1981BAAS...13Q.819C

Solar Physics Division/AAS
Session 15: Flares (I)
1430–1630 (Helms 252)

15.01 The Dynamics of Coronal Flare Loops: I. Dynamics, C.-G. Cheng, G.A. Doschek, J.P. Boris, J.T. Mariska, and E.S. Oran, E.O. Hulburt Center for Space Research and Laboratory for Computational Physics, NRL.

We investigate the dynamic response of a coronal loop to rapid flare heating, using the NRL Dynamic Flux Tube Model, in order to obtain a better understanding of the spatial and temporal distributions of solar flare energy input. In this paper we simulate a soft X-ray flare by depositing the energy in a small region at the top of the loop. The temperature of the flaring loop rises rapidly to values greater than 10^7 K. As the energy is deposited, it is conducted down into the chromosphere, resulting in the ablation of plasma up into the loop at velocities of a few hundred km s^{-1}. The density in the high temperature region of the loop rises by more than an order of magnitude, and the transition region of the loop steepens and is driven down into the chromosphere. In an accompanying paper by Doschek et al., the X-ray spectroscopic signatures of the heating are discussed and compared to available observations.

This work was supported by the NASA Solar Terrestrial Theory Program and by the Naval Research Laboratory.

15.02 The Dynamics of Coronal Flare Loops: II. Comparison to Observations, G.A. Doschek, C.-G. Cheng, J.P. Boris, J.T. Mariska, and E.S. Oran, E.O. Hulburt Center for Space Research and Laboratory for Computational Physics, NRL.

In an accompanying paper by Cheng et al., the gasdynamic response of a coronal flux tube to rapid flare heating is discussed. In the simulations performed, energy was deposited into the flux tube such that temperatures typical of soft X-ray solar flares (2 x 10^7 K) are achieved. In this paper we compare computed X-ray spectral line intensities and profiles to observations obtained primarily by the NRL and Aerospace X-ray spectrometers flown on the P78-1 spacecraft (e.g., see Doschek et al. 1981, Ap. J., 245, 372). The lines considered are the resonance, intercombination, and forbidden lines of O VII at 21.60, 21.80 and 22.10 Å; respectively; the 0 VIII Ly-α line at 18.97 Å; the resonance lines of Ca XIX and Fe XXV at 3.1769 and 1.8500 Å, respectively; and a dielectric line of Fe XXIV. The flux tube is considered to be spatially resolved by a hypothetical spectrometer in some comparisons, and spatially unresolved in others. In the unresolved comparisons, different angles of observation of the flux tube are considered. The spatially resolved computations may be compared to spatially resolved observations obtained from Skylab and SMM.

This work was supported by the NASA Solar Terrestrial Theory Program and by the Naval Research Laboratory.

15.03 Collisionless Conduction Front Propagation in Large Loops and Solar Hard X-ray Bursts
D.F. Smith and D.W. Hörn, University of Colorado

The propagation of collisionless conduction fronts down a loop of length 50,000 km including its chromospheric part is investigated in a one-dimensional fluid approach. Anomalous limmitin low conduction due to ion-acoustic instability of the return current is the dominant energy transport mechanism. The loop is heated near the top to electron temperatures above 10^7 K. The conduction fronts formed travel down the loop to the chromosphere and evaporate off a part of it. This relatively cool material travels back up the loop and eventually quenches the source for energy injection times the X-ray line. Both since the X-ray emission comes from the footpoints of the loop over most of the source lifetime. The spectrum is a power law with a typical index of 3.0. Although the efficiency gain over a nonthermal model is small, it is much easier from the point of view of plasma physics to heat all the electrons in a plasma than to accelerate a substantial fraction of them.

Work supported by NASA Grant NGR-7507.

15.04 Direct Evidence for Chromospheric Evaporation in a Well-Observed Compact Flare
R.C. Campfield, D.C. Driscoll, L.W. Acton, Lockheed, T.A. Genzler, H.S. Hudson, D.C. Kiplinger, NSF, J.W. Leibacher, Lockheed. We have observed the flare of 7 May 1980 with several Solar Maximum Mission instruments, including the Hard X-ray Burst Spectrometer, the Hard X-ray Imaging Spectrometer, and the X-ray Polychromator, in coordination with the Sacramento Peak Observatory Vacuum Tower Telescope. From the XRB we are able to determine the emission measure of all material at T > 2 x 10^7 K. Commonly attributed to chromospheric evaporation. Volume estimates from the X-ray and Hα images lead to an estimate of the number of electrons in the soft X-ray plasma. Comparison of theoretical calculations of the Hα signature of an evaporated state of the chromosphere to the SDO Hα line profile observations provides direct evidence that chromospheric evaporation indeed has taken place in conjunction with the appearance of the soft X-ray plasma. We have determined the amount of material that has been evaporated from the preflare chromosphere. This leads us to the conclusion that more than enough material has been evaporated from the chromosphere to account for the material in the soft X-ray plasma. Comparison of the Hα images with the XIS soft and hard X-ray images and XMM-Newton hard X-ray spectra shows that the sites of the most intense long-lived chromospheric evaporation, which coincide spatially with the location of the soft X-ray source, are not the sites of the most intense hard X-ray emission. This implies that the dominant driver of this chromospheric evaporation is not direct bombardment of the chromosphere by fast electrons.

15.05 Models of Electron-Heated Solar Flare Chromospheres: P.J. Ricchiuzza, R.C. Campfield, D.C. Driscoll: We have modeled the response of the solar chromosphere