

Hinode "A New Solar Observatory in Space"

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It is a fascinating fact that a solitary star like the Sun emits intense X-rays from its outer atmosphere. Observations with the Japan-US Yohkoh satellite showed that all the sporadic heating from X-class flares to ubiquitous tiny bursts in the solar corona is due to magnetic reconnection, which generates jets, heats and non-thermal particles. Magnetic fields do dissipate in the solar corona with a time scale 10^{12} faster than that of the classical Ohmic dissipation. Though this leads to an attractive conjecture that the solar corona is heated by nano or pico-bursts as initially proposed by Parker, the precise mechanism for the heating the solar corona and for the solar wind acceleration mechanism is not yet known.

These activities on the surface of the star are driven by magnetic fields created by dynamo mechanism. The magnetic field strength on the surface of the Sun exceeds 1kG, while that at the bottom of the convection zone may exceed 100kG. They are too strong, far stronger than the equi-partition magnetic field strength. We have not yet known dynamo mechanism that can amplify field strength upto the equi-partition field strength, and mechanism to produce field strength beyond that threshold.

The concept of Hinode is that two X-ray and EUV telescopes observe the dissipation part of the magnetic life-cycle, while the visible light telescope simultaneously observes the generation and transport of magnetic field. Discoveries with Hinode include MHD waves in spicules, prominences and on the photosphere, ubiquitous jets in chromospheres, ubiquitous transient horizontal magnetic fields on the photosphere suggesting local dynamo process, supersonic down-flow and convective collapse resulting in super equi-partition magnetic field strength, emergence of large-scale flux rope from below the photosphere, kG-magnetic patches in the polar regions, identification of the origin of slow solar wind, and enigmatic fine-scale flows in the prominence. This talk presents selected results from Hinode and summarizes how the new results from Hinode are addressing these critical questions as well as probing fundamental physical processes that will have applications in many other scenarios across the universe.