STEREO SWG @ Berkeley UCB
15-16 December 2003

Proj Introduction : Mike Kaiser

New Organizational Chart at Project:

Nick Chrissotimos has replaced Haydee
Jim Adams as Dep Proj Manager
Mike Delmont as Dep Proj Manager for Instrument
Pietro Campanela Dep Proj Manager for Resources

Mike Kaiser new Proj Scientist (replaces Joe Davila)
Terry Kucera as Dep PS
Bill Thompson as SSC

Larry Christianson retiring in January.

HQ: Eric Christian is the STP Program Scientist
Joint with Lika on the STEREO Program Scientists

STEREO Status
Nov 2005 launch
Overbudget by 5 to 6 % level
Meet GPMC on Jan 5th (Monday)
Meet w/ HQ on Jan 12th

Russ Howard – thought meeting w/ HQ not until 20th (?)

Descopes not being recommended by Project
- too disruptive to science goals
- not enough savings
-

External launch delay threats:
Thruster valves (15/24 to be reworked)
Launch vehicle preparation time (24 months shorter than 30 months Kennedy/Boeing prefers). Last Thursday, Project had meeting with Kennedy/Boeing.
Lack of FY04 budget – continuing resolution. Get money based on 80% of last year's rate.

Mailing server
Stereo-swg@listserv.gsfc.nasa.gov
List of who is on: mail to
majordomo@listserv..
Who stereo-swg

EPO Activities
Met with Goddard Visualization studio – Rachel Weintrab
Leslie Cusick – EPO proposals are being reviewed – decision by end of year. STEREO vs. STP in question.
New poster and booklets
SSC setting up parallel web page (Emilie Drobnes) but overall EPO funding source.
Possible EPO workshop at Hamburg Planetarium, Spring 05.

NASA HQ: Eric Christian

Things are not as rosey as Mike indicated. Can handle current cost projections, but cannot handle additional increases. Descope by schedule – if you are late in delivering, may fly without you. MK – if slip to Jan 05', for a 1M$ insurance can insure same price tag for coming year. Kennedy cost 1.2M$. Marching army is 6M$ per month.

Janet – under what conditions are a cancellation review would be called?
EC: because over cost cap, could be called at any time. Right now, no plans for Termination Review.

Janet – heard at AGU, STP does not have a big science program for the larger community to become involved. What is the best strategy? EC: put in GI proposals – does not have to be flying mission (?). Right now STP is a mission line. LK: be careful in checking the wording of the RA. Chris Russell: colleague had proposal rejected out of hand because it involved ongoing mission (Cassini).

SSC Plans -- Bill Thompson

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301-286-2040

SSC performs:
- Collecting telemetry and processed data – archives it. Connected to Joe Gurman's group.
- Receives beacon data, processes it, makes available NRT
- Focal point for science coordination
- Focal point for EPO
- Can act as focal point for s/w coordination.

Data Flow/SSC Block Diagram
NOAA SWx Antenna Partners – interface modeled from ACE and Wind
DSMS – MOC (APL) SWx, RT SCI, Level-0 data, mission data (20 day archive)

Space Weather Beacon Processing
SWAVES – IDL package

SECCHI – C to assemble image, IDL to decompress
PLASTIC – IDL code
IMPACT – C code

Discussion: Beacon data packets are also included in the Level-0 packets. Question on whether old data should be pre-processed if algorithms are updated? Teams can do this on their own from L0 data and resubmit to SSC (ABG). Janet – key parameters will be provided for in-situ, to supercede the beacon data (browse, nrt). Russ – intent is to have same such for images. Janet – at NH SWG, talked about such a browse tool.

Current status:
Amy Skowronek and Marc Despres from SOHO are working on programming. RT throughput test in the MOC in January 2004.
Emilie Drobnes is working on website design. Draft text is currently available for comments. http://stereo.nascom.nasa.gov, internal: http://stereo.nascom.nasa.gov/intranet
User SSC pw STEREOSC

S/W tasks: R/T telemetry ingest from MOC – also via FTP transfer; antenna partner ingest; tlm processing; data ingest from instrument teams; data management; web services.
Working with PERL. MYSQL.

