Helioseismic Magnetic Imager
Program at LMSAL

Contract PY-2223
Progress Report for January 2004

Introduction

This is the 16th monthly progress report on the HMI program at LMSAL. It would have been the fifth report under the second phase of the contract but the original contract was extended several 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.

Summary of Status

Highlights this month included having an interface working group meeting in Palo Alto, receiving a proposal from e2v for the flight CCDs, receiving a proposal from RAL for the flight CEBs, receiving a non-flight processor board from BAE and firing it up, and progressing on all manner of instrument designs. A disappointment was not signing the contract for the next phase of the program but rather receiving a no-cost extension. We continued to have weekly SDO Project telecons, weekly HMI-specific telecons, nearly 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 and the 8-month launch slip is a fact, a more detailed schedule has been developed and is undergoing constant iteration/expansion. The latest version was provided at the PDR, and an update will be provided in mid February. Shown below are some key program milestones, with an emphasis on those that will occur in the near term, or have occurred recently (for completeness).

HMI PDR	Nov 18-19	At LMSAL
Numerous splinter meetings	Nov 18-21	Project, e2v, RAL, I&T, AIA, Ops
Received prototype HCM	Nov 20	Performs nicely
I/F Working Group Meeting #4	Jan 12-14	At LMSAL
Ordered life-test HCMs	January	Vendor is H. Magnetics
Peer Review of HEB & Oven	Feb 4	Mechanical aspects only
Grounding/Bonding Meeting	Feb 5-6	At Boulder, Colorado

Visit RAL and e2v	Feb 9-11	Various topics as moving into flight phases
M&P and EEE PCBs	Feb 24-26	Initial Board meetings at Palo Alto
Define GSFC common buy	February	EEE parts
Begin Phases C/D/E	February	Phase A/B being extended until then
Begin shutter life test	February	Slipped from November
Michelson Performance Review	March 1-2	At LightMachinery
Mission PDR	March 9-12	At GSFC
SDO Science Meeting	March 22-25	At Boulder
Complete SM instrument	August '04	
HMI CDR	Nov '04	
Deliver HMI to S/C	Nov '06	
Launch	Apr '08	
Five-year baseline mission		

Major Activities During this Reporting Period

Steady progress was made in the mechanical and optical areas. The HEB enclosure and Oven structure have matured to where we will have a Peer Review (mechanical only) on them, and on our optical mount alignment method, on 4 February. The bracket/legs for mounting the CEBs were reviewed internally and the details of the interface are being worked with RAL. Various procurement drawings for the more simple optics were completed. Design of the oven internals progressed hand-in-hand with the appropriate thermal analyses of some subtle design options. This has been aided by the addition of thermal engineer Carin Lundquist to the team.

Good progress continued to be made at LightMachinery. They have now provided us with a Michelson Test Plan to review and comment upon. We will meet with them in early March to look at test results from the prototype beam-splitter they are producing. The front window/filter and blocking filter specifications were iterated and put into the release cycle. They have already been informally shared with three potential vendors. Sample ADP and KDP crystals are being produced by Cleveland Crystals. Evaluating them will both enable us to confirm their appropriateness for flight and establish more precisely the lengths of the calcite elements that will go into the Lyot filter with them. A trip to Lambrecht, the vendor who will cut and polish the calcite elements has been arranged for early February. We will take along some raw calcite as well as the equipment we use for evaluating the quality of calcite pieces.

The new housings for the life-test shutters were received and are now in inspection as are the additional motors. Unfortunately, due to some mix-ups, the higher precision rotors were not ordered as soon as they should have been and we may be faced with either delaying the life test to use them or sticking with the older style rotors. Two life test HCMs were ordered from H. Magnetics, our heritage supplier for such mechanisms.

After considering the number of mechanism life tests that need to be performed for the combination of HMI and AIA, we have decided to rework an existing large chamber to accommodate all of the life tests rather than have separate chambers for each test. The advantage is that we can then afford to make this chamber highly reliable and monitored, and spend less

total time chamber tending. If the large chamber is not ready in time for the HMI shutter life test, however, this will be done in the previously planned smaller chamber that is already ready for it.

Although we had planned to decrease the frequency of Working Group telecons with RAL and e2v there have been so many items to discuss that involved both groups that we have continued to do them weekly. Good technical progress is being made at both suppliers. e2v provided RAL with a mechanical sample CCD so that they can work up their GSE accordingly. They also began to probe test the second batch of thin-gate devices and the third batch of devices progressed well along towards completion. Meanwhile, they are commissioning their screening camera and packaging some functional devices, with the two activities coming together to produce results in early February. The e2v flight-phase proposal was received over the Holiday break and after reading it we discussed various points they brought up, none of which are showstoppers. Near the end of the month we received the RAL proposal for the flight CEBs. We are in the process of reviewing it and discussing some specifics of it with them. By the time of the meetings in the UK on 9-11 February we will may have both groups under undefinitized letter subcontracts and e2v may will have initial results from some packaged CCDs. Meanwhile, locally we received a first CCD protective cover and will shortly (after ITAR paperwork) send it to e2v.

Steady progress was made this month in the electrical area. Of high priority is getting the mini brassboard box completed for use by the software team. It will contain a CPU, a Local Bus Bridge/1553 Interface board, a Mechanisms Controller board, and a specialized backplane. All of these items are getting close to layout. The specifications for the other PWBs continued to mature and undergo reviews prior to detailed design. Parts (ATMEL space wire chips, LVDS drivers, and such) were ordered to enable us to fabricate a breadboard setup to evaluate the subtle difficulties (often noise) one may encounter with the high-speed interfaces between the camera and HEB and the HEB and spacecraft. Meanwhile, we have had little new interaction on the topic of EEE parts common buys and have encouraged the Project to remedy this before it becomes to late. On the positive side of this, however, the Project has placed a common buy order for a variety of non-flight power converters, some of which will come to us.

