ABSTRACTS

61.05
Simulation of Nonlinear Convection

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In a fluid layer embedded in a vertical gravitational field with a uniform horizontal temperature gradient, fluid convection occurs at any non-zero Grashof number (ratio of buoyancy to viscous forces). Linear theory predicts that this primary convection becomes unstable to a secondary (performed) flow above a threshold Grashof number. We study the nonlinear dynamics and heat transport by convection in the above system using hydrodynamic simulations. Starting with the primary flow, given analytically by the 1-D asymptotic solution, our fully non-linear 2-D hydrodynamic code follows the evolution of the perurbed flow. The code is spectral using Chebyshev polynomials to expand the horizontal coordinate. The simulation produces secondary flows consistent with experimental observations and quasi-linear theory. However, the simulated secondary flows develop at Grashof numbers below the critical value given by linear theory. Possible applications to solar and astrophysical plasmas will be discussed.


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61.06
Power Spectra of Solar Granulation

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Many high resolution images of solar granulation have been obtained from several different observing sessions at La Paloma, Sac Peak, and Spacelab 2. Fourier analysis and MTF corrections have been utilized to yield the average power spectrum of each set of images. The spectra agree fairly well, even though the images were taken as long as 12 years apart, indicating that the spatial characteristics of solar granulation are fairly static. The power spectra are also in good agreement with a spectrum obtained by speckle-interferometric techniques.

61.07
Vortex Flow in Granulation

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A very high-resolution movie of solar granulation obtained at the 50-cm Swedish Telescope in La Palma, Canary Islands, shows clear evidence of vortex flow. The movie covers 80 minutes of time. The images were obtained with a commercial CCD camera and video frame grabber at the "best" instant in each 8-second window. The best images in the movies have 0.3 arcsecond resolution. The digital images were aligned by algorithm. Both the aligned and destretched images show the vortex clearly. The vortex is in the center of a region about 7 arcseconds in diameter. Granules spiral into the center, and at the bottom, they move along the streamline direction and compress perpendicular to the streamlines. Granules collapse as they approach the sink point. The average velocity of the flow is 800 m/s ±400 m/s. The vortex was very persistent. At the start of the movie, the average velocity remained the same during the entire 80 minutes.

61.08
Chromospheric and Transition Zone Flows in a Solar Active Region

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During the Spacelab 2 mission simultaneous observations of a solar active region containing plage, filament and sunspot areas were made in Hα by the Heudon Multichannel Subtractive Double Pass (MSDP) spectrograph and in C IV by the NRL High Resolution Telescope and Spectrograph (HRTS). In addition, a photospheric magnetogram was obtained at Meudon a few minutes later. We report results from a preliminary analysis of these data. From the Hα profiles, images of the intensity and velocity at ±0.3 Å and at ±0.6 Å are constructed and from the C IV profiles at ±1548 Å and ±1550 Å, images of the intensity, velocity, and line-width are constructed. The C IV velocities are referenced to narrow chromospheric Si I lines to provide nearly absolute velocities. The sunspot shows the reverse Effect in Ha and, in C IV, regions of 10 km s^-1 upflows as well as 100 km s^-1 downflows. The best overall correlation between the Ha and C IV images is between Ha downflow and C IV intensity. Strong outflows are seen in C IV in a filament at an angle to the Ha filament, which indicates strongly sheared flows in the filament.

61.09
Photospheric Magnetic and Velocity-Feature Rotation in NS250.2

H. B. Snodgrass (Lewis and Clark College)

A study of "short-term" magnetic rotation using cross-correlations of magnetograms taken 1-4 days apart yielded an absolute rotation rate that is steady at each latitude to at least the 1% accuracy afforded by the data (Snodgrass, Ap.J. 270, 29S, 1983). The resulting (20 to Doppler-determined) differential rotation profile was compared with profiles obtained by autocorrelating the fields after one or more full rotations (e.g. Stenflo, Solar Phys. 38, 495, 1974), the latter were found to be considerably flatter. Recently this difference has been explained as a consequence of meridional flows (Sheeley et al., Ap.J. 519, 481, 1993); thus magnetic rotation may serve as a tool for studying the elusive phenomena of meridional circulation.

This and the existence of the much higher quality data taken since 1982 (in particular the newest "fast-gram" data) have inspired a renewed and more thorough study of the magnetic rotation using the Mount Wilson magnetograms. Apart from scope, the present study differs from the previous one in that it also includes "long-term" rotation, measured both through autocorrelations and also through the same cross-correlation technique as was applied in the "short-term" study. The cross-correlations, applied after one or more full rotations, provide a particularly sharp determination of the rotation rate at middle latitudes. An attempt at seeing meridional flow directly is made by correlating fields from adjacent latitudes after full rotations.

It is also found that the same cross-correlation technique can be applied to the Doppler residual arrays, which are left over after the known large-scale motions such as rotation and limbshift, have been extracted from the Dopplengram data. A velocity-feature rotation rate can be determined using arrays taken at 1 day apart, but correlations fade rapidly thereafter. This work is supported by NSF grant AST 86-13171.

61.10
Simultaneous Observations of Active Regions

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Simultaneous Observations of two Active Regions were made on Aug 10 and 11, 1987, using all operational digital imaging systems currently operated at STSC. Full disk observations were made using the Full Disk Telescope (CFDT) and Rotating Full Disk Photometer (RFDP). High Resolution images were obtained with the 11" vacuum telescope. All observations were made in the photospheric continuum in regions of the spectrum reasonably free of emission lines. The CFDT uses a 100A band pass inter-