E MANAGEMENT AND SCHEDULE

The HMI team is led by the Solar Physics group of the Stanford University Hansen Experimental Physics Laboratory (HEPL), in collaboration with the Lockheed Martin Solar and Astrophysics Laboratory (LMSAL), the Mullard Space Science Laboratory (MSSL), the Rutherford Appleton Laboratory (RAL), the High Altitude Observatory (HAO), and an exceptional group of science Co-Investigators.

This HMI team is committed to achieving the following objectives:

- Conduct the scientific investigation described in Section C of this proposal.
- Design, develop, fabricate, test, calibrate, integrate and operate the HMI instrument to acquire the necessary observational data.
- Manage the personnel, resources, and interfaces to accomplish the program on schedule, within budget, and in a manner that minimizes risk and maximizes the science return on expenditures.
- Accomplish the goals of the NASA/OSS education and public outreach strategy, as well as those for developing new technologies and involving small disadvantaged businesses.
- Perform the mission operations and data analysis activities after launch.

To accomplish these objectives, an extremely strong and experienced team has been assembled under the leadership of Prof. P. Scherrer as Principal Investigator (PI). The HMI flight instrumentation will be developed at LMSAL under the direction of Dr. A. Title with ongoing involvement of Stanford University personnel. The Stanford University and LMSAL groups have worked together for many years on successful NASA, ESA, and ISAS scientific space programs, including the MDI and TRACE investigations, which form the foundation for the HMI program.

In addition to the instrumentation developed at LMSAL, the CCD camera systems will be provided by RAL and MSSL in the UK, coordinated by Prof. J. L. Culhane of MSSL. MSSL is responsible for program management and CCD detector procurement and RAL is responsible for the CCD camera design. Expertise in vector magnetic field measurement techniques will be provided by HAO under the coordination of Dr. S. Tomczyk.

A focused group of Co-Investigators rounds out the capabilities of the HMI team. Meaningful educational opportunities for graduate students are available both at Stanford University and through our university partners. We anticipate that our Co-Investigators will provide a continuing base of knowledgeable personnel through extended operations of the HMI mission. Their responsibilities, as well as all of the items touched upon in this introduction, are described more fully in the following sections.

The HMI management approach builds on a process that has evolved in a successful series of programs. Many of the scientists and engineers who developed MDI will be involved in HMI effort. Years of experience in flight hardware, software, and ground data systems, combined with a thorough understanding of the GSFC approach to space missions, enables us to accomplish this major investigation at modest cost and with minimal risk. Further efficiencies will be realized if NASA selects the LMSAL proposal for AIA, since that instrument will be developed by LMSAL sharing many of the same hardware, software, and management elements as HMI. We cannot envisage a combination of personnel and institutional capabilities better suited to providing the HMI aspects of the SDO mission and LWS program.

E.1 Organizational Structure and Responsibilities

The HMI Program is under the direction of Prof. Philip Scherrer who as Principal Investigator is the formal interface to NASA and to Stanford University. He is responsible for

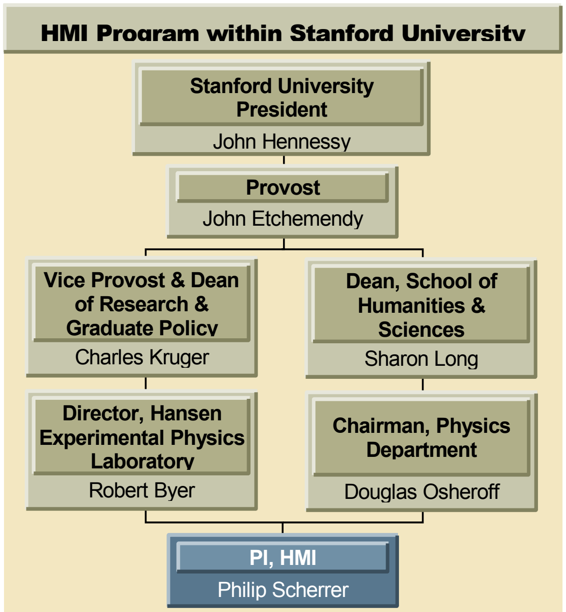

Figure E.1: Research functions are coordinated through the HEPL director in consultation with the Dean of Research. Academic matters are handled through the physics department chairman in coordination with the Dean of Humanities and Science.

scientific leadership, management, instrument development, ground and flight operations, E/PO, and data distribution, archiving, and analysis. Prof. Scherrer is extremely well qualified for this position. He is the PI for the MDI instrument; and has played a prominent role in developing and advancing the SDO concept. The organization chart in **Figure E-1** shows how the HMI program fits within Stanford University. Prof. Scherrer is ultimately responsible to the Stanford University president J. Hennessy.