Software continued to move forward on a variety of fronts. The non-flight PCU is now in house as is some recently ordered software, and we have begun to exercise the PCU (successfully). The Sun Workstations are also now in house and we installed a version of our “standard” EGSE software into them. A system for generating updates to command and telemetry lists and keeping everything under configuration control was put in place. Significant progress was also made in getting commands to flow from our EGSE to the SUROM. A new person, Ralph Sequin, was hired to help with the EGSE software. Lastly, we continued to consider what, if any, fundamental differences will exist between the basic flight and GSE software for HMI and AIA; on AIA’s nickel of course.

On 12-14 January, we hosted a successful interface working group meeting with many members of the Project team to iterate the ICD and progress in various other areas. Significant progress was made in resolving open items in the requirement areas of Mechanical, Thermal, Command and Data Handling, and Guidance, Navigation and Control. Other topics of discussion, and further understandings, were jitter requirements, Observatory I&T for HMI, and co-alignment of

HMI with AIA and its primary guide telescope. The S/C-HMI ICD will now be updated, released, and put under configuration control; all well before the Mission PDR.

Other Activities During January

1. S. Meyer and F. Lee attended a contamination working group meeting at GSFC. Some action items were received and are being worked. F. Lee is assuming the position of HMI Contamination Control Engineer while S. Meyer concentrates on AIA. Lee is the Solar-B FPP CCE. The FPP, like HMI, is a visible light instrument.

2. A discrepancy between the spacecraft thermal model and the HMI thermal model was resolved, and changes are being incorporated into the HMI thermal model. The updated model will be delivered in mid February.

3. We received the final versions of the SOW, Contract Performance Specification, and CIDRL that will apply to the remainder of the program. There were no real surprises rather just areas that need clarification.

4. We provided responses to 17 of the 28 RFAs that we received after our PDR, and provided an updated matrix of when we anticipate completing the remainder.

5. Members of the Project team, led by Risk Coordinator Jerry Klein, visited us on the 28th to describe their approach to Risk Management, learn of our approach, and discuss how to blend the two most effectively. It was a productive meeting and we think this can be done in a practical manner.

6. The approved HMI PAIP was modified to cover both HMI and AIA, with no changes to its meaning/content.

7. Internal requirements/design meetings were held on a variety of subsystems and assemblies.

8. The synergism between HMI and AIA continued to evolve in a positive manner as additional personnel joined the team to work specifically on one or the other of the two programs. We also began to have weekly meetings of the leaders of the two programs.

9. A writeup describing the planned fidelity of the HMI Structural (physical) Model was drafted. It is still unclear if the Project requires a SM (or mass model) that is vacuum compatible and flight-like clean.

10. As suggested in one of the PDR RFAs, we decided to use the 3 unused thermal control circuits to provide redundancy for the most important of the existing 5 thermal zones.

Planned Activities For February

1. Participate in meetings at both e2v and RAL.

2. Conduct the first LMSAL EEE Parts Control Board Meeting and the first M&P Control Board meeting. These will be in Palo Alto on 24-25 February and the Project, who have a member on each board, have been invited to attend.

3. Lay out the two HEB printed wire boards that are needed early by the software and mechanisms teams as well as the motherboard for the GSE box that will contain these two boards along with a CPU.

4. Provide the Project with an updated thermal math model, now that the discrepancies between the prior model and their model have been resolved.

5. Continue drafting procurement specifications for all of the optical elements.

6. Receive rotors for the life-test shutters that have more precisely aligned magnetics than those that came with the motor originally.

7. Participate in an Observatory Contamination Control Peer Review on the 24th, following by a working group meeting on the 25th.

8. Participate in a meeting on grounding, bonding, and shielding that will be held in Boulder, Colorado in early February.

9. Work with the Project to determine if the Structural Model instrument needs to be vacuum compatible and contamination free. Both would be upscopes to our plans but have been mentioned (by the Project) as perhaps being needed.

10. Continue to work with the AIA team to organize LMSAL personnel for both programs in an optimal manner.

11. Conduct a Peer Review on the HEB enclosure and Oven structure (mechanical only) as well as on our optical mount alignment method.

12. Get Vision Composite under contract for the flight phase portion of their work, including the structural model box and telescope.

13. Submit the remaining 11 PDR RFAs.

14. Attend/participate in the Operations Peer Review that will take place at GSFC on the 5th.

15. Scherrer and Title will go to GSFC for a top-level discussion on how HMI+AIA plan to deal with the large amount of SDO in a cost effective manner

16. On a routine (mostly weekly) basis continue to participate in telecons with the complete SDO group, the combined HMI/AIA-Project 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 significant design updates this month. A minor update that we will make use of the three unused thermal control circuits to provide redundancy for the three most important of the five zones presently being controlled.

Resource Requirements

The monthly power and mass status reports are being provided as separate files. The HMI estimates and allocations are not changed this month, and remain as shown at the recent PDR.

Issues/Concerns

- Undertaking the AIA program at LMSAL requires obtaining additional personnel quite rapidly and redistributing personnel between these two, and other, programs.

- Obtaining the waveform generator for the CEB is presenting a schedule concern and various options are being discussed with RAL. These are being shared with the Project who are incorporating this into their risk documentation.

- The existing version of the SMCSLite chip that is used in the CEB and in the Camera Interface board needs to undergo radiation testing to verify it is acceptable, and we need to keep on top of whether the newer version of this chip will be available in time for our programs.