

Helioseismic Magnetic Imager Program at LMSAL

Contract PY-2223 Progress Report for October 2003

Introduction

This is the 13th monthly progress report on the HMI program at LMSAL. It would have been the first report under the second phase of the contract but the original contract has been extended 3 months to allow more time to establish the Phase C/D/E contract. We/LMSAL are collaborators with Stanford University on the HMI/SDO solar physics investigation being led by Prof. P. Scherrer of Stanford University. A proposal for the Phase C/D/E effort at LMSAL was provided to Stanford, and onward to GSFC in early July, as part of the Phase A Concept Study Report that was submitted in early July.

Summary of Status

We had no face-to-face meeting with the Project this month, but continued to interact with telecons and e-mail exchanges. We also conducted six more technical Peer Reviews (at LMSAL). The present contract was extended to mid January in order to allow time for negotiating the Phase C/D/E proposal that we submitted in early July. Drafts of various items (SOW, CIDRL, Performance Specification, etc.) that will be part of the Phase C/D/E contract were iterated with the Project; and the PAIP was submitted to them for final approval. We continued to solidify designs in a number of technical areas and to enlarge the team to efficiently take the designs to the next level. We also continued to have weekly SDO Project telecons, weekly HMI-specific telecons, bi-weekly CCD camera system telecons, weekly telecons with LightMachinery, weekly HMI status meetings, and a constant stream of internal technical meetings.

Schedule and Milestones

The original HMI proposal contained a top-level schedule that was based on the dates given in the AO. Now that the program is in full swing, a more detailed schedule has been developed. It was provided with the CSR, and a further update will be issued shortly. It will take into account the 8-month launch slip. Shown below are some key milestones, with an emphasis on those that will occur in the near term, or have occurred recently (for completeness).

Electronics & Software Peer Revs	Oct 8	Half day each
OP Thermal Peer Review	Oct 15	Half day
Optics & Filters Peer Reviews	Oct 22	Half day each

Telescope & FPA Peer Review	Oct 29	Half day covered both
Magnetics Science/Co-I Meeting	Oct 30	At Stanford
Michelsons PDR	Nov 6	At LMSAL
HMI PDR	Nov 18-19	At LMSAL
Complete calcite inventory	November	
Begin shutter life test	November	
Receive prototype HCM	November	
Order life-test HCMs	November	Vendor is H. Magnetics
Define GSFC common buy	November	EEE parts
Begin Phases C/D/E	Jan 15 '04	Phase A/B was extended three months
Mission PDR	Feb '04	At GSFC; date TBD
HMI CDR	Nov '04	
Deliver HMI to S/C	Nov '06	
Launch	Apr '08	
Five year baseline mission		

Major Activities During this Reporting Period

Last month we noted that HMI (as well as SDO) was confirmed by Headquarters to transition from Phase A to Phase B, that SHARPP was not, and that it was decided to put the AIA investigation proposed by A. Title onto the mission in place of SHARPP. Since we/LMSAL are responsible for AIA this will impact how we conduct the HMI program as there will be considerable sharing of designs and personnel between the two programs. Unfortunately, the non-definitized contract for AIA was not received until 27 October and still not signed by all parties at the end of the month. So, that program is another month behind from what was anticipated as is the settling in of new personnel and the redistribution of personnel and efforts between the two programs.

Steady progress was made in the optical/mechanical areas this month. As noted in the last two reports, the size of the Michelson beam splitter cubes increased from 40 to 45 mm, resulting in dimensional changes to both the oven and the OP. A FEM (in a Nastran file) and a solid model (step file) of the revised OP were provided to the Project and a new optical/mechanical configuration drawing will be issued prior to PDR. A trade study was initiated to determine the design baseline for the telescope metering structure that adequately maintains the distance between, and alignment of, the objective and secondary lenses. The drawing that captures all of the optical parameters of HMI continued to mature (and expand). Members of our team made another visit to Vision Composite and T. Paige, of Vision Composite, came to LMSAL to spend a day working directly with our personnel.

Activity intensified in the filter areas. The weekly telecons with LightMachinery continued with design decisions being made and ETU elements being ordered. A half-day PDR on the Michelsons will be held in Palo Alto on 6 November, followed by a day and a half of working sessions. Interactions continued with candidate vendors for the front window/filter. The details of the Lyot filter continued to be refined. As part of this activity the flight spare MDI Lyot filter, which has been kept in only a regular laboratory environment for the last 8 years, was partially disassembled and a couple of the elements remeasured using sunlight and our spectrograph.

Their performance at the MDI wavelength is still excellent and we will shortly measure them at the HMI wavelength. This will be a big step towards further defining the details of the HMI Lyot elements as well as providing practice at measuring HMI elements when they are produced. Vendors for the various pieces of the Lyot filter are being identified and the specifications for the pieces are being drafted.

With the NRL SHARPP investigation being replaced by the LMSAL AIA investigation, the SDO CCD Working Group has shrunk in size and the group telecons with e2v and RAL have become bi-weekly instead of weekly. This also fits better with the advanced design maturity at both vendors. For example, the first batches of both thin-gate and thick-gate devices were completed by e2v (on schedule) and initial probe tested has commenced. Three members of our team visited RAL for a two-day session of discussing the technical interfaces between the CEB and HEB. Another comprehensive monthly report of the work at RAL was provided to the Working Group by N. Waltham. Several telecons with each of the UK vendors took place this month to refine the procurement specifications and SOWs that we will issue to them for the flight phase portions of their programs. We also spent considerable time interacting with NRL, GSFC, Praxis, Stanford, and e2v to initiate the transfer of the remaining Praxis contract (for e2v work) from NRL to either Stanford or LMSAL.