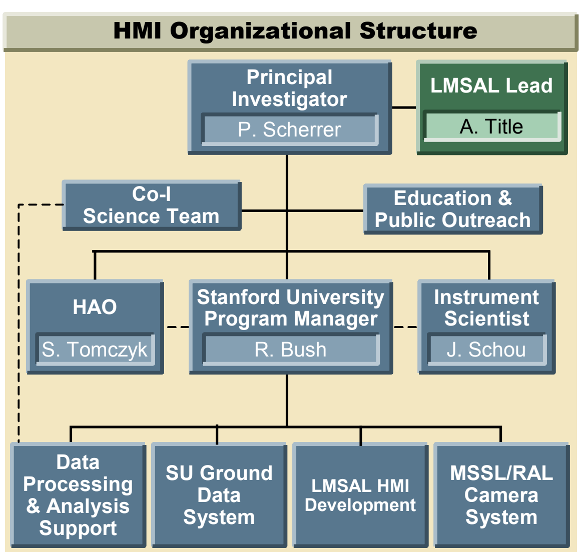

Figure E.2: The HMI organizational structure is similar to that used for the MDI program.

The HMI instrument development organizational structure is shown **Figure E-2.** The ultimate responsibility for the HMI program resides with the PI. The Stanford program management, ground data systems and mission operations is under the direction of Dr. R. Bush with the assistance of the HMI Instrument Scientist, Dr. J. Schou. The HMI program at LMSAL is under the direction of Dr. A. Title at LMSAL with the assistance of the HMI project manager, Mr. L. Springer.

The Stanford program manager, Dr. Bush, handled the MDI project management for Stanford and is currently in charge of MDI operations. He is responsible for the prime contract from NASA and for the interface with LMSAL and the other Co-Investigators. Dr. Schou, in conjunction with the HMI Science team, will establish the performance requirements for the HMI instrument. He will have oversight for the development, testing and calibration of the flight HMI instrument. Dr. Schou has been involved in similar activities during the MDI program.

E.1.1 Lockheed Martin Solar and Astrophysics Laboratory

The HMI functional organization within Lockheed Martin is totally contained within the Solar and Astrophysics Laboratory. **Figure E-3** shows the HMI organizational structure at LMSAL. Dr. A. Title is the lead for the HMI instrument development at LMSAL, and the contact to Lockheed-Martin management. He is a Senior Fellow at the ATC, a member of ATC Vice President A. Mika's staff, and is the PI for the TRACE and Solar-B/FPP programs.

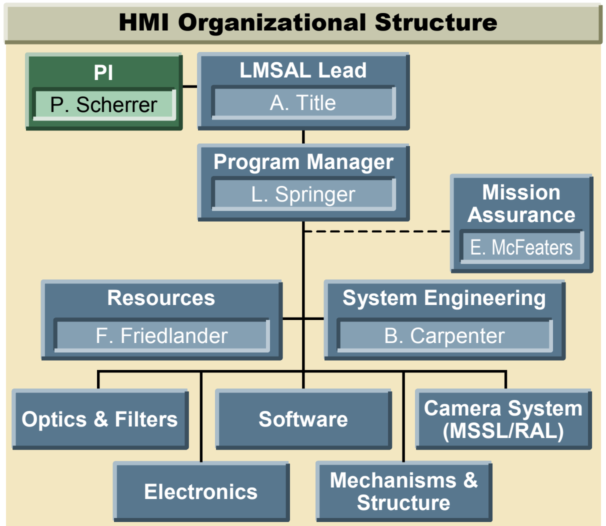

Figure E.3: The majority of the LMSAL team has worked together on prior solar physics space missions.

