value. However recent calculations have cast doubts on the ability of the turbulent field to enhance the dissipation of magnetic flux when the back reaction of the Lorentz force on the fluid is included in the calculation. In this poster a new mechanism for the dissipation of magnetic fields in the convection zone is proposed. If the magnetic fields are in a fibril form in the convection zone, fields may be twisted by large-scale forces (e.g. the Coriolis force, and giant cell convection). If there is a convection zone analog of the fast reconnection seen in surface fields, then it is possible to form isolated loops of flux. Such loops will be self-contracting unless there is a strong shear on the scale of the loop. In the absence of such a shear the entire loop will collapse and then reconnect. Conditions under which such reconnection is possible and the implications for solar dynamo theory will be discussed.

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15.12
On Magnetic Diffusion in a Turbulent Fluid

S. Vainstein, F. Cattaneo, and R. Rosner (UChicago)

We show that the turbulent magnetic diffusivity for large-scale magnetic fields embedded in a turbulent conducting fluid can be substantially depressed even if the large-scale magnetic field is very weak, e.g., much smaller than the equipartition value $B_{eq} = 2\sqrt{\pi \rho v}$ (where $\rho$ is the plasma mass density and $v$ is the mean flow velocity). This result has important implications for the loss of magnetic flux in the solar interior and for the solar dynamo, which we shall discuss.

A Sub-Grid-Scale Magnetic Resistivity Formulation

M. L. Theobald, P. Fox, and S. Sofia (Yale/CSSR)

We have developed a sub-grid-scale (SGS) magnetic resistivity for use in numerical simulations of magnetized convection. Its derivation is analogous to that of the SGS viscosities in use in simulations of unmagnetized flow, both in the Earth’s atmosphere and in the solar convection zone. SGS viscosities are used to make consistent representations, on the resolved scale lengths of the simulation, of those processes involving unresolved scales. In these cases, the relevant energy containing scale lengths are much larger than those involved in dissipation, making direct simulations exceedingly difficult. A similar scale separation is present in the structure of the magnetic field in the solar convection zone.

In our formulation, the magnetic resistivity plays the same role for the magnetic field as the SGS viscosity does for the flow field; namely, to model the effects of magnetic dissipation at unresolved scale lengths. We will present our derivation of the SGS term, and give examples of its application to the study of magnetized convection.

16.02
An Acoustic Poynting Vector for Solar p-Mode Oscillations

D. C. Braun and C. Lindsey (IFA, Univ. Hawaii)

We derive and demonstrate a relatively simple technique for locating local sources and sinks of oscillatory power at the solar surface. A vector $\vec{S}$ is defined as $-\nabla \phi \partial \phi / \partial t$ where $\phi$ is the velocity or intensity field observed at the surface and the brackets indicate the time-averages. For traveling waves, $\vec{S}$ points in the direction of propagation with a magnitude proportional to the square of the wave amplitude. Therefore, the divergence of this quantity should directly indicate the presence of any source or sink of waves.

The technique is applied to a velocity data set taken with the 512-channel magnetograph at the Kitt Peak vacuum telescope. For the purpose of isolating p-mode waves, a temporal filter centered at 3 mHz is applied to the data before computing $\vec{S}$. The result shows a large negative divergence of acoustic waves within the penumbra of a sunspot. This confirms the absorption of p-mode power by sunspots which had been previously recognized by the decomposition of the waves into cylindrical Hankel functions centered on the spot.

16.03
Analysis of p-modes in a Sunspot Umbra

Matthew Penn, Barry Labonte (JAAUH)

Imaging spectroscopy data of the main umbra of NOAA 5836 was collected on 15 December 1989 with the MCCD instrument at Maesh Solar Observatory, Hawaii. The data contains several molecular absorption lines at 5440Å which are formed only in the sunspot umbra and not in the surrounding quiet sun. Each scan covers a 25 x 25 arcsecond region centered on the sunspot with 0.6 arcsecond sized pixels; the umbra covers an area roughly 10 x 20 arcseconds in each scan. Observations were made continuously every 47.5 seconds for a 2.5 hour duration, which gives a frequency resolution of 3.90x10^{-7} mHz and a Nyquist limit of 10.53 mHz.

For the lowest order standing wave mode (corresponding to $J_1(kr)$ ), we find the line of sight velocities are always less than 105 m s^{-1}, except for 1250 m s^{-1}. A power spectrum analysis of the velocity time series of this spatial mode reveals several distinct, unresolved oscillation peaks between 2.5 mHz and 4.0 mHz, with powers ranging from 4x10^{-11} m^2 s^{-4} Hz^{-1} to 7x10^{-10} m^2 s^{-4} Hz^{-1}. The high frequency noise power is 1.7x10^{-13} m^2 s^{-4} Hz^{-1}. These oscillation modes are closely spaced in frequency with separations near 0.16 mHz. We present an analysis of the umbra oscillation power in several $J_1(kr)$ spatial modes.

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16.01
Properties of High-Frequency and High-Wavenumber Solar Oscillations

D. Fernandes
Stanford University

Doppler shift measurements of the Na D line, absorption line were made at the Swedish Solar Observatory using the Lockheed SOUP tunable filter. The velocities measured in the low chromosphere of the sun showed acoustic oscillations with frequencies ranging up to 8 mHz for p-modes $p_1$ through $p_5$, well above the acoustic cutoff frequency. The $p_1$ and $p_2$ modes appear with wavenumbers up to 5.9 Mm^{-1} (equivalent spherical harmonic degree, 4100). Parameters of the ridges in the k-v diagram, namely frequency, width, and relative-velocity-power, were measured.

16.04
The Role of Slow Mode Waves in P-mode Absorption by Sunspots

Y. Fan, G.H. Fisher and A.N. McClymont

We analyze the local dispersion relation for Magnetic-Acoustic-Gravity waves in a uniformly magnetized and vertically stratified atmosphere. We found that slow mode waves are not trapped in the upper layer of the convection zone, so that they can carry energy...