Steady progress was made this month in the electrical area as several engineers (finally) completed their efforts on Solar-B FPP. Based on some worst-case assumptions on what flight quality power converters we will be able to obtain, the layout of the power system was revised (and enlarged) to accommodate them. The overall dimensions of the HEB were then increased to accommodate this. The schematic capture step for one of the two types of mechanism controller boards was completed, as was the design of the FPGA that is central to it. These will shortly undergo an in-depth review. The bridge board progressed to a similar state of maturity. This is important since it is one of the first boards that needs to be functional for the software development effort. Meanwhile, progress continued to be made both in understanding whether any of our baseline parts will be difficult to obtain to a high enough quality level and in determining likely candidates for a Project-wide common buy.

Software continued to move forward on a variety of fronts. Bi-weekly meetings took place as did a number of mini reviews of the design progress. A Coding Standards document was drafted and distributed for internal review. The same was true for a Processor Resources List document. The Software Management Plan and Software Requirements Document were updated for distribution at the PDR. We received a questionnaire on IV&V, filled it out, and returned it to the Project. They acknowledged receipt and provided a second questionnaire, which we will fill out shortly. Specification of the Software Development System was nearly completed, and the items that make it up will be ordered in November.

Several Peer Reviews took place this month. On 8 October, the Electronics were reviewed in the morning and Software in the afternoon. A week later the various Thermal subsystems were reviewed. This was followed by a review of Optics and then Filters on the morning and afternoon of the 22nd and a review of the Telescope and FPA assemblies on the 29th. Every review was attended by LM personnel who are not part of the HMI program and by GSFC personnel by telecon. The charts for the reviews were provided to the GSFC personnel the

evening prior to the review to help in their participation, but it was still less effective than if they could have participated in person. The minutes of the reviews are being produced and distributed. They include a list of participants, an overview of the review, a set of recommendations, and a set of action items.

Other Activities During October

1. The last of the fixed assets that LM is procuring in CY-03 to support the HMI development were ordered.
2. An update to the HMI-S/C ICD, based on the working session that took place at GSFC on 9-10 September, was received.
3. Several programmatic discussions took place throughout the month. The SOW, CIDRL, and Performance Specification that will apply to the remainder of the program were iterated but not yet formalized.
4. Preparations for the HMI PDR commenced with the drafting of an agenda that was then discussed with the Project. The format for the presentations was defined as was a schedule for their development, and draft charts began to surface.
5. We received a GSE blocking filter whose central wavelength is 6173A. It is needed for various optical test activities.
6. Several members of our team participated in a half-day meeting on the scientific aspects of the magnetic field measurements that HMI will make. It was held at Stanford University.
7. The LMSAL Senior Staff held an offsite meeting to discuss the impact of the AIA program on personnel, facilities, and offices.
8. The decision to go with the higher performance (and more expensive) type of waveplates being used on Solar-B FPP was reversed because a lesser grade (and lower risk) type was determined to be adequate.
9. Internal requirements/design meetings were held on a variety of subsystems and assemblies.
10. We initiated the paperwork to enable the exporting of PRTs and capacitors to e2v, and polarizers to LightMachinery.
11. We received feedback on the CSR-provided Performance Verification Plan and folded the comments into the significantly expanded plan that will be ready prior to PDR.
12. We received a few comments on the Software Management Plan and the Software Requirements Document and folded them into the documents that will be ready prior to PDR.

Planned Activities During November

1. Personnel from LightMachinery will come to Palo Alto to conduct a PDR on the Michelsons on the 6th and participate in several technical and programmatic working sessions on that day and the day following.
2. Submit a proposal for the efforts required to accommodate the 8-month launch slip.
3. Submit the remainder of our responses to RFAs from the Mission SSR/SCR and elsewhere.
4. Conduct the HMI PDR on 18-19 November. Adjacent to the PDR, have a programmatic working session with the Project and some technical and programmatic working sessions with our two UK vendors.
5. Continue drafting procurement specifications for the optical elements.
6. Complete the evaluation of our existing in-house stock of calcite to determine its adequacy for making the flight Lyot filter and a set of flight spare elements; and continue to investigate obtaining additional calcite in case that supply is not fully adequate.
7. Receive the final SOW, CIDRL, and Contract Performance Specification from the Project.
8. Make the next iteration on a number of draft plans, in response to comments received on the copies that were provided with the CSR.
9. Distribute minutes for any Peer Review for which this has not already been done.
10. Work with the AIA team leads to organize LMSAL personnel for both programs in an optimal manner.
11. Order sample pieces of KAP and ADP to evaluate for use in the Lyot filter.
12. On a routine (mostly weekly) basis continue to participate in telecons with the complete SDO group, HMI-specific telecons, CCD Working Group telecons, LightMachinery telecons, BAE telecons; and to conduct HMI team meetings as well as specific meetings on Electronics, Software, Filters and Mechanical topics.

Design Updates

There were no major design updates this month. However the OP layout details were revised to take into account the larger Michelson cubes discussed in prior reports.

Resource Requirements

The monthly power and mass status reports are being provided as separate files. The HMI estimates this month include the impact of the larger Michelsons and maturity/conservatism in the power system design.

Issues/Concerns

- Undertaking the AIA program at LMSAL will require obtaining additional personnel quite rapidly and redistributing personnel between these two, and other, programs.
- Radiation hardness may be an issue with the SMCSLite chip that is used in the CEB and in the interface between the HEB and CEB.