.01
A Variational Principle for MHD Based Upon Magnetic Helicity

G. Field (CFA)

A variational principle for MHD based upon magnetic helicity leads to the correct MHD equation, including pressure as well as magnetic forces. Unlike a related principle proposed by L. Woltjer in 1958, this principle does not imply that the field be force free.

22.02
Coronal Holes: A Driven MHD Waveguide Model

Joseph M. Davila (NASA/GSFC)

It is now well established observationally that high speed solar wind streams originate in coronal hole regions in the solar corona. Models of the solar wind flow based on this observation indicate that heat conduction alone cannot account for the observed properties of the wind and that other sources of heat and/or momentum must be sought. One suggested source for this additional momentum is “wave pressure” generated by magnetohydrodynamic (MHD) waves. The waves assumed responsible for acceleration of the high speed solar wind streams should have periods ~ 2 few hundred seconds if they are driven by photospheric turbulence. But MHD waves with periods this large have wavelengths /d, where d is the characteristic transverse size of the coronal hole. Current theories for the acceleration of the solar wind by MHD waves are valid only if the wavelength of the disturbance is much smaller than the characteristic transverse size of the coronal structure. This limit is not appropriate for the propagation of disturbances with periods P ~ 100 sec in the acceleration region of the solar wind. The effect of coronal hole magnetic structure on the propagation of MHD waves of all periods was considered in a previous paper. It was found that for the wave period range discussed above the coronal hole structure acts as a “leaky” MHD waveguide, i.e. wave flux which enters at the base of the coronal hole is only weakly guided by the coronal hole structure. In that paper a description of the normal modes of the coronal hole was derived. The excitation of these modes by turbulent motions at the base of the corona was not discussed however. In this paper a simple model for a coronal hole with a turbulent source at the base is presented and the problem of excitation is considered. The implications of this model for the acceleration of high speed wind streams by MHD waves will be discussed.

22.03
Flows in Coronal Loops: Do Synchro-Flows Exist?

A. N. McClymont (UCSD) and I. J. D. Craig (U. Waikato)

A model of quasi-steady flow in coronal loops is developed, including thermal conduction, mass motion, radiation, and steady heating. Symmetric flows (i.e., evaporation or condensation) are considered, and a first order correction to the static loop “scaling law” is developed. The transition region emission measure in “draining” loops is larger than that in evaporating loops, consistent with the observed predominance of red shifted transition region lines. Antisymmetric flows (flows through loops, from one footpoint to the other) are modeled. We assert that steady state “synchro” flows, discussed by many previous authors, and presumed to be driven by a pressure difference between the footpoints in an otherwise symmetric loop, do not exist. We show that in fact an asymmetry in the heating rate or the loop cross-sectional area is required to drive these flows. When this driving force is explicitly taken into account conclusions regarding the emission measure characteristics of the loop are reversed. We find that the emission measure of the downflowing leg is larger than that in the upflowing leg, which is again consistent with observations of red shifted emission lines. The position of maximum temperature in the loop is displaced towards the upflowing leg, contrary to previous conclusions. We have not been able, however, to reproduce observed (~ sonic) flow velocities. Even large asymmetries in the heating rate give rise to only moderate velocities. We are forced to conclude that such large velocities can only be produced by transient heating or magnetohydrodynamic effects.

22.04
Solar Prominence Model Based on Eigenvalue Magnetohydrostatic Solutions

V. A. Oshchepkov. (Cooperative Institute for Research in Environmental Sciences/University of Colorado)

A non-isothermal magnetohydrostatic model of a solar prominence is presented. This two-dimensional model is based on the eigenvalue approach already successfully applied in sunspot modeling (Return-Flux Sunspot Model, Oshchepkov 1982a) and in solar coronal modeling (Oshchepkov 1982b; Gilmer 1984).

The connection between magnetic and thermodynamic structures for two topologically simple configurations (ground state and first excited state) is considered in detail.

References:


*Work done at the Space Environment Laboratory, NOAA/ERL, Boulder, CO 80303 USA.

22.05
The Differential Emission Measure in the Lower Transition Region

S.K. Antiochos (Stanford U.)

At temperatures below 10^7 K the differential emission measure is observed to increase rapidly with decreasing temperature. This observation is not compatible with static models for coronal loops in which the cool transition region material occurs at the base of a hot, T_e > 10^7 K corona. We show, however, that for flux tubes that are low-lying, heights above the chromosphere ~ 1000 km, the coronal loop models are thermally unstable. For such flux tubes the plasma will preferentially be in a cool state with maximum temperatures < 10^5 K. We show how these cool loops can account for the emission measure observation. We also discuss the significance of our results for stellar observations.

22.06
Sunspots in Collision

V. Galitskaukas (HIA/Ottawa) and K.L. Harvey (SPRC/Tucson)

During the active lifetime of a complex of activity, the persistent injection of new magnetic flux in the form of