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 45 times. The contractual launch date is 31 August 2008 which is now in the past; however the NASA specified “launch date” is now October 2009 but maybe August or between or later.

The development of the HMI flight instrument is subcontracted to the Lockheed Martin Space System Company at its Lockheed-Martin Solar and Astrophysics Laboratory (LMSAL) in Palo Alto California. The monthly progress of the LMSAL subcontract is reported in parallel with this report and is considered to be an attachment to this report. The monthly report for E/PO activities is also attached to this report. All monthly 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 13 March 2009 and describes activities at Stanford University in support of HMI and JSOC-SDP development.
Status and Activities during February.

Administrative Issues:

We have submitted proposals for cost variance II, launch delay III and inclusion of a science component for all of Phase-E, and now launch delay IV. We expect negotiations to implement all but perhaps the last of these proposals to be in 2009. We have received a proposal from Lockheed for the first two years of Phase-E Co-I effort. We will negotiate this contract with LMSAL soon after we know the real target launch date.

Instrument Development:

Overview:

HMI is finished and ready for launch. Details are in the LM monthly report. There are a few open issues, none of which will require modifications to close.

Instrument Calibration:

The HMI calibration team is still working on completing the detailed calibration report and the instrument description and performance papers to be published prior to launch.

HMI SDP:

HMI Level 1

A full dataflow list has been made and full definitions of the input and output of each constituent module are being finalized. A prototype main flow control module for level1.0 has been developed. The work prior to this has been in preparing what we refer to as level0.3 and level0.5 products. These are the collections of HK data, FDS data, etc. Now the work of taking these parts and wrapping them in the control module is proceeding. We expect to make lev1.0 products, version 1, by then end of March.

Work is well along to produce calibrated observable products (labeled lev1.5) from the lev1.0 flat fielded images. The first version of this code is also expected to be functioning by the end of March.

HMI Level 2

Work is continuing on tasks for several standard product pipelines. The status described here is for projects that extend over many months and the status thus is slowly changing from month to month.

Work is proceeding on implementing the time-distance pipeline by mid April. Since all of the computational components exist in FORTRAN code have built c wrappers for the FORTRAN functions to incorporate the hooks to the DRMS/SUMs system. This will allow more rapid inclusion of new algorithms in
the future since the science team plans to continue developing the numerical analysis code in FORTRAN (as well as IDL and some Matlab for prototyping).

The global helioseismology pipeline work is also progressing well. The MDI production processing pipeline has been fully automated converted to DRMS. Work has now shifted the “high-l” peak fitting code which has been developed by two groups over the past decade. The more complex (and higher degree l) code has been moved into the local system (it was developed at USC and in Germany) and is being tested for reliability.

Solar simulated wave field programs are functioning (computations at NARC on the Columbia system) and have been used to test understanding of time-distance, global, and farside processing methods. Most recent work on this topic has been supported by NASA LWS TR&T grants.

The synoptic LOS magnetic field is ready to move the existing MDI code into the DRMS system. We are making progress at defining data series to contain these products. The magnetic field team members are now active JSOC developers.

**JSOC SDP:**

We have developed a task description for a database sysadmin contractor to help completion of the DRMS/SUMS database standby and replication system. We have made little progress on this search.

**JSOC Capture System**

The Data Capture System (DCS) is complete.

**JSOC Storage Unit Management System (SUMS)**

The SUMS system code development is complete.

We are continuing the migration of the MDI archive into the JSOC (supported by MDI). There are now more than 24,009 distinct dataseries in DRMS containing DSDS datasets. There are more than 42,000 distinct DSDS dataset names, most with many datasets included. The present rate of migration has been improved but still slower than initial expectations. About a fifth of the data has been migrated. The code to support running the MDI analysis pipeline with DRMS underpinnings is advancing quickly. The main component (jpe) is complete and work is progressing on supplementary scripts to replace the tools that accessed the DSDS Oracle database. This is not HMI work directly but is necessary to accomplish prior to SDO launch so that key personnel will be available during commissioning.
**JSOC Data Record Management System (DRMS)**

The base DRMS system is complete except for minor bug fixing and better documentation.

We have identified a few DRMS query modes that were very time consuming and will likely be used often. A minor rearrangement of the generated SQL has speeded this up such that a former 2 minute query is now accomplished in a few ms. We expect this type of tuning to continue as we get the pipeline modules in place over the next several months.

