24.04 Detection of Propagating Waves in the Solar Photosphere, S. L. Kell, AGU, Sac. Peak Obs., CIRO MARKOLOSO, Istituto Di Fisica Sperimentale, Napoli - The transfer function for short-period acoustic waves must be known to interpret the high-frequency power seen in power spectra of observed solar line shift observations. Measurement of the propagation of acoustic waves through the photosphere also requires accurate knowledge of how the line-formation process is affected by the waves. Several authors have investigated the effects of acoustic waves on line formation. Durrant (1979, Astron. Astrophys. 73, 137) has provided a good summary of earlier work. Most of the earlier efforts used kinematic models of the waves and only discussed their effects on average line profiles (averaged over space and/or time). Cran, Kell, and Ulmschneider (1979, Ap. J. 234, 768) discuss the formation of spectral lines in the presence of short-period, non-linearly, radiatively-damped, acoustic waves of a fixed period (30 seconds), propagating through a model of the solar atmosphere. They compute the emergent line profile at several phases of the wave as it propagates vertically through the photosphere. Durrant (1980, Astron. Astrophys. 89, 80) has developed an analytic perturbation theory for the effect of an arbitrary wavefield, that is everywhere small, on the emergent profiles. He makes several simplifying assumptions about the distribution of opacity and source function with height. We expand on this earlier work by investigating effects of acoustic waves having several different frequencies on a number of Fe I lines formed in the photosphere. We use a dynamic model of the waves (i.e., we consider velocity, temperature, and pressure fluctuations as functions of time) to compute the line profiles. In addition to determining the time-averaged properties of the line profiles, we investigate the measurability of vertical phase differences as a function of frequency.

24.05 Response of an Emerging Flux Tube to a Current-Driven Instability, J. T. KARPEN and J. P. BORIS, Naval Research Laboratory.

Current solar observations have shown that emerging magnetic flux can play an important role in the development of active regions and the subsequent activation of flares. The physical mechanisms through which a flux tube becomes a flaring loop, or induces nearby loops to flare, are not known at present, although magnetic reconnection is a popular candidate. We have investigated the triggering and evolution of another set of physically realistic mechanisms: current-driven instabilities (CDIs). Because the threshold criterion for onset of a CDI is determined by local plasma parameters, this process may provide a direct link between the changing physical characteristics in an emerging flux tube and the explosive heating of flares. The ability of CDIs to turn on or off as the stability condition is violated or satisfied in response to temperature, density, and geometric changes in the rising loop also suggests an explanation for the observed brightening and dimming of X-ray loops in regions where a flare is about to occur. Three phases of this work are discussed here. First, a simple, analytical, lumped-parameter model is developed for the evolution of geometry and internal physical properties in an emerging flux tube with an axial current and associated generic CDI. The results then are incorporated into the NRL Dynamic Flux Tube Model (DFTM), thus allowing 1-D simulations of the hydrodynamics and energetics within this rising and expanding loop. In the final stage, observations of structural and intensity changes in preflare and flaring loops are compared with the predictions of the DFTM simulations.

* Berkeley Research Associates

24.06 Early Signs of New Active Regions, S. F. MARTIN, Caltech. New active regions are traditionally recognized by the appearance of arch filament systems in Hα images and by the birth of new sunspots in white light or continuum images. We now have photographically recorded, in Hα and on magnetograms, the birth of several active regions which definitively reveal the existence of an earlier stage of active region development. Before the development of an arch filament system or sunspots, the sites of several new active regions in Hα were found to be clearly marked by a succession of very small flares and associated surges. The surges are the more obvious features because they are larger and endure longer than the flares. However, the surges emanate from the flare sites, suggesting that the surges are the energy source for the surges. In those cases in which flares and surges were the earliest signs of the new active regions, the associated bipolar magnetic field of the new active region emerged at the site of pre-existing magnetic field. However, the flares and surges were seen one or more hours before the bipolar magnetic field of the new region was clearly resolved and identifiable in the magnetograms from Big Bear Solar Observatory. The flares and surges are thought to be a consequence of the new bipolar field interacting, possibly by magnetic reconnection, with the pre-existing magnetic field. The flares and surges occur near the boundary between the pre-existing magnetic field and the half of the new emerging bipolar field which is opposite in polarity to the pre-existing magnetic field. Support from AFOSR grant 82-0018 is acknowledged.