

Helioseismic Magnetic Imager Program at LMSAL

Contract PY-2223 Progress Report for February 2003

Introduction

This is the fifth monthly progress report on the HMI program at LMSAL. We/LMSAL are collaborators with Stanford University on the HMI/SDO solar physics investigation, being led by Prof. P. Scherrer of Stanford University. The investigation was selected in response to NASA Announcement of Opportunity AO 02-OSS-01. Phase A, which includes the periods described as Phase A and the Bridge Phase in the AO, began on 1 October 2002 and will last 12 months.

Summary of Status

A key activity this month involved providing the Project with detailed comments on their Mission Requirements Document, discussing our comments with them by phone, and then participating in the Systems Requirements Retreat on 11-12 February and the SWG on the 13th. In addition, we continued to progress in several technical areas and to have weekly SDO Project telecons, weekly HMI-specific telecons, and HMI weekly status meetings. Efforts continued to define recovery options now that our UK partners are no longer going to be able to provide the CCD camera systems. The LMSAL team continued to grow, primarily as people transitioned from other programs. The biggest event at the SDO level was changing to a much larger launch vehicle to remove the very tight mass constraint/challenge the program was under.

Schedule and Milestones

The HMI proposal contained a top-level schedule that was based on the dates given in the AO. Now that the program has begun, a more rigorous schedule has been developed. A draft version of it was described to the Project during an SRR Splinter session on the 12th and an electronic update was provided on the 21st. Shown below are some key milestones, with an emphasis on those that will occur in the near term, or have occurred recently (for completeness).

Systems Requirements Retreat	Feb 11-12	Done
Science Working Group Meeting	Feb 13	Done
HMI Requirements Retreat	Mar 13	At Palo Alto & by us
HMI Team (Co-I) Meeting	May 1-2	At Stanford
Systems Concept Review	Apr 9 or later	At GSFC & by the Project & us
Submit Concept Study Report	Jun '03	Includes a formal cost proposal

Begin Phase B-E	Oct '03
PDR	Fall '03
CDR	Fall '04
Deliver HMI to S/C	Summer '06
Launch	Aug '07
Five year baseline mission	

Major Activities During this Reporting Period

A major activity this month was preparing for, and then participating in, the Systems Requirements Retreat that took place near GSFC on 11-12 February. Early in the month we provided the Project with a detailed set of comments on the MRD (Mission Requirements Document). This document contains an extensive list of requirements, at a series of levels, on the Spacecraft, Instruments, and Observatory. A telecon took place to discuss our comments, after which the Project revised the MRD and we provided additional comments and/or clarifications. Seven members of the LMSAL HMI team and three from Stanford then participated in the Retreat. Significant progress on detailing the specifics of the requirements is being achieved.

In the optical-mechanical area we continued to iterate the optics package (OP) configuration towards one that can be frozen. With the luxury of the new launcher, we are allowing the OP to grow a bit to provide room for two redundant hollow-core motors (HCMs) and to make the layout easier to assemble and align; and are keeping the Project informed of our desired modest growth. The design effort is also aimed at freezing the size of the HCMs and camera shutters so that these can be detail designed and ordered ASAP as they will be subjected to an extensive life test. This requires establishing the specifications on these two mechanisms, such as number of steps of the HCM and the repeatability of making desired moves. Both mechanisms will be very similar to those we are producing on other flight programs. Establishing potentially viable vendors for producing the Michelsons and arranging site visits was another activity in the optical-mechanical area this month.

On the electrical and software front, the trade study mentioned in the last couple of monthly reports has resulted in selecting the BAE RAD6000 CPU for HMI. The driver in this decision was the large amount of experience we have had with it on the SXI and Solar-B FPP programs. This will enable us to take advantage of many "lessons learned." The processor is much more capable than required for the HMI tasks, but that should enable the software to be written in a less constrained and simpler manner. The Software Requirements Document moved forward as a couple of meetings on this topic took place and the Software Management Plan moved forward as well. The latter will be a straightforward modification of the Solar-B plan. We provided the Project with a preliminary EEE parts list and are eager to discuss it and EEE parts in general with them. Our intent is to take advantage of knowledge the Project has gained in the parts area over the last year to refine the parts we will be using. A prime example of this is moving to higher density FPGAs.

As noted in the last two progress reports, our UK partners have not been able to secure the funds required for them to participate in the HMI program as planned. Considerable effort was expended this month to determine how to now obtain camera systems for both HMI and SHARP.

