16.05
On the Measurement of the Chromospheric Magnetic Field Using the NaI \lambda 5896Å Spectral Line

We show results of a study using the chromospheric \lambda 5896Å NaI line to determine the height-dependence of the solar chromospheric Magnetic Field. We extend our computation of the solar chromospheric Magnetic Field to different heights by computing the magnetic field at several wavelengths in the line. The VAL-F solar structure model is used to compute the contribution function, and hence the height dependence, for each of the wavelengths used. Based on our data from July, 3, 1992, we show the 3-dimensional solar chromospheric magnetic field structure and test the field's force free properties as a function of height with a regularized inversion method on the above data. The field becomes more force free higher in the atmosphere.

16.06
The Structure of Prominence Magnetic Fields
S.K. Antiochos, R.B. Dahlburg (NRL), J.A. Klimchuk (Stanford U.)

We have recently developed a model for the magnetic field of prominences. The assumptions in this model are that the prominence field is strongly three-dimensional, and that the footpoint shear at the photosphere is concentrated near the neutral line. We have calculated numerically 3-D force-free fields that satisfy these assumptions. The field lines have dipped regions near their centers which are suitable for the support of cool prominence plasma. In this paper we present detailed results from the calculations, and compare the results with observations.

Our model is essentially characterized by two geometrical parameters, the width of the shear region on the photosphere and the magnitude of the shear. We discuss the effect of both parameters on the distribution of dipped field lines. We show the distribution of the dips that result from various sets of parameters, and compare this distribution with the observed structure of prominences. An important feature of our model is that it can readily account for prominences of inverse polarity, i.e. the magnetic field in the corona is observed to have a polarity opposite to that inferred from the photospheric flux. The polarity of the prominence field calculated in our model is shown, and the origin of inverse polarity prominences is discussed.

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16.07
Measurement of Plasma Electric Fields in Prominences
P. Foukal, B. Behr (CRI)

We are carrying out measurements of d.c. and wave-related solar plasma electric fields using the transverse Stark effect in solar hydrogen lines. We describe the spectrograph we have developed at the NSO Evans facility, and present observations of the transverse Zeeman effect in FeI \lambda 6468, in penumbrae on the disc, as verification of the electrograph sensitivity and calibration. We also present observations of several bright quiescent prominences, obtained with an electric field sensitivity of 5 volt cm\(^{-1}\), in the Paschen-18 line at \lambda 6348. We discuss how these electric field observations can be used to a) test the validity of current-sheet models of quiescent prominences, and b) place constraints on Alfvén-wave heating and support of prominences.

16.08
Solar Magnetic Fields, Multifractals and Dynamos
A.C. Cadavid, J.K. Lawrence, A.A. Ruzmaikin & A. Kayleng-Knight (SFO/CSUN)

Line-of-sight magnetic fields, in high-resolution, digital, photoelectric images, scale in a self-similar way with resolution and therefore can be expressed in the form of a multifractal measure (Lawrence et al. 1993). Similar results have been encountered for the magnetic-field modulus in data generated via direct simulations of hydromagnetic turbulence with low magnetic Reynolds number (Brandenburg et al. 1992).

We investigate the multifractal structure of a fluid with high magnetic Reynolds number where the turbulent generation of magnetic fields is simulated via a random cell dynamo (Ruzmaikin et al. 1992). The fluid is divided into cells where the chaotic fast dynamo is modeled by random amplification and the effects of reconnection appear through random destruction. Additional effects due to non-linear feedback and diffusion are also included. The results encountered correspond to the quiet sun photospheric fields.

In collaboration with D. Galloway, we are modeling active regions, via the simulation of a linear kinematic fast dynamo with a modified chaotic "two-dimensional" ABC flow and slow diffusion (Galloway & Proctor 1992). After correction for the effects of a Gaussian random component in the distribution, the generated fields show self-similar multifractal scaling.


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16.09
Waves in Magnetic Flux Tubes: Initial Numerical Results
Peter J. Cargill (SAIC), James Chen (NRL)

The first results of a study of wave propagation in magnetic flux tubes will be presented. A two-dimensional finite difference code has been constructed to solve the linear MHD equations as an initial value problem. The waves are injected at one boundary, and their evolution is followed as the wave fronts travel through the simulation box. The equilibrium magnetic field and plasma can be arbitrary functions of both spatial coordinates, leading to the possibility of studying wave propagation in a wide variety of situations that are not amenable to a simple analytic treatment. Either floating or Sommerfeld (radiation) boundary conditions are effective in minimizing wave reflection at the boundaries. Periodicity boundary conditions are not assumed at any point. Examples of this approach will be shown for smoothly varying profiles in the slab geometry. Leakage of wave power from the tube turns out to be important (as discussed by Murawski and Roberts, Solar Phys. 144, 101) for models corresponding to both photospheric (high field, low density) and coronal (high density) conditions. Results showing how the three different MHD modes behave in such atmospheres will also be presented.

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16.10
Twisting Motions in Emerging Active Region Flux Tubes
G. H. Fisher (U.C. Berkeley), Y. Pan (U. Hawaii)

In Fan, Fisher, and DeLuca (1993, Ap. J. 405, 390; henceforth FFD) we describe numerical simulations of emerging flux loops originating from perturbed toroidal flux tubes residing at the base of the convection zone. We argue in FFD that an asymmetry of the magnetic field strength in emerging flux loops provides a natural explanation for the different morphological properties describing the lead-