**JSOC Database Development**

We now have fully functioning remote DRMS systems. We have completed a test of “vacuum” on a clone of the main database to verify timing estimates. A full vacuum on the 5th year mission database will require about a day, supporting our decision to do this activity only on the “warm standby” database.

We are running performance tests on the current database system using simulated normal JSOC operations dataflow. We have developed some more complete simulated processing pipelines (in terms of DRMS usage) to look for performance and capacity issues prior to placing orders for the final pre-launch database machines. Preliminary testing of this new suite shows that we can sustain a level of 2 million record queries per day with a 20% load on the present database machine. However since the first version of the test did not include a representative use of SUMS nor of the number of records managed, we are modifying the test suite. The results are expected within a week. This needs to be complete prior to placing the order for the warm standby system, in case extra performance is needed. We maintain the option of having the warm standby system have poorer performance than the prime system. The implication is that the current system could become the warm standby with a new more capable processor becoming the prime database machine. If needed.

**JSOC Level-0 Processing**

Work is nearly done on the lev0.3 and lev0.5 data products. Final work is proceeding with our import and rotation transformation of the spacecraft attitude data and the FDS data into our required coordinate systems.

**JSOC Data Export**

The prototype development of the basic web access code is complete. We still need to implement export transport protocols for efficient export of large datasets. Work has begun as part of the VSO (Virtual Solar Observatory) to allow “daisy-chaining” of exported storage units. This is part of work now underway to integrate SDO data access into the VSO. We still need the design and prototype of a browse-able data catalog vs relying on the user to “know” what data is available.
We have begun a series of JSOC-SDP coordination meetings with some members of the AIA science team to develop connections between the LMSAL provided Heliophysics KnowledgeBase interactive analysis planning tools and the JSOC DRMS datasystem.

**JSOC Hardware**

The JSOC-SDP hardware is in place and in regular use. We are nearing the end of the hardware procurement and configuration for the beginning of the mission. We need to define and buy the database warm standby and web access machines. Our present target is to have these machines functioning by the end of May. To accomplish this we must place orders in April which requires paperwork beginning end of March. The dedicated line to Lockheed-Martin is installed and active and performance tests are continuing.

**Science Team:**

Two Co-I lead teams were successful in the “SDO-Science Center” AO and we expect the development of tighter interaction with the CORA group and SAO group to enable rapid inclusion of their work into the JSOC-SDP. Most members of the CORA team were at Stanford the past few days as part of the Local Helioseismology Comparisons group annual meeting. There were 25 people including 9 HMI Co-Is from 6 institutions present. Good progress was made in discussions of the ongoing development of techniques to analyze helioseismic data.

We will plan a final pre-launch science team meeting when we know a target launch date. We need to have a full Co-I science team meeting after the base pipeline processing is complete but before commissioning. For an August launch a date very near the launch time may be the only choice. For a launch later than August, we will look for a near-Stanford meeting site in the early fall.
Planned Activities for March

We plan to continue a comprehensive status review of the software components needed to support processing through to the level-2 science data products. The goal is to have individuals assigned to each module with an achievable schedule to support the arrival of science data in the late fall.

Near-term Milestones

15 March 2009  Level 0.3, 0.5, 1.0 products available.

31 March 2009  Level-1 Observables code for Dopplergrams, Continuum, LOS magnetograms, and IQUV images ready for commissioning phase. Was 15 March, delayed for vacations.

31 March 2009  Level-2 Global helioseismology, Farside imaging, time-distance 30 Mm mapping products ready for testing during commissioning phase.

30 April 2009  Level-2 Rings Helioseismology and Magnetic synoptic maps including “synoptic frames”, PFSS coronal field extrapolations, and Vector field inversions ready for testing during commissioning.

Data Export browseable catalog available.

Ready to place orders for final database and web server computers.

31 May 2009  Vector field disambiguation and Force-Free field line mapping ready for initial use.

Attachments

Lockheed Martin Solar and Astrophysics Laboratory HMI progress report and the HMI/AIA EPO progress report for the month are attached. This report, the LMSAL report, and EPO reports are also available at http://hmi.stanford.edu/Status_Reports for convenience.