Title:

WHI Targeted Observation #2: Origin of the slow solar wind

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Additional authors for synergy with WHI Target of Opportunity #3 Filament cavity campaign: S. Gibson, T. Kucera, D. Webb, D. Williams

Update History:
18 March 2008

Participating instruments and observatories

Targeted (all have not been confirmed)

Space Based:
SOHO/UVCS – campaign contact Leonard Strachan
SOHO/LASCO – campaign contact Simon Plunkett
SOHO/CDS – campaign contact Terry Kucera
SOHO/EIT -- campaign contact Terry Kucera
Ulysses – campaign contact Steve Suess
TRACE – campaign contact Kathy Reeves
Hinode/XRT – campaign contact Taro Sakao (ISAS/JAXA), Alphonse Sterling
Hinode/EIS -- campaign contact David Williams, Alphonse Sterling
Hinode/SOT -- campaign contact Scott McIntosh
SMEI -- campaign contact David Webb
Geotail – contact Masaki Nishino (for analysis)

Ground based:
OOTY Radio Telescope – campaign contact is P.K.Manoharan
EISCAT – campaign contact Andy Breen
NAGOYA –campaign contact Munetoshi Tokumaru
Nancay radioheliograph – campaign contacts AlainKerdraon, Christophe Marque

Synoptic:
SOHO/LASCO-C2/C3 (higher cadence is desired)
STEREO/SECCHI/EUVI/COR1/COR2/HI
MLSO
ACE (SW composition)

Scientific Objective

Our primary goal is to understand the nature and origin ofthe slow solar wind and its relation to coronal streamers. We will characterize solar wind source regions from streamers, including their boundaries and helmet tops. Velocity measurements will be madeusing Doppler dimming and correlation tracking of plasma blobs in white light. Abundance measurements will be made both in the corona and in the solar wind to track the origin of solar wind streams. In situ and IPS measurements of wind speeds will be used to map the slow wind streams from the Sun to the heliosphere.

In the event there is a cavity within the streamer, the lower coronal observations in the core of the streamer will obtain cavity observations.

Scientific Justification

We require multiple instruments in order to track the slow wind from its origin in Sun's lower atmosphere, through the corona, and out to interplanetary space. The slow solar wind, while often associated with the streamer belt at solar minimum, most likely originates from more than one type of coronal structure. The various instruments required have capabilities that are suited for probing the Sun in different observational regimes. Instruments with the highest time cadence are best suited for studies of intermittent sources. Spectroscopic instruments are best suited for time averagedobservations of steady source regions. The strength of the spectroscopic observations is that they can tag the wind by characterizing the kinetic temperatures, outflow speeds, and abundance composition of the solar wind source regions in the corona. Imaging instruments can provide thebest constraints for the magnetic field geometry and also determine electron densities and temperatures. The IPS instruments will provide information on the velocity, density, magnetic field, and spatial distribution of fast and slow wind in the heliosphere. Solar wind instruments on Ulysses andother in situ spacecraft will provide the composition data to make the connections back to the Sun.

Operational Considerations
The majority of the coronal observations will be made off-limb and so the same streamer regions will be observed twice (1/2 rotationapart) with at least one observation made during the main campaign period. The starting times for any solar wind measurements along the Sun-Earth line will have to be shifted in time to correspond to the same periods as the limb observations. The streamer target will be selected just prior to the start of the WHI campaign.

In general, observations will be made within the core of the streamer (and in the cavity if one exists), and in the streamer flanks, or legs.

Detailed Observing Plans per Instrument (may need revision later, based on more detailed inputs from instrument teams).

FOCUS TIME 1600-2000 UT

SOHO/UVCS
The OVI and LYA channels will be used for measurements of line profiles and intensities of H I Ly-alpha, O VI 1032/1037, and other minor ion lines. FOV is 40Õ(tangent to limb) x 28Ó (radial) adjustable from 1.7 to 10 solar radii. Slit width (and spectral/spatialresolution) is variable depending on whether profiles or line intensities are being measured. Exposure times will be on the order of minutes and summed for the desired statistics for eachtype of observation. UVCS will determine kinetic temperatures, outflow velocities, and abundances.

SOHO/LASCO
Polarized brightness (pBs) and brightness images are requested with a higher cadence than the usual synoptics. Full disk images (C2 and C3) are requested.