What do they need from us:
What formats will data be in?
SECCHI fits; IMPACT CDF, ASCII, binary flatfile
Any example data files or tlm files available
What s/w to process beacon tlm? SWAVES idl; SECCHI idl/c, PLASTIC idl; IMPACT C
What s/w will be used to analyze the data?
What should appear in the catalog? What kind of queries should be supported?
When will first generation s/w for processing beacon data be delivered to SSC?
Each instrument should designate a contact person to discuss s/w and data flow issues.
For PLASTIC – Lynn Kistler. SWAVES – Keith Goetz. IMPACT – Peter Schroeder, SECCHI Bill knows.

Draft timeline – something from PLASTIC needed by 9/04

What do we need from SSC? S/w coordination and distribution; coordinate transformations? SPICE? Data Cataloging, VSO (search criteria, data visualizations) science coordination.

Discussion: There is now an IDL toolkit for SPICE. The Project is using SPICE. EC: don't forget VHO. Important to have a non-interactive way to access the data. That does not involve clicking buttons, filling in forms, etc.

Bill is envisioning a weekly telecon. For both data and commanding issues. SSC is required to help manage the resources on the s/c. Questions about need for weekly. Russ says certainly need it for s/c maneuvers.

Coordination needs: Momentum dumps about every 4-7 days. Rolls for calibration (MAG, SECCHI). SECCHI wants 30 deg steps, and staying. MAG wants continuous. UVI may want to collaborate with Solar B. CStC: Campaign – meant in terms of getting additional telemetry (planned for 30 days in early part of mission – requires extra downlink that has to be paid for). CStC – daily log from FOT on s/c operations and data loss intervals. But also need something for instruments. Adam Szabo wants time:event log. Russ suggests compatibility check early in the mission. Bob Wimmer – should also talk about cross-calibration opportunities across instruments. Tycho – mentions need to do this for cross s/c also. Russ: will BT set up these coordinating aspects? Bill, ok.

Operations Working Group Meeting – APL would like to hold meeting to follow up last March meeting. Focus would be on allocation of resources.

Early Operations – Bill Thompson

Telemetry constraints during early operations – tlm rate is restricted during phasing orbits. MK: third week is changing for the better. By Sept 2004 – need the instrument tlm requirements.
Week 2 is the main problem – only get 30 kbits/sec, 8 hrs per day downlink. 9 kbps for R/T for instruments. 220 Mbits/day. LK: is this per s/c , and at same time? Yes per s/c, probably same time – no one has looked.
Week 3: 96 kpbs , 3 hrs. 30 kps available R/T , 220 Mbits/day (to 1st lunar swingby, which is day 55 after launch). After 1st lunar swingby this is alleviated.

Constraints: tlm takes power (during delta V burns), 1553 bus schedule. EA mode checkouts (instruments must be off), and increased tlm as each instrument is turned on.

No instrument commissioning activities will be conducted +/- 18 hours of maneuver, about once a week.

Possible Scenarios

Most favor option 2 – data taken a reduced rate during out of contact periods, and much higher during RT passes. Most used for commissioning activities, rest for dumping SSR (mainly HK and maybe Beacon). Also may get priorities based on who is commissioning then.

Would like draft telemetry budget by Jan 30th 2004, to get process started.

Unresolved issue is whether the instruments or the s/c have to manage the tlm flow? APL does not want to do it.

ABG gave PLASTIC presentation, and emphasized that power on is only contingent on the IDPU being commissioned, and need to be commissioned ASAP in order to have minimum 2 weeks, maybe 4 weeks (Carrington Rotation) before s/c split up.

SCIENCE Discussion – Rob Wimmer as moderator

Discussion on when the next science workshop, maybe on the Friday morning or the Monday beforehand of the LWS workshop. March 23-25, 2004 in Boulder CO.

Markus Aschwanden (LMSAL) on 3D imaging with STEREO.

