BOSTON UNIVERSITY

Space Physics Seminar
Thursday, March 31, 2016

Some Like it Hot: Plasma Heating and Impulsive Energy Release in the Solar Corona

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Abstract:

The solar corona is hot, at temperatures of ~1-2 million Kelvin (MK) globally and up to ~10 MK above the magnetically-complex features known as active regions. This is 2-3 orders of magnitude hotter than the underlying chromosphere and photosphere, and this "coronal heating problem" remains one of the fundamental unanswered questions in solar and stellar physics. During solar flares, where enormous quantities of energy are impulsively released and explosively converted to accelerated particles and superheated plasma, temperatures can reach yet another ten-fold higher, but the details of these processes and how (or whether) they relate to quiescent heating remain poorly understood. Characterizing these phenomena on the Sun is important to understanding impulsive energy release in magnetized plasmas throughout the universe, but solar variability also holds crucial importance for space weather studies, as the extreme ultraviolet (EUV) and soft and hard X-ray (SXR, HXR) emission from hot coronal plasma is the primary driver of dynamical processes in Earth's ionosphere, mesosphere, and thermosphere (ITM).

Standard flare models typically consider hot plasma as originating in the chromosphere, heated by collisional energy losses from flare-accelerated particles and "evaporating" into the corona. However, evidence is mounting that a significant amount of flare thermal plasma, especially at the hottest temperatures, is heated in situ, directly within the corona, with important implications for flare energy release mechanisms and flare energetics. During quiescence, a leading candidate theory for active region heating is the nanoflare model, whereby many tiny impulsive, flare-like events occur in rapid succession. However, these events are too small to be resolved either spatially or temporally, so it is not known where in the atmosphere the heating occurs, nor hence what physical mechanisms dominate. Consequently, while both flares and nanoflares are likely to be powered by the Sun's magnetic field, a clear connection between these two opposite regimes of energy release has not yet been well established.

We present a brief overview of solar flares and coronal heating, and discuss results from SDO, RHESSI, and other missions using EUV and X-ray observations to study plasma heating in intense solar flares. We present recent sounding rocket observations of the quiescent Sun using a new SXR spectrometer, and discuss the MinXSS CubeSat that will make routine observations with this instrument after its imminent deployment from the ISS. We also review a recent Antarctic long-duration balloon flight to space-qualify new HXR spectrometers for flare observations. Finally, we introduce new mission concepts, including the CubIXSS 6U CubeSat and a larger-scale microsatellite, that will make breakthrough measurements of flaring and quiescent X-ray emission, using both imaging and spectroscopy, for understanding solar coronal plasma heating and its influence on Earth's ITM.

3:15 pm
Refreshments
CAS Room 500

3:45 pm
Seminar
CAS Room 502

Next Week

- Bonnie Buratti
  JPL
- *TBD*

http://www.bu.edu/csp/edoutreach/seminar/

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