Observations of the Solar Chromosphere and Corona from the Mauna Loa Solar Observatory and the Coronal Multi-Channel Polarimeter(COMP)

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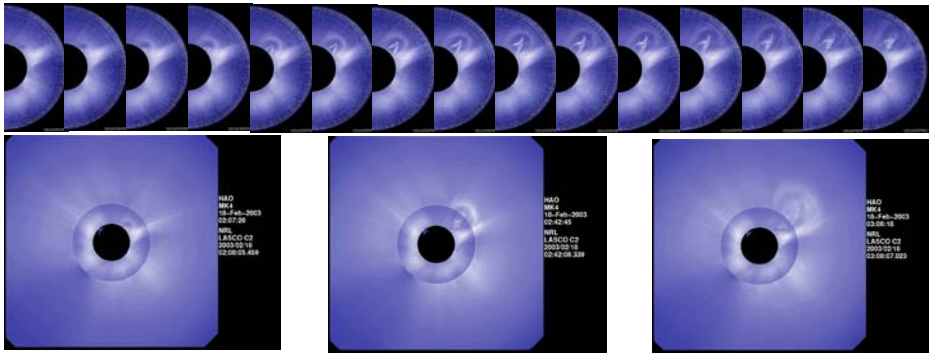
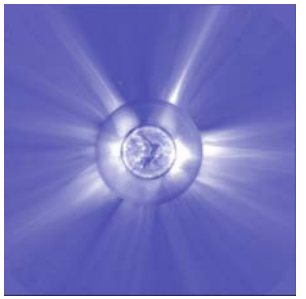
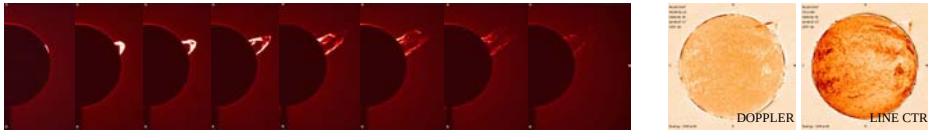
Abstract: Ground-based solar observatories provide critical observations in support of space-based missions such as NASA STEREO and ISAS Solar-B. A major component of these ground-based observations are provided by HAO/NCAR Mauna Loa Solar Observatory (MLSO) and the HAO/NCAR Coronal Multi-Channel Polarimeter (COMP) at Sacramento Peak Observatory. The MLSO advanced coronal observing system (ACOS) records images of the solar chromosphere and low corona that are used to study solar activity such as Coronal Mass Ejections (CMEs), prominence eruptions, flares and associated waves and transient coronal holes, as well as long term (years) evolution of the solar atmosphere. The COMP instrument at Sac Peak provides quantitative measurements of magnetic fields and line-of-sight velocities in the low corona. These unique and important observations can be combined with data from STEREO and Solar-B to provide a more complete picture of the state of the solar atmosphere, and thus help to advance the goal of determining the causes and impacts of solar activity at earth and throughout the heliosphere.



CME of February 18, 2003 as seen in the MK4 K-coronameter (uppermost panels) every 3 minutes and in combined observations of MK4 (inner corona) and LASCO C2 (outer corona) in the 3 composite images shown above. Combined observations can be used to determine CME properties over a wide range of coronal scale heights and provide information on the state of the corona prior to eruptions. MK4 is ideal for observing quiescent coronal cavities which are often seen to exist in the corona for multiple solar rotations and have been observed to erupt as part of the CME 3-part structure. These cavities are consistent with the existence of magnetic flux ropes.



A composite image of the solar corona on December 7, 2000 as seen by EIT (solar disk), MK4 (inner corona) and LASCO C2 (outer corona).