Philosophy:
Sci question expressed by quantifying observables
Development of data analysis tools
- Pattern recognition ("finger printing")
- 3D parameterization of field lines
- Reconstruct time evolution B(x,y,z,t)
- Measure footpoint convergence
- Measure vertical motion h(t), v(t), a(t)
- Fit theoretical model of h(t) to data

- Loss of equilibrium model by Forbes & Priest (1995)
- Magnetic breakout model by Antiochos (1999)

- Tools needed:
  - Automated pattern recognition
  - Forward fitting, constrained by second STEREO image – biased by model used
  - Inversion – get out the 3d distribution of the image observable parameters, but this may also include assumptions. Choice of 3D model method: 3D tomography, 3D pixon reconstruction.

- STEREO timing: small stereo angles (1st year, < 45 deg) most suitable for stereoscopy. Large angles (2nd year, < 90 deg) better for volume tomography. SOHO EIT could act as a third eye. Also TRACE. Solar B is more x-ray (not as appropriate). For HI, SMIE is in polar earth orbit, planned to be active for 5 years.

Interfacing 3D images: SECCHI, HI, SMEI, SDO

Automated pattern recognition for finding tie points (Paulett Liewer and Eric de Jong).

Discussion: Joe Devila, this is from a solar physics perspective – people here may be interested in more global science. Janet – for example related the SMEI smudge into the insitu signatures. http://cassfos02.ucsd.edu/solar/smei_new/analysis.html.

Example – shock identification, particle acceleration sites. JD: Tracing ions back to SECCHI data, what are in insitu looking for? Janet, coronal holes, active regions. RWquestion/JD responses: Coronal graph goes directly with density. HI as a factor of 2 (8x emission results in factor of 4 density increase). AZ – but interplanetary really more like x2 density increase. Janet, critical height in coronal 2 – 10 solar radii for SEP acceleration. So how well can SECCHI do shocks at 2 Rsun? Dave Webb/Russ Howard: good question. Where is shock located? At leading edge or above the leading edge. MK – triangulation from the radio emission (30-40-50 solar radii).

Webpages:
http://stereo.nrl.navy.mil/html/3dindex.html
http://sol.oma.be/SECCHI/
http://sol.oma.be/SIRW/
http://secchi.lmsal.com/Science/
http://star.mpae.gwdg.de/secchi/index.html

Chris Davis – HI simulations for getting out useful images.

HI image simulation, including noise effects from planets and stars, "blooming", cosmic rays, F corona, the PSF, stray light, saturation, non-shutter operation. HI2 has an occulter to mask Earth and Moon. Do not want to remove NEOs.

HI could contribute to beacon data. SECCHI has 7 256x256 images per hour. HI would like one HI per hour (alternate between HI1 and HI2.

Discussion:
Janet remarks that Co-rotating interaction regions also have density pileups, and how that would look for SMEI, HI – especially if CME also launches through the CIR.
Bob Wimmer mentions that it would be good to overlay an image of earth's location, to help the user get oriented.
Dave Webb – uses Rice compression to bring the SMEI data down. Using 128 x 128 images.
For SMEI the data latency is 24hrs. NOAA says that AirForce says that is too long to be used for forecasting. STEREO level 0 may also be at 24 hrs. Beacon data is what is available more timely.

Doug Neudegg -- HI Scientific Operations

Operations document for HI is located at http://www.stereo.rl.ac.uk

SECCHI will have different operational modes depending on what type of science questions they want to look at. Have 15 scenarios so far.

Bill Thompson – VSO

Steering committee – Todd Hoeksema, Joe Gurman…

What should it be? Distributed, allow searches for and access to data from multiple missions without intimate knowledge of the data organization; provide access to s/w, instrument descriptions; easy to add new data sets.
http://virtualsolar.org/
and http://vso.stanford.edu/

Adam Szabo – VHO (Virtual Heliospheric Observatory)

Is a thin middleware layer that allows uniform, user=friendly data discovery and query on existing and future SEC Heliospheric data sets.

Meta data
See what the PI sees
Have access to the same tools

Metadata development – requires a dictionary will use SPASE+
Automated data exchange – allows version maintenance, allows cross calibration; allows merged data sets.
Develop tool library
Prototype it on a small number of existing data services.

Connect VHO to VSO and other VxOs to eliminate duplication.

HelioSoft tool library. Uniform data model.

Bob W, EC : ancillary data like s/c trajectory is important.

