may be analyzed with these etalons. This work partially
sponsored by NASA under grant NAGW-522.

7.11
Alfvénic Pulses in the Solar Atmosphere
J.T. Marsida (NRL), J.V. Hollweg (UNH)

We investigate numerically some nonlinear aspects of
Alfvénic pulses propagating in coronal loops and the
underlying chromosphere. Heat conduction and radiation
are included. The Alfvénic pulses are modelled as
axisymmetric twists on a vertical cylindrical flux tube.
They nonlinearly couple into acoustic-gravity waves
propagating along the flux tube. A single
Alfvénic pulse is found to leave two acoustic-gravity
waves in its wake. These pulses can result in significant
motions of the transition region and underlying chromosphere.
These motions do not resemble spicules, but they may correspond to a variety of
observations indicating that the solar atmosphere is in
a continual dynamic state. Indeed, we suggest that a
dynamic chromosphere and transition region may be the
inevitable consequence of the coronal heating process
itself.

7.12
Viscous Normal Modes on Coronal Inhomogeneities
R. S. Steinolfson (University of California, Irvine)

Viscous damping of Alfvén surface waves is examined both
analytically and numerically using incompressible MHD.
Normal modes are shown to exist on discontinuous as well
as continuously varying interfaces in Alfvén speed. The
waves experience negligible decay below the transition
region. High frequency waves damp just above the
transition region, while those of lower frequency loose energy
further out. A comparison of dissipative decay rates
shows that viscous damping by velocity gradients approxi-
mately two orders of magnitude faster than by resistivity.

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Session 8: Oscillations and Variability

8.1
Changes in Subsurface Horizontal Velocities Inferred
From Observations of High Degree S-Minute Solar
Oscillations
F. Hill (NSO/Tucson), J. Toomey (U. Colorado), D.O.
Gough (U. Cambridge)

The inversion of frequencies from high-degree acoustic
modes of oscillation of the Sun provides a picture of
large-scale velocity fields in the convection zone below
the solar surface. Such information is of importance to
stellar convection and dynamo theories. We have applied
an optimal averaging inversion procedure to oscillation
frequencies measured on solar images from the Mt.
Wilson 5173 line at NSO/Goddard. Typically frequency
splitting data for over 700 modes has been used in the
inversion for each observing day. These data allow us
to infer the horizontal velocity as a function of depth and
time within a shell of depth 20 Mm below the solar
surface. The results indicate that the time-averaged
horizontal velocity, associated with differential
rotation, increases with depth by about 100 m/s in this
shell. This is consistent with the observed higher
rotation rate of sunspots compared to the photosphere if
we assume that the spots are anchored at deeper
depths. Comparison of the horizontal velocity at a
given depth as a function of time shows substantial
daily variations. These variations have a magnitude of
about 100 m/s in the shallow depths near the surface,
decreasing to about 50 m/s deeper down. The variations
may result from solar rotation bringing different
patterns of giant cells of convection into position
beneath the observing window. The modulated horizontal
flow attains peak amplitudes in the H ionization zone.
Analysis of possible spatial periodicities with longitude has been carried out.

8.2
Deconvolution Methods for Analysis of Solar Oscillation
Observations
P. H. Scherrer
(Stanford University)

Current observational questions in helioseismology
require high spectral resolution that can only be
obtained with observations spanning many days or
months. The primary constraint in the full utilization
of single mid-latitude observing sites is the presence
of diurnal data gaps. Several methods for removing
the effect of these gaps in the spectra obtained
from velocity observations have been suggested.
In the case of data coverage of less than 50%, none
of the methods considered has been successful at
unambiguously recovering the true spectrum from test
spectra with realistic complexity. The limitations
of these methods and their applicability to the
helioseismology problem will be discussed.

8.3
Amplitude Ratio of Solar p-Mode Intensity and Doppler
Oscillations
T. L. Duvall, Jr. (NASA/GSFC), J. W. Harvey (NSO/
Tucson), M. A. Pomranz (Bartol)

We observed p-mode oscillations of the sun and
address the question of the frequency dependence of the ratio
of intensity and Doppler shift oscillations. Intensity
observations of the solar atmosphere temperature
minimum were made from the geographic south pole using
a 6 ft filter centered on the K-line and a two-dimen-
sional diode array camera. Doppler shift observations
of a pair of photospheric spectrum lines near 6191 Å
were made at Kitt Peak using a large grating spectro-
graph and a similar camera. Both sets of observations
were processed to produce power density spectra of
zonal oscillations for spherical harmonic modes 0 to
200. Non-oscillatory background power was subtracted
and then the average power over degree ranges 10 to 200
and 50 to 150 was determined. Over the frequency range
2.5 to 5.0 mHz the ratio of intensity fluctuation to
Doppler shift amplitude increases linearly with frequency
by a factor of 3.9. This behavior is roughly in accord
with the naive idea that low frequency intensity
fluctuations will be relatively smaller because of the
longer time for the atmosphere to passively adjust to a
velocity perturbation. The behavior we observe bodes
ill for the detection of p-mode intensity oscillations
at frequencies much below 2 mHz.

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8.4
An upper limit on the size of giant cells
A. A. van Ballegooijen (Lockheed)

Theories of large-scale convection in the Sun
predict that the typical velocities of giant
cells are of order 100 m/s. However, Doppler
measurements put an upper limit of 2 m/s on
the east-west component of the flow at the
equator (Snodgrass and Howard, 1984). To
explain this discrepancy, it has been proposed
that the giant cells are screened off from the
sunspot surface due to the density
stratification in the convection zone (Stix,
1981). We present a simple model of the
velocity field in giant cells. The model