critical (cutoff) frequency and that the latter depends on the scale heights of the medium inside the layer and on the characteristic velocities for MHD waves. We also present that no singular points exist in the wave equations which describe the interaction between MHD waves and the HCS and thus the wave amplitudes are well-defined everywhere inside the layer. The results of our calculations show changes in the wave amplitudes as a result of this interaction and present the conditions for transmission and reflection of MHD waves. Finally, we discuss some observable consequences of our results.

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28.06
Solar-Wind Acceleration in Coronal Holes

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Fast solar wind may be partially accelerated by hydromagnetic waves above the sonic point in coronal holes. How can waves reach the super-sonic region of the wind and yet be dissipated at that height? I explore the physics of the conversion of Alfvén waves to fast-mode waves, based on the derivation by Melrose (1980, Plasma Astrophysics, ch. 12). Conversion is most effective when the Alfvén wave vectors are nearly along the magnetic field. Dissipation of the resulting fast-mode waves is most effective when their wave vectors are not along the field. Both directional conditions can be satisfied when waves are strongly refracted, particularly by the variation of Alfvén speed across the coronal hole. Important are the lack of symmetry of a coronal hole and the variation of the gas density across it.

28.07
Generation of MHD Waves by Convective Turbulence

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The generation of magnetohydrodynamic waves by turbulent fluid motions has been considered by a number of authors, usually within the context of the classical Lighthill theory for wave generation. Recently, Goldreich and Kumar have pointed out that in the case of fluid turbulence driven by thermal convection, the dominant source term for wave generation is the fluctuating buoyancy force, which had been heretofore ignored in wave generation problems. We have considered the effect of the fluctuating buoyancy force in the context of our earlier calculations of wave generation in a fluid characterized by weak and diffuse magnetic fields; and will discuss our results. We find that although the efficiency of wave generation is considerably enhanced by including the buoyancy fluctuation term, it remains true that the observed variation of coronal emission at fixed spectral type cannot be easily accounted for by a wave generation process of the type discussed here.

28.08
Numerical Simulations of Impulsively Heated Solar Flares

J.T. Mariska (NRL), A.G. Emalie, Peng Li (U. Ala. Huntsville)

The impulsive phase of a solar flare is generally thought to be due to heating of the solar atmosphere by collisional degradation of a beam of high energy electrons. This electron beam can be characterized by a maximum flux, a spectral index, and a low-energy cutoff. We present the results of a series of numerical simulations which detail the atmospheric response to changes in these parameters. The electron beam flux spectrum is a power law with a low-energy "knee," which begins at the low-energy cutoff. We have calculated model flare atmospheres with cutoffs ranging from 10 to 20 keV, spectral indices of 4 and 6, and maximum beam fluxes from $10^{10}$ to $10^{13}$ ergs cm$^{-2}$ s$^{-1}$. All of the calculations assume a linear rise time of 30 s. Generally, the atmospheric response depends on both the total amount of energy deposited, higher fluxes result in higher coronal temperatures and larger upflow velocities, and on where the energy is deposited, lower cutoff energies result in more energy being deposited in the corona and thus in higher coronal temperatures. Understanding fully the implications of the simulations for observations of the impulsive phase of a flare, however, requires detailed calculations of line profiles of selected X-ray emission lines.

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29.09
Soft X-Ray Diagnostics of Impulsively Heated Solar Flare Atmosphere

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The impulsive phase of a solar flare is characterized by significant motions of the hydrodynamic gas driven by the pressure gradients resulting from the heating of the solar atmosphere. These motions are manifested by the shifting and broadening of the soft X-ray spectrum line profiles whose intensity and shape can therefore be used as a diagnostic of the flare energy input. We assume that the atmospheric heating is due to collisional degradation of high energy electrons, whose flux spectrum takes the form of a power law with a low energy "knee", and have used numerical hydrodynamic simulations to model the effect of the total X-ray flux, spectral index and "knee" energy on the Ca XIX $4w$ line profile. The effects of varying the viewing angle to the loop have also been evaluated. The results show that blueshifts of order 400 km s$^{-1}$ are ubiquitous, indicating the earlier results of Emalie and Alexander (1987, Solar Phys., 110, 295) and suggesting a powerful diagnostic test of the thick-target electron-beamed model. A weaker stationary component, due to material settling at the top of the loop, may also be present. The peak intensity of the line correlates well with the electron flux; this information, together with hard X-ray burst spectra that give the total electron number, can be used to determine the area of injection and hence the beam filling factor.

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28.10
Force-Free Magnetic Fields in Toroidal Geometries

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The existence of loop-like structures in the low-β plasma of the solar atmosphere suggests that the containing magnetic fields obey the force-free equation,

$$(\mathbf{v} \times \mathbf{B}) \times \mathbf{B} = 0$$

i.e. the Lorentz force $\mathbf{j} \times \mathbf{B}$ vanishes for these loops. While much attention has been given to the solution of the force-free equation in cylindrical geometries, little has been devoted to its solution in the more natural toroidal geometry. In fact, even the existence of such a solution is in some doubt.

In this paper, we report on our endeavors to solve the force-free equation in two "toroidal" coordinate systems: one