Introduction
The Helioseismic and Magnetic Imager (HMI) investigation contract (NAS5-02139) between NASA and Stanford University has been in place since 27 September 2002. As of this date the contract has been modified 55 times.

The development of the HMI flight instrument was subcontracted to the Lockheed Martin Space System Company at its Lockheed-Martin Solar and Astrophysics Laboratory (LMSAL) in Palo Alto California. This subcontract is nearly closed with final disposition of parts and final billing remaining. The monthly (or bi-monthly) report for E/PO activities is also “attached” to this report. All periodic reports are available at http://hmi.stanford.edu/Status_Reports/. The quarterly reports from science Co-Investigators are also available and are considered to be attachments to this report. These monthly reports are written a week or two into the following month and include some status as of the date written. This section of the monthly report is written on 19 April 2011 to cover the activities at Stanford University in support of HMI and JSOC-SDP for March 2011. This report will continue in the style used during development until the LM subcontract for phase A-D is closed.
Status and Activities during February.

Administrative Issues:

We apparently can not convince LM to do as was contracted and give us the final bill shortly after the end of Phase-D, which passed by 9 months ago. It is our understanding that if LM rates change for the time of the contract that we will pass any increased costs on to NASA.

We also have not yet received all the documents needed to calibrate HMI in a form that are not marked ITAR. The information we need for calibration is not ITAR sensitive but LM has labeled the documents ITAR and while agreeing that the information we need is not ITAR sensitive, will not remove the labels.

HMI Instrument:

Overview: (this section unchanged from last month)

HMI continues to operate very well. While the final vector field sequence still may be changed the Doppler camera sequence is not expected to change. The vector sequence being used is likely to remain stable until substantial experience with the inversion and disambiguation code has been attained.

Instrument Operations:

No issues to report for March.

Instrument Calibration: (no changes in report this month)

The HMI calibration team is working on completing the instrument description and performance paper to be published prior to end of commissioning. The goal for submission to “Solar Physics” is as soon as possible. Most of the planned initial papers have been submitted and accepted and the Calibration team is hard at work finishing the remaining HMI paper. I have begun work on the HMI investigation paper.

HMI SDP:

HMI Level 1

The current status is available at: http://jsoc.stanford.edu/cgi-bin/ajax/show_jsoc_proc_status.html. Final level-1 is complete for past times and is keeping up with a 4-day lag. As of this writing, data from the 1 May is complete for LOS observables and Vector observables. There a several hours that will be reprocessed where they did not have final cosmic-ray hits removed properly on the first pass. This is a slow process since various improvements were made to the processing between 3 and 6 months ago so each frame with non-normal QUALITY indicators is being verified. This work is expected to be complete before the end of April.
All of the hmi.X_45s and hmi.X_720s products have now been published and available to the community as soon as they are processed. Work is proceeding on an online document describing known limitations and other issues with these products.

The known issue of “fringes” arising from the front window contaminating all level 1.5 data products is being worked. Jesper Schou has determined that the variations across the field from these fringes in the calibration mode can be isolated from the field variations from the Lyot and Michelsons since the window fringes move with telescope temperature and the filter oven non-uniformities do not. The variable component can be isolated from the desired static component in the calibration tables. Some spans of test data have been processed and are being evaluated. If successful, new calibration tables will be introduced at some near term time TBD.

**HMI Level 2**

Work is continuing on tasks for several standard product pipelines.

Work is proceeding on implementing the time-distance pipeline. Remaining work still includes primarily pipeline management scripts. Some of the code still does not make DRMS function calls but rather ad-hoc calls to open and write FITS files. The full integration into DRMS is still a near term goal. The code to splice processed inversion cubes into 360-degree maps is complete and the data is available online in test formats. Initial products are available and analysis work is proceeding in parallel to completing the pipeline processing. *(unchanged since last month although much work is now complete this description still applies)*

The “Rings” analysis pipeline is operating with tracked data cubes being generated and spectra computed, and analysis of flows generated. The Co-I provided 3-D inversions of this data are nearly operational and we have provided processor access to accommodate this processing (JILA group).

We now have 4 72-day intervals for global helioseismology analysis. Each completed interval is processed as soon as the level-1.5 data is available. The first 72-day interval began on 30 April with subsequent sections beginning on 2010.07.11, 2010.09.21, 2010.12.02, 2011.02.12. We will soon have a 5th interval. The processing pipeline is complete and final tweaks are being made to the data series names and data will be published shortly.

Initial vector field products have been produced and are being tested for accuracy. The issue causing the delays is developing processes to manage the many cases where the field strength is too low for the inversion process to yield anything but noise. A number of concepts are being tested or planned. A reasonable implementation to suppress inflated noise in quiet regions is in place and the hmi.ME_720s data – i.e. inversion products – is published. The disambiguation
products will quickly follow and be called hmi.B_720s. Initial segments of this data are available upon request.