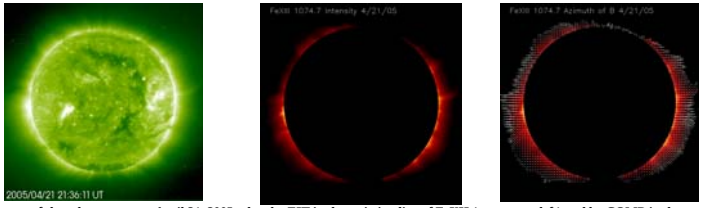


The February 18, 2003 prominence eruption as seen in a sequence of MLSO Hα images (farthest left, in red) taken between 01:51 and 02:42 UT and in He-I doppler and line center (at left) which were both taken at 02:05 UT. The MLSO He-I instrument provides unique observations of prominence eruptions, chromospheric waves and transient coronal holes, while the occulted Hα provide observations of prominence eruptions out to 2 solar radii. All MLSO data are acquired every 3 minutes.

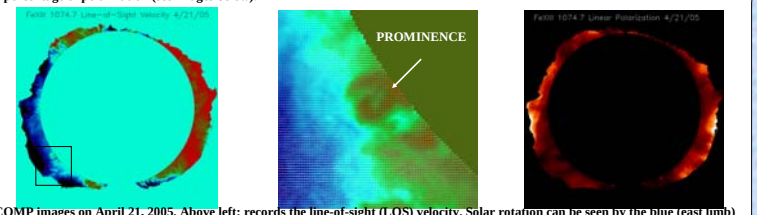
MLSO observations: The MLSO advanced coronal observing system (ACOS) records full disk and limb images of the solar chromosphere in the emission lines of Hα and Helium-I 1083.0 nm as well as white light images of the low corona from 1.12 to 2.8 solar radii, every 3 minutes during its nominal observing window of 1700 UT to 0230 UT, about 340 days per year (weather permitting). The MK4 white light coronameter provides unique observations of the low corona along the earth-sun line, providing a 3rd line-of-sight of the low corona for STEREO and SOHO observations. The rapid time cadence of the MK4, Helium-I and Hα make it possible to measure the acceleration of even the most rapid CMEs and prominences in the low corona, where CMEs form and their acceleration peaks.

COMP: Coronal Magnetic Fields

COMP is a filter-based polarimeter that measures the Stokes parameters (I,Q,U and V) at the 1074.7 and 1078.9 nm FeXIII coronal emission lines (1.7 x 10^6 degrees K) in the low corona and the 1083.0 nm He-I chromospheric line between 1.03 to 1.5 solar radii (see images at right). COMP obtains the strength of the line-of-sight magnetic field component from Stokes V (Zeeman) and the direction of the field in the plane-of-the-sky using the Stokes U/Q ratio (resonant scattering). Line-of-sight velocities are determined from Stokes I amplitudes.



Images of the solar corona on April 21, 2005 taken by EIT in the emission line of FeXII (uppermost left) and by COMP in the emission line of FeXIII (upper center and right images). The direction of the magnetic field in the plane of the sky (POS) has been superposed as vectors on the COMP intensity image in the upper right figure. The length of the vectors are proportional to the percentage of polarization (see images below).



COMP images on April 21, 2005. Above left: records the line-of-sight (LOS) velocity. Solar rotation can be seen by the blue (east limb) and red (west limb) signals indicating motion toward and away from the observer respectively. The boxed region is zoomed in the center panel which shows the full resolution of the COMP (6 arcsec). The prominence displays complex motions in the zoomed LOS velocity image. The vectors once again indicate the direction of the field in the POS and their lengths are proportional to the percentage of polarization. The direction of the field is more complicated in and around the prominence and the polarization is reduced. The image at right shows the linear polarization in the low corona.

All MLSO data are available to the community via our web site:

http://mlso.hao.ucar.edu

A major goal of the MLSO team is to provide the community with daily composite images of MLSO, STEREO and LASCO observations via the MLSO web page.

FUTURE PLANS: NEW INSTRUMENTATION

HAO is collaborating with the University of Hawaii, the University of Michigan and others in the community, to design a meter-class coronagraph dedicated to studying coronal magnetic fields, along with an array of smaller telescopes to acquire supporting observations of prominence magnetic fields, coronal density structures and solar activity such as CMEs and prominences.