Satisfies NASA open data policy requirement.

Enable existing data service sites to achieve common goal. Minimal incremental funding required (he says).

Will have peer-reviewed process to decide to what to put in.

Peter Schroeder for STEREO. Fred Ipavich for SOHO insitu plasma.

http://VHO.nasa.gov

Discussion: ABG – asking about the peer review – AS: can always give data for free, and this will be expected from the STEREO teams. But older data sets may need money to make data set usable. ABG noted that the VHO submission is not a STEREO requirement – need to ensure that the submittal to SSC is the same as for VHO so that there is no increase in effort. Paulette Liewer – need to insure that VHO and VSO do not end up segregating the in-situ vs the solar imaging on STEREO.

General Concern: have been working hard to find a way to integrate the solar imaging and the in situ, by combining them at the SSC and working on combined browse, and both residing in SDAC/VSO. HQ wants to split up the data sets into "separate but equal" VSO and VHO. Good for the Heliospheric community, but not necessarily for STEREO mission objectives. Need to make sure that supplying to VHO does not create schism. [As the NSSDC CDF vs. SDAC FITS did in SOHO community.]

Russ Howard – Electron Scattering Function
Explaining what the intersecting ray paths of HI & COR1 observations on the two s/c helps to yield. Also use of HI1 and HI2, with different FOVs.

Pixons – reconstruction algorithm that allows pixels to adjust their size to become larger if there is less information content [like an adaptive grid].

Dave Webb – Solar Mass Ejection Imager (SMEI) First Results & Capabilities

http://www.smei.nso.edu
http://www.vs.afri.af.mil/Division/VSBX/SMEI.html

Running difference images (one orbit subtracted from next in sequence)
Launched 6 Jan 2003, piggy backed on Coriolis mission (navy) from Vandenberg AFB
Cost 10M$ for the instrument. Mainly Air Force, so requirements were very minimal.

Have Observed:
68 CMEs, 3-5 Earth directed.
1 comet, 1 asteroid, auroral light when Kp>4

YR 1. Calibration, data processing, develop techniques. Data latency (photon – ccd-afrl) is 24 hrs.
YR 2-5. Hope to have data latency in 6 hrs. But there will be fewer telemetry contacts than in first year - challenge.
Some CCD pixels are overheated, and are hot "flicker" pixels, adding to the noise.
Right now the CME identification is completely subjective. Very difficult pattern recognition.

Day 2: 16 December 2003

Paulett Liewer – Stereographic analysis of coronal features
Use of triangulation to determine the 3D location of a point seen from two known locations. Tiepointing tools. Use commercial s/w ENVI or JPL developed tool. XYZSUN for planetary processing.

Use prominent feature – like dark area, to use as a tracking feature..
Now working on using concepts of direction and directionality. For each pixel, find direction which minimizes change in intensity regardless of intensity. End product is a

file of pixels for corresponding segment / feature in 2nd image. Locate pixel in 2nd image correcting for solar rotation (SC motion). Search around this pixel for a pixel with a "bar code" with a high correlation. Showed example from TRACE where images were about 1 hour apart. Successful tests with TRACE 15 minute and 1 hour separations. Test with 2hr separations identified very few common features.

Discussion: ABG: examples are only an hour apart – is this for each single s/c or is it expected to work for s/c separated by large angles (like STEREO)? PL: Plan to use this for the two separate s/c (up to 45 degree apart). Do not have any data to test against. Paul Kellogg suggested they test with a modeled feature that looks different from two sides. Russ Howard suggests getting an intricate wire (table) model of coronal loops from Sara Martin. Janet L: also have global MHD simulations.

Computer language is called VICOR (developed by JPL).