OOTY
IPS measurements at 327 MHz will be made over the entire WHI campaign period.
Multiple lines of sight (using ~1000 radio sources) will be used to provide 3D views of the solar wind speed and density turbulence.

NAGOYA
Daily IPS observations between 22h and 7h UT will be made starting as possible after 1 Apr. 2008. Approximately 30-40 lines-of-sight per day will be used for each scan. Tomographic reconstructions of solar wind velocity covering the entire range of heliographic longitude and latitude witha spatial resolution element of 1 deg by 1 deg will be made. Solar wind structures from 0.1 to 1 AUcan be observed.

EISCAT
Not yet confirmed. Detailed schedule is TBD. Application for observing time in progress.

NANCAY radioheliograph
Daily observations from ~8:30 UT to 15:30 UT. Observations will utilize 5 frequencies between 150 and 450 MHz (additional frequenciesTBD). Spatial resolution about 1 arcmin (depending on frequency); Time

cadence: several images per sec and per frequency. FOV: full sun images with a 4 Rs FOV.

GEOTAIL
Geotail/MGF (magnetic field), Geotail/LEP (plasma). Exact observingdates are TBD. For approximately 2 days in every 5 days, the Geotail spacecraftstays in the solar wind near the Earth's magnetosphere.

TRACE:
Main wavelength: 171 A
High cadence requested
FOV: 512"x512" -- to include both pointings for targetted instruments (streamer core and streamer flank)
Available from 10 Apr 2008 onward: eclipses in all orbits,from 10 to 30 min. duration

Hinode/XRT:

There will be two pointings, streamer core (or cavity center if present) and streamer flanks.

If target location is quiet: Al/poly - 2 min cadence, with one Ti/Poly, 10 min cadence, and exposure times 16 sec or 22 sec (or shorter if the target is bright). Would also like one thin/Be every 10 min, with long exposure time. FOV to be 512" X 512".

Compression of images to be done with Q=90 (expect to reduce data volume to ~1/3 original), 2 X 2 binning (reduced data volume by ~1/4 original).

When this program is run, XRT will use up to two synoptic periods per day, adjusting for data-rate limitations by modifying the content of the synoptic programs.

Hinode/EIS:

There will be two pointings, streamer core (or cavity center if present) and streamer flanks.

There are two possible studies. We strongly prefer the second.

1) Slot (40" wide slit) study CMEO_SLOT_STUDY [10 Mbits, 4 min], which is a study designed to observe CME eruptions and related phenomena. This would be run repeatedly.

2) A 4.5 hour raster which includes several different cool (TR) lines; this study is GAD002_AR_RAST [130 Mbits, 4.5 hrs], and would allow us to make deep spectrograms over a fairly large (about 300") FOV. This run may exceed the allowed daily data-volume capacity, in which case the run will end prior to completion of the raster. The nearly-complete raster, however, should be of good data quality.

Hinode/SOT:

There will be two pointings, streamer core (or cavity center if present) and streamer flanks.

BFI: Ca II H (3968.5 Ang) full field (200"x100") of region, 5s cadence

NFI: H I 6562.8 Ang. line core at 5s cadence (200"x100")

For the filtergraph observations, implement in "burst mode," with observations at highest reasonable cadence, around ~1 min, for ~10 min, followed by ~50 min idle time; repeat this four times during the four-hour observing window.

SOHO/EIT:

One 284 A, full resolution, each hour + regular 195 CME watch during WHI observations.

SOHO/CDS:
STRE4W. Two pointings, streamer core (or cavity center if present), streamer flanks. Overall mosaics should overlap with Hinode-EIS spatially and temporally as much as possible. If Hinode time is limited, however, (e.g. to less than than the time needed for two iterations of STRE4W) CDS should ensure sufficient time is spent on each pointing even if exact temporal overlap with EIS is not possible. Preference should be given to overlapping temporally with the core rather than flanks in such a case.

STEREO/SECCHI
No special requests made. STEREO/SECCHI/COR1 and EUVI synoptic data is desirable.

SMEI
SMEI will try to reserve the time period of campaign observations (1700-2000 UT minimum, 1650-0230 UT maximum) as "no=cal" during the campaign.

MLSO
TBD. No special requests made.

ACE
No special requests made.