Simulated Current Sheet Formation in Three Dimensions
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It has been suggested that the physics of the high density magnetic fields in coronal loops could be a significant source of coronal heating. If the magnetic plasma of a coronal loop is modelled by the equations of magnetohydrodynamics, then, in order that significant heating losses occur, the high conductivity of the solar plasma requires current density to be singular. Although discontinuities (in this case, of the magnetic field) are common to hyperbolic conservation laws, the magnetic field gives an essential third dimensionality to the equations of motion which are lacking in ordinary fluid dynamics.

We study the numerical simulation of the MHD equations in three dimensional space under the assumption of a strong homogeneous field. The interior magnetic field and fluid velocity is driven by prescribed velocity fields at opposite ends in the z-direction. This models the effects of flows on the solar surface on the coronal magnetic field. The model is shown to produce high density current sheets at hyperbolic points in the plasma flow. Three dimensional color plots are used for qualitative analysis and to suggest the direction for further investigation on the structure and evolution of the high density region. In particular, the development of such a current concentration from smooth initial and boundary conditions is shown.

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Numerical Simulation of the Kelvin-Helmholtz Instability on an Alfven Resonant Layer in a Solar Coronal Loop
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Alfvén wave resonant absorption is one of the leading candidates for the heating mechanism in the solar corona. Like any thin-layer heating theory, however, this model requires a sufficiently rapid energy dissipation rate to account for the observational data. This may be achieved by exciting secondary instabilities near the Alfvén resonant layer.

To investigate this possibility, we use a 3-D reduced MHD initial value code and study the stability of a straight cylindrical plasma of finite length that begins in a steady state with cylindrically symmetric Alfvén resonance layer. This code is spectral in the radial direction and finite-differenced in the azimuthal and axial directions.

We have successfully identified a Kelvin-Helmholtz instability that thrives on the velocity shear in the Alfvén resonant layer. We have shown that the linear growth rate of this instability is proportional to the Alfvén wave driving amplitude and scales approximately as \( (\delta B)_{\parallel}/3 \) and \( (\delta B)_{\perp}/3 \). \( \delta B_{\parallel} \) and \( \delta B_{\perp} \) are the ratios of viscous and resistive decay times to the Alfvén bounce time, respectively. We have also shown that the linear growth rate increases linearly with \( n \) up to a certain \( n \), saturates, and begins to decrease at higher \( n \). (\( n \) is the azimuthal mode number.) The mode number at which the linear growth rate assumes its maximum value increases with \( \delta B_{\parallel} \) and \( \delta B_{\perp} \).

We intend to develop and implement an efficient numerical method to facilitate the nonlinear simulation of this instability.

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Photospheric Abundances of Oxygen, Neon, and Argon Derived from XUV Spectra of an Impulsive Flare
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The XUV spectrum of an impulsive flare observed by the S082A spectroheliograph on Skylab was investigated. The spectrum which was emitted by a high density plasma \( n_e \sim 2 \times 10^{12} \text{ cm}^{-3} \) included intense lines of O III, IV; Ne II, III, IV, V, VI, VII; Na VIII; Mg VI, VII, VIII; Ar VI, VII, and Ca IX, X. An investigation of line intensities revealed that the Oxygen, Neon, and Argon abundances are close to their expected photospheric values and some 3-4 times higher than the values observed in the corona.

Imaging Solar Flare Gamma-Rays and Hard X-rays with The Gamma Ray Imaging Device (GRID) on a Balloon
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Imaging gamma-ray and hard X-ray sources of solar flare emissions is a primary scientific objective for solar flare research during the approaching activity maximum. The Gamma-Ray Imaging Device (GRID) is the instrument selected for NASA's Max '91 Solar Balloon Program to pursue this objective. GRID employs the technique of Fourier transform imaging and utilizes scanning modulation grid-collimator optics to provide full-Sun imaging with 2-arcsecond angular resolution over the energy range from 20 to 700 keV and temporal resolution commensurate with the timescales of the physical processes being investigated (0.1 second to 2 s). GRID will cover much higher energies than any previous instrument and is several orders of magnitude more sensitive than the HXIS instrument on STMM. The payload is scheduled for a long-duration balloon flight from Antarctica in December 1991.

A Simple Model of 2-Ribbon Flare Hard X-Ray Images for GRID (Gamma Ray Imaging Device)
S. Benka (UNC-CH, NASA/GSFC), G.D. Holman (NASA/GSFC), G.J. Hurford (Caltech)

The Gamma Ray Imaging Device (GRID) is a balloon-borne detector capable of imaging the sun in Hard X-Rays (HXR) (20 keV \( \leq E \leq 1 \text{ MeV} \)) with a spatial resolution of \( \approx 2 \text{ arc-seconds} \). We here present a model of some of the phenomena that GRID might see. The model follows a prevalent view incorporating a current sheet, which supplies both energization of electrons and heating of the flare plasma, co-aligned with the top of an arcade of magnetic loops. The energetic electrons are scattered out of the current sheet.