Russ: one technique is to assume a structure and then modify it to fit the observations. PL's technique is good in that it does not pre-assume any structure. Tycho – what is main science use? PL: to correspond with magnetograms before and after flare eruptions. Dan Moses (NRL): has higher hopes for white light coronagraph CME images than for EUVI loops. Bob W: how does this relate to in-situ? Joe D: do a time series to determine if heading toward A or B? JL: we know that there will be a lot of evolution from COR to s/c: need to bring in the MHD modelers. DW: problem is predicting the trajectory and the velocity. AZ: it is not always clear if we will see the filament material at in-situ? What is the relative position – off center, for example? RH not always seen in C3 (DW – that's because by then it is all ionized). RW: that is where PLASTIC can look at the ionization state. So it would be nice to know if it is going to hit. RH: if they give JL's modelers a density model, what can they do? JL: they need to input a pressure pulse. Doug Biesecker: all this modeling so far is not done in real time – very time consuming. RH: they cannot take a density profile per se, but need to put in a driver. May need to create a 3D velocity model (using tie points to track features and therefore may a velocity field) – and then give these to the MHD guys. RH therefore thinks that the 3D density distribution is not sufficient for the MHD to do anything useful. AZ: can a simple model for the magnetic field be input. RH: would be useful, does not currently exist. PL: believes the bi-directional electrons will be most interesting in situ to look at what field lines are still connected to the sun and compare to models. DW: notes that the velocity fields will not be that good early in mission with the minimum s/c separation. RH: they will be more halo-like, but hopefully can still use the tie pointing to features in the halo. HI's will not be effective for earthward CMEs until the second year. RH: up to 30 Rsun, have not seen where the CME decelerations (as seen at 1 AU by in-situ) occurring. The HI's should be able to tell us where is this occurs. Dick Mewaldt: can use low energy particles as precursors to shocks (foreshock) to give about 12 hour notice. George Ho has been developing an algorithm. DW: and don't forget S/WAVES.

In situ

Stuart Bale – using Cluster to show multi s/c data sets.

Four spacecraft fairly close in spatial. Small scale stuff. Density like vs time at shocks (actually s/c floating potential). Plot shown show 5 times per second. For impact, one per second, same for field values.

Planer boundary/structure: V, Normal(direction) vectors. Compute cross correlations between different s/c. Usually of derivatives. Xcf vs dt(secs) Peak gives optimal time delay between s/c. Then plot vs time minus dt (s/c).
Also know relative position vectors between the s/c.
R12 * normal = V delta T12
Etc

Can determine thickness of shock. Found that the thickness is an ion scale – that are trapped in the shock front. The convected ion gyroradius. [not the ion inertial scale – can distinguish if look over wide range of mach numbers.]

Discussion. SB: Stereo – two spacecraft, best work will be when closely separated. AZ: this technique will not work at all. Even for ACE and Wind, which are close – but this does not work. Probably cannot assume a planar surface. There will be bumpiness, different speeds, etc. Have to use RH relations. Then start looking for correlations. Strong shock from fast CMEs tend to be rigid and straight, while weak shocks then to have much more variability. AZ: have about 150 IP shocks from ACE and Wind. Quality of measurement is the most important. Anisotropy in protons, also need the alphas – makes a big difference from 4% assumed vs. 8% due to mass contribution. Need the electron temperature. RW: how good? 1 km/sec for speed. 5% on density. PK: also depends on time resolution, because changing very fast, so that is going to increase the delta in measurements. DM: how good is your fits? AZ: Five degree uncertainty in normal calculation. Speeds 5-10 km/s (best case). AZ: would like to do flux rope fits between two s/c. There the error bars are bigger, so they fit both s/c better. There could use the third dimension. DW: when looked at with Wind and NEAR, the cylinder model does not fit well. JL: force free does not work. AZ: hopefully will have the statistics and see where the deviation starts to occur. JL: will depend on how busy the stream structure will be. DW: how many flux ropes in solar minimum. AZ but at least easy to see. BW: can we use the HI data to see the connection with in situ? JL : somewhat pizza shape – flat circular. AZ: if high speed stream pizzo model shows pizza will curve.

Lynn Kistler – Cluster multispacecraft data – lessons learned

Cluster has high requirements for micro physics limit, while stereo more like ISTP, more like measuring same event in different places.

Best time to intercalibrate is when the s/c is in same location, and instruments are operational. Most orbits appear to be in the magnetosphere. The nominal first day

launch gives most in the magnetosphere. MK: if launch is delayed by 5 days, will completely shift. LK: when will the 3 hours be? MK: mostly at apogee, not at perigee. Once the intercalibrations have been done, need to track relative calibrations as the detectors change with time.

