Session 6
Influences on Coronal Complexity

6.1 (Invited)

The Athay Paradigm

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Grant Athay recently found a neat articulation of why physically there should be the three discernible layers in the solar atmosphere — the photosphere, chromosphere and corona. He pointed out that the solar interior is constantly spewing out three physical quantities; photons, material motions, and magnetic fields, in addition, of course, to the steady outpouring of extremely weakly interacting neutrinos of no interest in this context. The former three quantities, once created, either escape or dissipate through processes that create those three atmospheric layers, respectively. This paradigm will be the start of my talk to see some global relationships between the solar interior and the active solar atmosphere that physically fascinates all of us. It is high electrical conductivity and astronomical scales that give longevity to magnetic fields and enable them to reside in the corona for extended times, with many physical consequences, but in the end to leave as Coronal Mass Ejections.

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6.2 (Invited)

Coronal Counterparts of Photospheric Electric Currents

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To be done

6.3

Connecting the Quiet Sun Convection Zone and Corona

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We present the latest in a series of simulations designed to directly investigate whether the magnetic field generated by a convective dynamo in the upper convection zone can account for some of the observed properties of the Quiet Sun corona. The simulations are performed using a new numerical code capable of evolving a model solar atmosphere that extends from the upper convection zone into the low corona.

6.4

Solar Torsional Oscillations and their Relationship to Coronal Activity

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Torsional Oscillations were first observed on the surface of the Sun as waves of small deviations from differential rotation, which propagate from the pole to the equator over solar-cycle time scales. More recently they have been inferred from observations of solar global oscillations to occur in the convection zone. Long-lived brightenings in the corona have also been observed to propagate from near the poles to the equator over similar time scales. This paper will discuss the relationship between torsional oscillations as observed on the surface and in the convection zone and brightenings in the corona. We find that there is an apparent connection between these two phenomena that extends from the equator to latitudes as high as 70 to 80 degrees.

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6.5

Ephemeral Bipolar Regions in Coronal Holes

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Coronal holes are characterized by the presence of a large region of unipolar magnetic field. Several studies have found that the evolution of magnetic flux is much faster in quiet Sun regions without coronal holes than in regions with coronal holes. This is equivalent to the finding that coronal holes form where the emergence of new magnetic flux is a local minimum. We study 6 SOHO/ MDI sequences that show one or more coronal holes in SOHO/ EIT. We study the density of flux concentrations and the possible difference between the distribution of the two polarities. We discuss our findings and the implications for the flux emergence rate in- and outside coronal holes.

6.6

Photospheric Source Regions of Coronal Mass Ejections

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Many source regions of coronal mass ejections show signatures of magnetic flux changes prior to the CME onset (Muglach & Dere, 2005). In this talk we present a detailed study of the evolution of the photospheric magnetic flux using data taken with MDI on board *SOHO*. Magnetograms and Dopplergrams will be used to characterize the flux changes that happen in connection with the CMEs. E.g., flux emergence can be easily identified in the magnetograms, but shows complex behavior in Dopplergrams.

References

Muglach, K., & Dere, K. 2005, IAU Symposium, 226, 179

6.7

Coronal Heating, Weak MHD Turbulence and Scaling Laws

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Long-time high-resolution simulations of the dynamics of a coronal loop in Cartesian geometry are carried out, within the framework of reduced magnetohydrodynamics (RMHD), to understand coronal heating driven by motion of field lines anchored in the photosphere. We unambiguously identify MHD anisotropic turbulence as the physical mechanism responsible for the transport of energy from the large scales, where energy is injected by photospheric motions, to the small scales, where it is dissipated. As the loop parameters vary different regimes of turbulence develop: strong turbulence is found for weak axial magnetic fields and long loops, leading to Kolmogorov-like spectra in the perpendicular direction, while weaker and weaker regimes (steeper spectral slopes of total energy) are found for strong axial magnetic fields and short loops. As a consequence we predict that the scaling of the heating rate with axial magnetic field intensity B_0, which depends on the spectral index of total energy for given loop parameters, must vary from $B_0^{3/2}$ for weak fields to B_0^2 for strong fields at a given aspect ratio. The predicted heating rate is within the lower range of observed active region and quiet Sun coronal energy losses.

6.8

Solar Activity and Coronal Bright Points

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Solar cycle variation in number of coronal bright points (CBPs) was studied by several researchers. Still, the reason why CBP number varies inversely with sunspot cycle is not well understood. To explain CBP cyclic variations, some researchers propose the existence of a secondary dynamo operating in anti-phase with the main, sub-photospheric dynamo. Others have suggested that it is a “visibility effect”, when a growing brightness of corona increasingly hinders identification of faint CBPs. Sattarov et al. (2002, Fig. 2) found that in 1998 and 1999, the latitudinal distribution of X-ray bright points (XBPs) showed two distinct maxima corresponding to active region latitudes drifting toward solar equator as solar cycle progresses. The relative number of XBPs was enhanced at active region latitudes, contradicting the visibility effect. Hence, Sattarov et al. (2002) suggested that coronal bright points associated with active region belts form a separate group of CBPs whose magnetic and coronal properties are intermediate between quiet Sun CBPs and solar active regions. Sattarov et al. (2004) found the presence of active longitudes in CBP distribution coinciding with active longitudes of active regions. Later, McIntosh & Gurman (2005) described these two types of coronal bright points in SOHO/EIT data. Recently, studying latitudinal distribution of CBPs Sattarov et al. (2006) found that number of high latitude CBP shows negative correlation with sunspot cycle, while number of CBPs in active region belts positively correlates with solar activity. These recent findings suggest a more complicated relationship between CBP number and solar activity cycle than was previously thought. In this report we present the latest results of our investigation of properties of coronal bright points.

References

McIntosh, S. W. and Gurman, J. B. 2005, Solar Phys., 228, 285

Sattarov, I., Pevtsov, A. A., Hajaev, A. S., & Sherdanov, Ch.T. 2002, ApJ, 564, 1042

Sattarov, I., Pevtsov, A. A., Karachik, N. V., & Sherdanov, Ch. T. 2005, IAU Sym. 223, 667

Sattarov, I., Pevtsov, A. A., Karachik, & Sherdanov, Ch.T. 2007, Journal of Advances of Space Research, (in press)