We met with members of the SHARPP team while both groups were at the SRR and updated one another on progress to date on the action items that came out of a similar meeting in December, and defined actions that need to occur next. A couple of draft “white papers” were written that describe possible scenarios for obtaining CCDs and camera electronics. These were distributed to NRL and the Project and then discussed, along with a set of charts that NRL produced, in a telecon on the 28th. During the telecon it was agreed to move forward with establishing Phase-1 (design and production of non-flight devices) of a contract with E2V for the CCDs and to continue the discussions on how to obtain the camera electronics. A follow-on telecon with the Project is scheduled for mid March. Several interactions with NRL, E2V, and RAL are needed before then.

Other Activities During February

1. While at the SRR, members of the HMI team met with the Project a couple of times to discuss various programmatic topics. A package of information that shows the basis of the estimated costs in the original proposal was discussed as was an overall program schedule.
2. Immediately following the SRR, the three Stanford travelers plus Springer and Wolfson participated in the first SDO SWG (Science Working Group) meeting. Progress was made on defining several “tricky” items including the Level-1 Science Requirements and the Minimum Mission Criteria.
3. While at the SRR, McFeaters discussed with Calvo the set of extensive comments we had previously provided on the MAR. Agreement was reached on a large number of points, with some remaining open. Calvo will provide a written response to our comments in early March. However, even before then, McFeaters provided Calvo with a set of notes on what he thinks resulted from their discussions.
4. Drafting of the HMI Contamination Control Plan was initiated. It will be based on the Solar-B FPP plan as the FPP also observes in the visible range of the spectrum so is much less contamination sensitive than TRACE or the EUVI on SECCHI (or SHARPP).
5. A preliminary/incomplete fault tree analysis and reliability block diagram was produced and given to the Project to aid in discussing how to proceed in this area.
6. Evaluation of the Fillfactory CMOS camera continued, as a possible candidate for being used within HMI now that the UK-provided cameras are not longer part of the program.
7. We continued to enlarge the HMI team, with nearly a half dozen individuals being identified who will begin working half time on HMI while completing their tasks on the Solar-B FPP.
8. We continued to think about mechanism life testing. This will need to begin very early in the program for the mechanisms that will move every 2-4 seconds during the 5 year mission in order to be able to undergo an accelerated life test that is adequate.

Planned Activities During March

1. Hold a one-day meeting in Palo Alto, the morning being an HMI Systems Requirements Retreat and the afternoon being preparations for the Systems Concept Review that will take place at GSFC in mid April. Approximately 10 people from the Project are expected to come to Palo Alto.
2. Provide the Project with an updated mass and volume estimate that includes adding some features to enhance reliability and make assembly and alignment of the OP straightforward.
3. Increase the size of the LMSAL HMI team, with several people beginning to work half time on HMI while they finish their Solar-B FPP responsibilities.
4. Continue to exchange information with NRL (and RAL) on possible camera recovery options and hold a telecon on this subject with the Project.
5. Receive responses to our comments on the MAR and perhaps the revised MAR itself, and begin drafting the HMI PAIP.
6. Produce a draft Software Development Plan and update the draft Software Requirements Document.
7. Initiate Technical Assistance Agreements with potential foreign vendors.
8. Visit potential Michelson vendors.
9. Continue to participate in weekly Project telecons and HMI-specific telecons, and conduct weekly HMI team meetings.

Design Updates

There were basically no design updates this month. Last month we reported on several items, repeated here in snapshot form.

- A slightly non-telecentric optical configuration is now the new baseline.
- Two hollow-core motors, or at least space for them, have been added to provide redundancy.
- The OP configuration has the CCDs mounted to a relatively permanent piece of the OP lid.
- The OP will grow, if acceptable to the Project, to allow easier assemble and more range by the ISS.

We are considering going to the larger 1553 chip to make use of its three outputs, as contrasted with the single output on our baseline chip. The second output might be used for reliability enhancement and the third for ground test access.

Issues/Concerns

- The numbers of reviews and additional documentation required by NASA on flight programs ever since the Mars failures make it difficult to put adequate effort into doing “real work.”
- The lack of a UK-provided camera systems puts an additional burden on us and will be a cost impact to NASA.

Note – we have removed the concern on how to reach an acceptable MAR and PAIP since the discussions in this area are progressing well. Some additional costs will be encountered, however, and the Project is aware of this.