Pipeline programs to compute “synoptic” Carrington charts are complete for both synchronic frames and synchronic charts (like the traditional maps but with corrections for differential rotation). These products will also begin to be visible as “published” hmi series in very soon. Final step to incorporate into the semi-automatic pipeline processing are expected to be complete and verified before the end of April.

The set of standard products is documented via the jsocwiki. See e.g. http://jsoc.stanford.edu/jsocwiki/Processing

**JSOC SDP:**

The new filesystems and disk that will help to mitigate against the failures we had in December will arrive in a few weeks and are expected to be available at the end of April.

**JSOC Data Record Management System (DRMS)**

The initial modifications made to isolate DRMS processing modules from the SUMS availability questions missed one case, where SUMS continued but a SUMS sub-service, the tape service, was unavailable. The correction reported last month failed to correct the problem and it is being investigated.

**SUMS data Storage Unit Management System**

The arrival of the full load of data flow has exposed several weaknesses in the implementation of SUMS. One due to the much larger than designed data flow level resulting from catch-up processing of HMI data and one due to the requirements changes for handling AIA data. Both of these issues continue to take significant effort to resolve.

The system was designed to archive and make available about 3 TB per day. We have been producing and archiving data at more than twice that rate. This has exposed a weakness in the assigning of tape drives for reading and writing with the result that tapes were being inserted and removed much too often. This has now been fixed (well, a work-around is in place) but needs some further refining for the long term in order to achieve the expected net bandwidth to the tapes.

In contrast to HMI “science” level products which remain online at all times, the requirements from the AIA team were for a data online retention of just 60 days for level-0 products and level-1 products. The plan was to keep lower cadence and lower resolution full image browse products combined with full cadence full resolution region cutouts for the duration of the mission. This was expected to
be sufficient since it was believed that most use of AIA data would be for active region studies. The cost of taking the HMI approach was believed, in 2004 when the requirement was made, to be too high for the benefit. Two things have joined to convince most users that this requirement was incorrect. The first is due mainly to impatience. The second issue is more important – and that is that after seeing what the Sun does from initial AIA “movies” it is clear that the long range connections which have been long known, are much more important to the dynamics than was formerly appreciated. Now most AIA data users want and or need full disk data. After discussions with the SDO and LWS project leaders we have concluded that the scientifically required response is to keep the entire AIA level-1 product online for rapid access.

This new approach is complicated by two issues, first is cost. This adds about 200TB per year to the budgeted AIA planned 90TB per year disk growth. A short term solution has been found for this issue. The second is due to more detailed technical/administrative difficulties. One of the needs for keeping the AIA level-1 data online is for the LMSAL AIA team to also have online access. In anticipation of the need for disk-speed access to the AIA data the JSOC procured and installed a 10gigabit per second leased connection between the JSOC-SDP and JSOC-AVC prior to launch. This should have been sufficient but LM rules require a firewall in this connection that makes LMSAL access to the SDP data much too slow. But we learned that the disks can be installed on the LMSAL SAN system and access from the SDP side allowed at full bandwidth. So this approach has been implemented. This took some minor modifications to DRMS and SUMS to allow seamless access.

This implementation is now in place but it makes SUMS significantly less robust since it now depends on the availability of a remote. The reliability problem reported last month has been resolved with NFS configuration changes at LMSAL. We have also learned that it may be possible to mount Stanford disks on the LM system if a particular NFS configuration change is made on the Stanford side (this is a IT security policy issue). If this works OK, then we will have much more flexibility in the location of new disks and by various methods we will be able to support almost two full years of AIA lev1 data online by combining current disk space at LM and Stanford.

We are investigating working with AIA to develop an online retention policy for Stanford, LMSAL, and the remote DRMS sites with large storage capability to extend the combined online storage further.

**JSOC Database Development**

No new capability. System is stable.

**JSOC Data Export**
Work is continuing on providing an easier to use user interface

**JSOC Hardware**

The JSOC-SDP hardware is in place and in regular use. We very near the end of the hardware procurement and configuration for the beginning of the mission.

The new D03 and D04 servers have been ordered and are due shortly.

We are continuing to postpone the purchase of an analysis machine until we fully understand the requirements in detail.

**HMI Science Team**

The HMI science team is busy learning the characteristics of the HMI data as compared to SOHO/MDI and other data sources and is evaluating methods to use on this newer and much much larger data volume to address their science questions. The Stanford SDO supported science team’s efforts to date are fully used to complete the initial characterization and calibration activities and making the data available to the broader community. That community is supported by other grants/contracts and reports their progress via papers and conferences. Summaries of recent accomplishments of the Stanford SDO team will be reported here as new science results develop after the initial push to get calibrated data is complete.

We are looking forward to new science to be presented at the SDO workshop in May.
Planned Activities for April

Get the Time-Distance and Vector field pipelines integrated into the pipeline environment.

Get the initial vector inversion and disambiguated products available to the community.

Near-term Milestones

Winter 2011  Most HMI science data products (Level-2) ready for release.

Attachments

This report, Co-I reports, and EPO reports which are considered attachments and available at http://hmi.stanford.edu/Status_Reports for convenience.