SWAVES will not be as good as WAVES because of shorter antennas. Better at higher densities. Paul K: can use Lamour waves upstream. Can get high resolution for short periods of time. LK: start early and make the cross-calibrations regularly (on same s/c) during mission. RW: should we have a cross calibration working group. Paul and Stuart on SWAVES. ABG: need to cross calibrate not just the solar wind parameters, but the energetic ions (like PLASTIC and SIT). Tycho – SIT will not open door until in heliocentric. JL: seems like don't need a group. That it is only needed for the early ops. Tycho: right now getting turned on for early calibrations is completely up to APL. Bill Thompson – need to get a clean up of the early timeline that APL is using.

Sam -- electron data

IMPACT electrons will have SSDs down to 2 keV, therefore very good signal to noise. Compare with SWAVES radio emission. Data looked at with WIND. Case study Dec 6, 2000. Onset times at 1 AU, vs. inverse velocity and correlate with solar release time from plasma waves. Waves occur whnen the 2-5 keV electrons arrive. They conclude that the electrons seen at 1 AU are producing the type III burst. Other events show the timing is off, and therefore not producing the type III. April 1997 event. Think this is because the EIT flare site was more central-east. Usually get good data from solar west connection. Thinks it takes about 30-60 minutes for the coronal shock to reach W60deg. So it may show the time it takes for the wave to reach 60W. So for STEREO may see one s/c well connected, while the other s/c will see the delay. RW: how often will it be seen? MK: these events are not rare. JL: one thing we have to discuss how to merge with SWAVES data. Tycho – 3DP on Wind does this (this was what Sam was showing).

Janet Luhmann – connecting models to sw geometries

Dusan from Boston has some assumptions for 30 Rsun inputs. Movies of case studies. Injects pressure pulse.
http://sprg.ssl.berkeley.edu/~jgluhman/stc/comps.html

Discussion: RW: can we invite the modeler's to the Boulder meeting. Janet is urging money from HQ. EC (HQ) - will look to make sure allowed in SR&T.

Dick Mewaldt – overview of ACE energetic particle events during Oct-Nov 2003 (Halloween events). Low energy (1 MeV/n) are locally accelerated at shock – showing peak at the shock. Higher energy (15 MeV/n, 60 MeV/n) ions peak earlier. Oxygen fluence spectra from 100 MeV/n down to 0.4 MeV/n – integrated over the event. SIS combined with Glenn Mason's low energies ULEIS. RW: will have energy dependent structure. DM: integrating over whole event, they agree for heavy ions. Low energy oxygen can get trapped behind the shock. After the shock see spectral breaks at 10

MeV/n, dependent on species. E-1.4 vs E-4 power laws. Have some charge measurements from SAMPEX. Q/M dependence vs. Ebreak, log-log. Fit gives 44*(Q/M) ^1.60, theory says should be (Q/M)^2. 44 MeV for protons, theory gives 60 MeV. Protons make the waves, heavies react to the waves. Can deduce temperatures using the charges using Arnould (sp??)and Rothenflug. Large variations from event to event. Seem to correlate with ACE/SWICS. Iron T~ 1.6 MK before shock (day 302) changes to T~ 4-5 MK after shock Days 303 – 306. RW: PLASTIC will measure same type of ions as SWICS. DM: still controversial as to why there is an energy dependence on charge state. Chris Cohen – does STOF have some data to look at? JL: how does this relate to STEREO? DM: can see the sw from 45 deg off from the parker spiral. Is it only shock accelerated, or flare mixed in? So will see different combinations from different s/c aspect angles (Hilliary Cane hypothesis). Also want to compare like Mazur shows with ULEIS data (drift plots), showing dropouts in field connection – compare signatures at both s/c.

Dave Webb – discussion lead for "combining images and in-situ data"

Doug Biesecker - Beacon status
Ground station network – no signatures on the bottom line yet. Ahead of ACE at this stage. Probables can give us the needed coverage. NOAA Fairbanks, NOAA Wallops, RAL (UK), CNES (France), and CRL (Japan). Near probable is ACRES (Alice Springs Australia), but there are competing projects. Possible is USAF (California), NOAA Boulder. Others contacted, but no response -- Brazil, Canada. ACE will have priority over STEREO on ground receipt at RAL and maybe other sites.

