

Helioseismic and Magnetic Imager

Stanford University

Contract NAS5-02139
Progress Report for July 2006

Introduction

The Helioseismic and Magnetic Imager (HMI) investigation proposal was submitted to NASA on 24 April 2002 in response to the Solar Dynamics Observatory Announcement of Opportunity AO 02-OSS-01, and this investigation was selected by NASA on 15 August 2002. The contract (NAS5-02139) between NASA and Stanford University was in place as of 27 September 2002. That contract has been modified (via Modification #13) to extend through Phase-E at launch plus 30 days plus six years with the launch expected in 31 August 2007. The contract has been modified 29 times.

In late November we submitted a complex proposal in response to an RFP for the merged program changes which include changing the original launch date to April 2008, the addition of 2-months to Phase-D after launch, the merging of HMI and AIA SOC and EPO activities to form the JSOC and merged EPO, and the funding driven launch delay to August 2008. We are proceeding with development of the JSOC and support of AIA development under the verbal assurance that NASA approves of the plan.

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 online 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 report is written on 14 August..

Status and Activities during June.

Administrative Issues:

None other than future funding and proposal negotiations.

Instrument Development:

Overview:

The SU team supported regular Weekly HMI meetings at the LMSAL facilities including the regular weekly status meeting and topical development and I&T meetings in areas including mechanical, optics, thermal, electrical, software, CCD cameras, and others as needed.

The Stanford personnel responsible for the HMI instrument performance (R. Bush and J. Schou) are working intensively supporting the calibration activities. Sebastien Couvidat, Cristina Soares, Richard Wachter, and Tom Duvall are participating in analysis of calibration data.

Instrument Calibration:

Following the initial “Sun Tests” which were completed in the first week of March we have continued development of analysis programs and are preparing for the resumption of calibration activities. A number of important issues/anomalies were found and have been resolved or work-around plans are being developed. There is remaining uncertainty about the source of some of the optical “distortions” but they will be fully characterized as built during in-air and in-vacuum calibrations. There was a discrepancy in focus between tests with the Sun and stimulus telescope. The focus issue has been determined to be in the new heliostat where the mirrors were made from pyrex instead of a more stable substrate as planned. We are developing work-around plans to be able to verify the thermal-optical performance of the HMI window. After the February tests we substituted the second pair of Michelsons and found difficulty in calibrating the newer narrow band unit. It was determined that there is a c. 10% “ripple” in transmission over the free spectral range making this unit unacceptable for flight. We have removed and fully characterized the new wide-band unit and have retested the original narrow-band unit and will proceed with final optical integration using the second wide-band and original narrow-band Michelsons. We will continue some effort to determine the source of the new NB ripple to determine if it is repairable in case we need a spare. No action is being taken to obtain a spare at this time. We expect the flight units will be mounted and sealed into the filter oven within a week and short of some catastrophic failure during environmental testing the risk is small.

The “In Air” calibration is likely to begin about the third week of August. The flight cameras should be available shortly after the beginning of the in-air testing and certainly before vacuum cal.. For some aspects of the instrument, polarization measurements in particular, the in-air cal will be the definitive calibrations while for most aspects the definitive tests will await in vacuum calibration with flight cameras now in mid September.

On 13 July we had a “review” of the calibration plan. We invited several outside experts in solar instrumentation to help us examine our plans. The outside people were Vasyly Yurchyshyn from BBSO, David Elmore, Steve Tomczyk, Juan Manuel Borrero, and Bruce Lites from HAO, and Jack Harvey from NSO. We

believe the meeting (all day) was useful. Their reports will be on the HMI web pages shortly.

Pre-Environmental Review:

The preparations for the PER were near complete when NASA decided we should postpone the review until early October. Work on updating the presentation material will not resume until mid September.

Data EGSE:

We are working on including more complete image crop and image modes into the EGSE as well as handling the instrument image status housekeeping packets in the EGSE as well as in the Capture System level-0 processing. Except for possible modifications to and addition of more camera readout modes the EGSE effort is complete and the equipment is ready for both HMI and AIA I&T activities.

