18.03

Numerical Simulations of the Rebound Shock Model for Spicules

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Using time-dependent numerical simulations, we have examined the proposed rebound shock mechanism for spicules. The calculations include heat conduction and an approximate treatment of radiation. At temperatures above a critical value, $T_c$, the radiation is characteristic of the conditions in the optically thin corona and near optically thin transition region. When $T < T_c$, the atmosphere has a radiative cooling time, $\tau_{rad}$, characteristic of the chromosphere. We initiate the spicule with a quasi-impulsive force in the low chromosphere, which drives a train of upward propagating rebound shocks along the rigid magnetic flux tube. These shocks then move the transition region upward. The material below the displaced transition region has temperatures and densities similar to those of spicules when $T > 20,000$ K and $\tau_{rad} \approx 1000$ s, but not when $T \approx 10,000$ K, and probably not when $\tau_{rad} \approx 100$ s. For all the cases we have studied where the cross-sectional area diverges rapidly with height, the upward velocity of the transition region is less than that of spicules. Moreover, the maximum height is less than that of average spicules. Taller (maximum height $\approx 10,000$ km), higher velocity ($\approx 23$ km s$^{-1}$) spicules result when the magnetic field cross-sectional area is constant. In all cases, the rebound shock mechanism produces substantial motions and temperature and density variations in chromospheric and transition region material. We suggest that this may be a partial explanation for the continuous dynamic state of the lower solar atmosphere.

18.05

Fine Scale Structure of the Quiet Solar Transition Region Observed by the Harvard EUV Spectrohelioimeter on Skylab

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In the standard picture of the hotter portion of the transition region of the quiet Sun, EUV-emitting plasma at temperatures between $2 \times 10^4$ K and $10^6$ K is confined by magnetic field lines, which diverge from the supergranular network at the surface to the corona overhead. The plasma is heated by steady energy transfer from the corona, presumably either back conduction or enthalpy flux due to steady downflows. This picture appears to model the gross structure at these temperatures seen by Harvard's EUV spectrohelioimeter on Skylab as reported by Reeves (1976, Solar Phys. 46, 53). In that study it was shown that 75% of the total intensity originated in the supergranular network consisting of the 45% of the surface which contained the brightest pixels.

In a follow-up study of the Harvard data, we have found that 50% of the total intensity originates in bright points within the network which occupy 25% of the surface. The number, sizes, shapes, and relative intensities of these bright points all vary somewhat as a function of temperature. They also vary on time scales of 20 min down to 1.5 min. The fine scale spatial and temporal variations are not consistent with models of steady back heating from the corona.

18.06

IUE Observations of Solar-Type Stars in the Hyades and the Pleiades

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We have made the first IUE observations of solar-type stars (spectral types F5–G5) in the Pleiades. Spectra were obtained in January and August 1988 for both the transition region (CIV 1550Å; low-resolution) and chromospheric (MgII 2800Å; high-resolution) emission wavelength regions. Long wavelength, high-resolution spectra were also obtained for previously unobserved solar-type stars in the Hyades. With the inclusion of spectra of additional Hyades stars obtained from the IUE archives, we have calculated mean surface fluxes for both clusters' solar-type stars. These values lie close to, but below, the saturation levels $(F_{CIV} \sim 10^{-6}$ and $F_{MgII} \sim 10^{-5}$ ergs cm$^{-2}$ s$^{-1}$) for cool dwarfs. In addition, these spectra of such young stars (Pleiades $\sim 10^7$ yrs; Hyades $\sim 8.8$ yrs) extend the main sequence age baseline for activity–age relations over more than two orders of magnitude and, hence, allow for further discussion of proposed evolutionary scenarios for solar-type stars. In particular, we compare the exponential decay times for the activity in the chromosphere and the transition region determined here with that previously obtained for these stars' coronal X-ray emission.

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18.07

The Evolution of Stellar Chromospheric Activity

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Low resolution spectra of rapidly rotating, spotted K and M type dwarf stars in the Alpha Persei, Pleiades, and Hyades clusters have been obtained with the IUE satellite in order to chart the time decay of chromospheric activity among low mass stars. Measurements from these spectra of the integrated flux of the chromospheric Mg II emission feature have been compared with the fluxes observed for pre-main sequence and field stars. As illustrated by the accompanying