Discussion: MK & JD: ESA is (maybe) interested in whole data stream, but not for the Beacon data. Southwood has blessed the idea, and it is now in committees. Need to talk to Bernard Fleck.

Turbo encoding has cost (56K$ to JPL for decoding s/w, plus additional costs for equipment at ground stations). Can live without Turbo for at least 3 years: 6 m good for 3 yrs, 9m for 4.9 years. Turbo gives an additional 9 months.

Ready for s/c beacon mode telecom testing maybe in January 2004 (?). APL will record on DAT tape and sent to SEC. Fake packets, nothing needed from instruments.

What SEC might do with STEREO data
Geomagnetic storms: CMEs, high speed streams, solar wind properties
Long Term forecasts:
Lots of potential improvements.

<u>CMEs</u>
Currently SOHO/LASCO
Halo CME: 1-3 days of advance warning. Uncertain hit or miss estimate for "partial" halos. Error of +/- 11 hours in arrival time and rough estimate of intensity and duration. Uses Gopolswampy scheme.

With STEREO still 1-3 days warning, but more reliable hit/miss prediction. Maybe arrival times to within hours. Want to know when back of cloud is arriving -- gives improved estimate for storm duration.

Recurring High Speed Streams
Currently for first time stream, estimate from longitude of the equatorial CH. For recurring, use previous occurrence and changes in CH since then minus 27 days. STEREO Lagging s/c will have actual observations a few days before.

Solar wind discontinuities and more
Currently Insitu observations at L1 , 1 hr warning of n,v,B
STEREO – may provide 1 day warning of V, B -- Weimer et al (2003)

Long term forecasts
Current up to 7 day lead
STEREO – 14 or more day lead
EUV flux, new equatorial CH, new active regions, level of flaring activity

Far Future
STEREO will be of limited use because of short mission lifetime. Hope to use as proof of concept for a NOAA mission at L4.

What we'd like to see in the Beacon data. Non imaging data desired, high SWx forecast impact and low impact on telemetry. Image data has tradeoffs – high SWx forecast impact, high impact on telemetry.

SECCHI Space Weather Channel – 500 bits/sec
Original CCD image is 2048x2048. Need compression.

RH: Compression rate is built in. Want to see low signal (low contrast feature). One possibility is to put up some kind of background image before compressing. Looking at on board detection, save telemetry until you detect/define something. DW: also discussed HIs – somehow need the subtracted image (done on ground by SSC).

Example CME related geomagnetic storm:
Did a CME occur (COR2)? Is it Earth directed? When will it arrive? How long will the storm last? How strong will the storm be (get from ACE, but only for about half hour in advance)?

Has draft SECCHI observing plans;
Hourly plan has 7 256x256 pixel images
Hourly plan 28 128x128 pixel images
Right now only EUVI, COR1, COR2. Missing HI.
RH: these are just samples, and can process real data that night anyway.

Suggestion:

Hourly plan for 7 256x256 pixel image
00 minutes COR2, HI1 or HI2
15min COR2
30min COR2
45 min COR2
Provides 4 images of 2500 km/s CME (fastest) and reliable velocity and acceleration determination.

DW: surprised not to see EUVI on this list. DB: official flare detector satellite is the SXTI experiment. ABG: how about EUV images for the flares beyond the west limb, for those energetic particles that are well connected beyond the limb? DB and guy in audience: the EUV beacon snapshots will be hit or miss on seeing the flare anyway.

Beacon questions: Observing plan, non image data (e.g., cosmic ray counts from HI scrubbing, brightest pixel in each 64x64 block), do we generate SW beacon images when we don't know someone is listening? Apparently this is still in SECCHI discussion, as Dan Moses and RH seemed to have different answers. RH says that actual tests on flight hardware CPU processing time, that there is excess capacity.

JD: For 3D images, there is a new computer display that has two screens or prisms or something that allows 3D viewing without the "glasses".

