A New Angle on Solar System Observational Science

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We advocate the establishment of a program for observing the solar-terrestrial system at right angles to the Sun-Earth line from spacecraft in 1 AU heliocentric orbit. From this unique vantage point, science not possible from the ground or from Earth-orbiting spacecraft can be readily undertaken. For example, in conjunction with observations taken simultaneously from Earth, it should be possible to engage in multi-perspective imaging of various solar structures in order to provide height and location discrimination. Potential science objectives include 3-D spectroscopy of magnetic structures in the photosphere and chromosphere; imaging of X-ray structures, active phenomena, and prominences in the lower corona; measurement of the fast evolution and differential rotation of the upper corona; and stereo mapping of coronal mass ejections directed towards the Earth.

It is clear that major, though highly focussed, scientific objectives can be achieved with small payload packages and at modest cost by taking advantage of ongoing progress in instrumentation and launch vehicles. We discuss salient aspects of current launch capabilities, orbit configurations, telemetry rates, and spacecraft constraints for such missions, and we invite participation in an unfunded workshop to be held November 3 – 5, 1993, at the Space Environment Laboratory, Boulder, Colorado.

3.02

PROPERTIES OF SPICULES

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and
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and
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We (mostly Suematsu) have completed the study of a two-hour spicule movie obtained at BBSO in Hα and Hα ± 0.65Å. Images were reregistered with a correlation coefficient > 0.9. Doppler images produced by red-blue subtraction show a upward radial velocity during the extension phase and downward during contraction. Therefore the spicules are truly moving. The Doppler movie shows that the entire spicule rises and falls as a whole, like a fountain jet. There is only a small relative peak velocity in the middle. Bright points at the bases of the spicules occurred near the peak elongation or the beginning of the fall, and may be unrelated. The proper motion fits a ballistic trajectory well, with initial velocities 30-45 Km/sec and effective downward acceleration between 0.2 and 0.5 solar gravity. The lifetimes range from 2 min to 16 min (average is about 10 min), while the maximum lengths are from 2,000 km to 9,500 km and the average is about 5,200 km. Allowing for the height of the Hα wing background and a typical tilt of 60°, the spicule forest extends to about 4000 km, 1000 km below the top of the chromosphere.

The region observed was enhanced network, so the spicules measured are unusually long and tilted unusually far from the radial; further, there is a tendency to measure the longer spicules. Multiple or recurrent spicules from the same source are also observed.

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3.01

Sunspot and Active Region Chromospheres from Submillimeter JCMT Observations

G. Kopp and C. Lindsey (NSO/NOAO)

We present nearly full-disk images of the Sun in 350, 850 and 1,300 µm continuum radiation made using the 15 m James Clerk Maxwell Telescope on Mauna Kea. These wavelengths sample the solar atmosphere at altitudes above the temperature minimum, giving us thermal diagnostics of coronal structures at altitudes where non-radiative heating first becomes dominant.

We find that the low chromospheres of sunspots are at least as hot as the quiet Sun at the relatively low latitudes sampled by 850 µm and longer wavelengths. Active regions have chromospheres roughly 20% hotter than the quiet Sun. Filaments are not apparent against the disk at these wavelengths. This seems to be because they are nearly the same temperature as the underlying chromosphere (rather than simply being optically thin). Dark "circumfaculae" indicate a cooler chromosphere surrounding magnetically active regions.

3.03

Transition Region Explosive Events in an X-ray Dark Lane Region of the Quiet Sun

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The NRL High Resolution Telescope and Spectrograph (HRTS) and the AS4E Soft X-ray Imaging Payload were launched from White Sands on 1987 December 11 in coordinated sounding rocket flights. The goal was to investigate the correspondence of fine scale structures from different temperature regimes in the solar atmosphere, and particularly the relationship between X-ray bright points (XBPs) and transition region explosive events viewed in the C IV lines at 1548 Å and 1550 Å.

The transition region explosive events do not correspond directly to XBPs. The explosive events appear to be concentrated in the quiet Sun at the edges of strong network, or within weaker field strength network regions. We find a greater number of C IV events than expected from the results of a previous Spacelab 2 HRTS disk survey, but partly attribute this to better spatial resolution with our newer HRTS data. The full-disk X-ray image shows a pattern of dark lanes in quiet Sun areas. The number density of C IV events is twice as large inside as outside a dark lane which is within the HRTS raster area. 4.8x10^-3 explosive events per arc sec² inside vs. 2.4x10^-3 explosive events per arc sec² outside the dark lane. The dark lane corresponds to an old decaying neutral line on Hα synoptic maps. We suggest that this provides an increased opportunity for small-scale convergence and reconnection of opposite polarity magnetic field features.