HMI SDP:

HMI Level 1

The semiweekly development meetings continue to discuss refinements to the plans for HMI level-1 observable computation algorithms. This topic will be addressed in the coming months with initial implementations to be used for test data obtained in the in-air calibrations. Jesper Schou is leading this effort. Rick Bogart is coordinating the effort to gather keyword lists used by the various commonly used analysis packages. Little progress happened on this topic in the past month.

JSOC SDP:

JSOC Capture System

Work on the capture system has continued. A revised specification document was developed with many issues dealing with the back-end of the capture system now clarified. The goal is to have the capture system software essentially complete by November when we can finally order the hardware. The “infrastructure” for the capture system development has been installed on a temporary system.

JSOC Storage Unit Management System (SUMS)

The SUMS system development is complete. This entry in the monthly reports will be maintained for a few months to report any issues that arise as the use of SUMS increases.

JSOC Data Record Management System (DRMS)

Karen Tian has completed testing the replication feature of the database system. This will be used for the outside user access.

Work in July has continued to focus on getting more personnel familiar with the DRMS implementation and improving the documentation. There is now a documentation “wiki” on the new <http://jsoc.stanford.edu> web site. As noted elsewhere we are now using DRMS/SUMS for access to the HMI ground test data. A number of small issues have been resolved and there are now, in addition to Karen Tian, four “developers” of DRMS based modules. Two at Stanford (Rick Bogart and Phil Scherrer), one at LMSAL (John Serafin), and one at NSO (Co-I Hill’s colleague Igor Suarez-Sola). This group is quickly improving documentation, identifying and correcting bugs, etc. We expect useful modules to begin to be produced in the coming month.

JSOC Level-0 Processing

Work is beginning on moving the level-0 code developed for the EGSE into the DRMS/SUMS environment. Rock Bush is coordinating this effort.

JSOC Science Module Development

No work planned for July. We are beginning to get back to work on the definition of a base set of metadata keywords in anticipation of starting work on some simple pipeline modules.

Science Team:

The absence of sufficient apparent support for the science team is the primary risk to the success of the HMI investigation and the SDO mission goals. The new NASA ROSS LWS TR&T NRA provides funding opportunities for the development of coronal and local-helioseismology science techniques to support SDO and we will be responding to this opportunity.

Most of the helioseismology part of the science team attended the SOHO-18 Workshop from 7-11 August in the UK. A major conclusion reached at that meeting was that there remains significant development work to learn how to make meaningful estimates of sub-surface flows near magnetic regions on the Sun. The presently used techniques show systematic errors. Work is proceeding in the UK, Australia, Germany, and in the US (Stanford, CORA, JILA, and NSO) to understand the problems. This work, essential to many of the HMI higher level data products, is being supported by research grants.

HMI Home and JSOC-SDP Site:

The construction of the new Varian-II Physics building (now called the Physics and Astrophysics Building) is essentially complete. A room in the NE corner of the basement level is allocated for the JSOC SDP data center. Plans are progressing for the move into this space in the fall. In terms of office space, there has been little positive progress in the past month. We are still working the problem. We have a deadline of about May 2007 for a move date to new quarters somewhere. We will not do any move into the new

building until the plan for the rest of the group is certain. If we need to move most of the staff off campus we may need to move the computer room also.

Planned Activities for August

We expect to continue documentation updates and code development of the DRMS system.

We will continue analysis of the Sun Test data begin in-air calibration activities.

We have completed and posted the announcement of open positions for two scientific programmers to support DRMS completion and science module development. More than 80 applications have been received and have been reviewed. We expect interviews and selection in mid August.

Near-term Milestones

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| 1 January 2005 | Decision on space location within Stanford for the JSOC and Stanford HMI team facilities. <i>This may have some progress this summer.</i> |
| 25 August 2006 | First round of interviews for scientific programmer staff additions complete. |
| October 2006 | HMI Pre-Environmental Review |
| 1 November 2006 | Place orders for Capture System |

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.