ABG: what is the latency? DB: about a minute from station to SSC. ACE is 5 minutes to the public. DW: what kind of format for in-situ is wanted by SEC? DM: have viewgraph showing for particles. DB: got inputs already from each team. BT: does SEC just look at web at SSC, or do they pull data? DB: pull the data. JL: how is insitu used? DB: increase in low energy protons at ACE shows that a storm is coming (I suspect means shock that can cause a storm) about a day ahead of time, and that it will hit earth (ACE at L1). Chris Cohen: George Ho's algorithm does not predict strengths. DM: some launches worry about energetic iron for SEU's so look at Fe/H ratios. DW: space weather group should look at images to be included in SECCHI beacon data, but also how to display in situ data. DW: what is the deadline for deciding these beacon issues? MK: when is SIM2 scheduled? BT: January 2005. By then the s/c has to be producing beacon data.

RHESSI - SolarSoft

Interested in combining data from different instruments. Developing tools to combine images. Example TRACE with RHESSI observations. X-Y solar region plots. Overplots of energy and time series. Same in time series and energy domain.

Mike Kaiser – WAVES and shocks

http://www-lep.gsfc.nasa.gov/waves/wavesII.html is a catalog of possible Type II an IV radio bursts observed by Wind/Waves in 2003.

Both Wind (1 AU) and Cassini (at 9 AU) track same Type II features, even with s/c 62 degrees apart. Looks like type IV is tightly beamed. Will also see the events as they engulf s/c will be able to see wave fluctuations (densities). Can detect shock down to 2 Rsun, with very crude strength estimate. Have seen shocks with starts as high as 10 Rs or even 90 Rsun.

Dave Webb -- CIRs/Streamers

JL: there are prediction code models for the CIRs which could embed the STEREO data. Effectiveness is mainly a function of speed, somewhat of southward Bz.

Dave Webb -- Miscellaneous

Incorporating 3D models: Cook-NRL

Incorporating data from other missions: SMEI, Solar B (B field), TRACE, SOHO, Wind, ACE, inner Heliospheric missions (< 1 AU), such as AF Sentry mission. Messenger.

JL – don't forget ground based, such as SOLIS magnetograms. GONG capability.

Space Weather
Not just beacon! I/F with geospace. Forecasting vs. "real" science. SECCHI SW group, web site --- SSC.

Bob Wimmer – Other Items

Put talks, including Paris WS on SSC web site, attendance list too. Also talks given here. So BT wants them emailed to him and/or MK. Right now only on internal site.

JL: would be nice if the website had a webmaster to make it user friendly entry assistance and pointers.

Planning science campaigns

Next meetings/SWGs and their format
RH: planning a session for solar physics division
PL: how about AGU session 3d modeling for multi spacecraft missions. Add Marcus and Janet. ABG: There is a solarB/STEREO COSPAR session. AGU Spring 2005, with STEREO SWG in Hamburg, with an EPO special session at the planetarium.
Boulder LWS, connecting meeting either Monday or Friday. JL says Barbara T. thought Monday was better. JL would be inviting modelers. There is an ISSI CME workshop the previous week (March 16-20th). LWS is March 23-25th. Question about when/if the space weather group should meet during LWS or at Space Weather Week or at all?

ABG: Would like some window into what is going on at s/c. JD: Would like to see the monthly reports that project sends out? MK says, why not?

SSR instrument/mission/science papers
Start writing about time of delivery, submit 6months later?
Tycho: Science like papers usually come out of a workshop held about a year before launch. BW: should include modeling papers. BW: how about a table of contents.

Example TOC:
Mission Science and Orbit overview
CMEs in general, Spacecraft and FOT
Each investigation given a chapter (order TBD)
- **SECCHI**
- **SWAVES**
- **IMPACT**
- **PLASTIC**

SSC: Data flow & EPO
Space Weather
Modeling
3D visualization techniques (?)
Public Data Access and Usage (?) – could include VSO & VHO (?)

Post-first-CME press conference material.
This would not occur until after SECCHI commissioning, when both s/c are in heliocentric orbit. Should bring ideas to next SWG.

Early Ops working group / cross- and intercalibration plans.