1990BAAS...22R.815D

Absolute Velocities and Center-to-Limb Variations of EUV Emission Lines in the Quiet Sun

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We present an observational study of the systematic radial flows representative of the quiet Sun's chromosphere, transition region, and corona. A sounding rocket experiment (27 July 1987) obtained high resolution EUV spectra along a solar diameter with spatial resolution of 20 x 20 arcsec. The center-to-limb behavior of representative lines (\(\lambda 1533\) Si II, \(\lambda 1563\) Fe II, \(\lambda 1548\) C IV, \(\lambda 770\) NeVIII) formed at different heights in the solar atmosphere is discussed. Assuming that horizontal motions cancel statistically so that the line-of-sight velocity approaches zero at the limb, we find a net radial downflow of approximately 7 1/2 km/s for C IV and upper limits on the radial flow for Si II and Ne VIII. The absolute wavelengths of each emission line were determined by direct comparison with wavelengths of known platinum lines generated by an inflight calibration lamp. We then test the assumption of line-of-sight velocity approaching zero at the limb by comparing our wavelengths with recently published laboratory rest wavelengths of the solar emission lines. From these results, we are able to obtain an approximate picture of the net radial velocity fields as a function of height in the quiet Sun's chromosphere, transition region, and corona.

14.03

Observational Evidence for Transition Region Network Loops

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The spatial structure of the quiet solar transition region is ambiguous. Based on the general characteristics of EUV spectroheliograms and fine-scale magnetograms, Dowdy, Rabin and Moore (1986) have proposed that the supergranular network is populated with small magnetic loops (< 10^6 km) which are internally heated to transition region temperatures. Initial efforts to model small loops at transition region temperatures (cf. Craig and McAlister 1967, Ap. J. 312, 402; Mariska 1989, Ap. J. 334, 498) have successfully accounted for net downflows and other observational features. Small transition region loops are thus theoretically plausible, but direct observational evidence for them has yet to be presented.

We present image data taken by the Harvard/ATM EUV spectroheliometer on Skylab with a magnetogram of the same field of view taken simultaneously at Kitt Peak. Because a sequence of five EUV raster was taken (5.5 min intervals), a steady background image can be derived. This background can be subtracted from each raster to highlight features whose intensities change. Many of the features are small, extended and slender, suggesting small loops. Furthermore, many of the features straddle magnetic dipoles in the magnetogram. Although the subtraction process is sensitive to noise, the confidence level in these features is high because many persist for two or more rasters in the sequence and because many are seen simultaneously in different rasters which sample different emission lines (different temperatures). This data set is unique among recent EUV data sets for observing lines at temperatures in the hotter transition region (10^5 K to 10^6 K) where the small loops are also observed.

14.04

Magnetic Loops in the Chromospheric Network

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We present observations of the magnetic structure of the solar atmosphere in a quiet region at disk center. The data are a magnetogram from Kitt Peak National Solar Observatory, a time sequence of H-alpha filtergrams from Big Bear Solar Observatory, and spectroheliograms from the Harvard EUV Spectroheliometer on Skylab. By superposing these images, we examine the location of chromospheric spicules and chromospheric, transition-region, and coronal bright points relative to magnetic flux concentrations and polarity inversions in and along the network lanes. We find evidence (1) that many H-alpha fibrillar structures that look like spicules are transient tracers of magnetic loops in small magnetic bipoles, and (2) that there are many similar small bipoles present that are below the threshold of the magnetogram. These results are in agreement with the "magnetic junkyard" picture proposed by Dowdy, Rabin, and Moore (1986: Solar Phys. 105, 35) for the magnetic structure of the quiet network lanes. Because the plasma at chromospheric and transition-region temperatures in the short, low magnetic loops is magnetically insulated from the corona, this plasma must be heated from within the loops, rather than by heat transfer from the corona. Some of this internal heating occurs in the form of microflares that Porter et al. (1967: Astrophys. J. 323, 380) have found in network bipoles and that probably produce the bright points in our EUV snapshots of the network.

This work was supported by NASA's Office of Space Science and Applications through the Solar Physics Branch of its Space Physics Division.

14.05

Ultraviolet Spectra of a Prominence

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Ultraviolet spectra of a prominence were obtained by the NRL High Resolution Telescope and Spectrograph (HRTS) on August 5, 1985 during the SpaceLab 2 mission. Na and Ca K spectroheliograms were also obtained at the Meudon Observatory. These show a large prominence consisting of several loop structures that gradually disappeared over the next 3-4 days. The HRTS spectrograph slit was placed parallel to the solar radius and rastered in 10° increments. Spectra were recorded at 17 raster positions so that one complete loop of the prominence was spanned. Lines of Fe II, C I, C II, C IV, Al II, Si II, Si IV and Fe II are evident and well exposed on the 60s exposures. Many of these lines are self-reversed on the disk but appear as narrow Gaussian profiles in these spectra. At altitude in the prominence, the lines are all quite narrow. Most probable velocities of only 3 to 8 km s^-1 are derived from the line profiles. Most profiles show little evidence of net Doppler shifts higher than 3 km s^-1. Near absolute velocities have been obtained by referencing the spectra to lines of Si I and Fe II observed on the disk. In one of the loop footpoints, Doppler shifts of 50 km s^-1 are evident in the cooler lines. The strong C IV lines also show small regions with Doppler shifts of 50 km s^-1 at several position in the prominence.