Mr. L. Springer, as the LMSAL Program Manager (PM), is responsible for day-to-day implementation of the program. He was the SXI PM during its early years and is presently PM for the LMSAL portion of SECCHI. The systems engineering, mission assurance, and resource management leads will support Mr. Springer, and have worked together with him on several similar programs. In particular, Mr. B. Carpenter was the Chief Systems Engineer on the SXI program during its design phase and is now the CSE on SECCHI. He and Mr. Springer will transition from SECCHI to HMI as SECCHI goes from design to fabrication.

E.1.2 UK Participants

In the UK, Prof. J. L. Culhane of MSSL will coordinate a scientific team for participation in the HMI investigation. He has been involved in many NASA missions, being the PI or UK PI on SMM/XRP, Spacelab-2/CHASE, Yohkoh/BCS, and Solar-B/EIS. Prof. R. Harrison of RAL will join Prof. Culhane in executing the UK hardware responsibilities He is the PI on SOHO/CDS and the UK PI on STEREO/HI.

MSSL has been active in space sciences for more than forty years and has provided instruments for more than thirty orbiting and interplanetary space missions, including Yohkoh, SOHO and Solar-B. Instrument development work is undertaken either in house by teams of professional engineers or on contract to industry. There is a strong management capability, with Prof. A. Smith in overall charge. He will be responsible for procurement and testing of the Marconi CCDs. Similar activities have been undertaken jointly with LMSAL in the SXI and FPP programs.

RAL has been active in experimental space science missions including HIRDLS, Yohkoh and SOHO. RAL is currently involved in Solar-B and in the provision of CCD cameras for the SECCHI investigation. This latter work, undertaken by Dr. N. Waltham, is of considerable relevance for HMI because the HMI CCD camera will be developed from the SECCHI cameras.

E.1.3 High Altitude Observatory

Requirements for the vector magnetic field capability of HMI will be supported at HAO under the leadership of Dr. S. Tomczyk and Dr. B. Lites. The HAO team has extensive experience in instrumentation for the observation of solar oscillations and magnetic fields (e.g. the LOWL oscillations experiment, the Advanced Stokes Polarimeter and the Solar-B/FPP spectropolarimeter), as well as in the inversion and interpretation of vector polarimetric data. In addition, they will development algorithms for the analysis of the vector magnetogram data from HMI.

E.1.4 Science Co-Investigators

The roles and responsibilities of all HMI Co-Investigators and their institutional affiliations are summarized in Table C.4.2. Those Co-Is whose roles have not already been described fall into two groups and are shown in the lower two sections of the table. The first group is U.S. Co-Is whose role is to produce analysis code that will be incorporated into the higher-level data pipeline processing shown in **Foldout 1.L**. The second is non-U.S. investigators who will be primarily providing science data analysis. All members of the U.S. Co-I team already have versions of analysis codes which are the prototypes for the needed HMI codes. Only those who have particular expertise to develop and verify the particular analysis techniques needed to produce HMI data products are included. Their role will be constrained by funds to implementing a version of their then-best code into the pipeline and, after launch, doing sufficient analysis to verify the processing.

Prof. S. Basu and Dr F. Hill will provide helioseismic ring analysis code to probe local velocity and structure. Prof. J. Toomre's group, which leads in the analysis and inversions using ring data, will provide code to convert the ring measurements into SSW flow maps. Dr. R. Howe and Prof. E. Rhodes will provide code for global helioseismology mode and frequency determination and inversions for interior motions and structure. Dr. C. Lindsey and Dr. D. Braun will provide the code to compute the farside active region maps. Prof. J. Kuhn will provide the code for limb shape fitting and continuum analysis of convection efficiency. Dr. N. Mansour and Dr. A. Wray will provide convection zone modeling code to allow testing of inferences from local methods. Prof R. Ulrich and Prof P. Goode will provide code to enable cross-comparisons of magnetic field observations to other line-of-sight long duration magnetic series and to ground-based IR magnetic observations. Dr. J. Linker will provide MHD models for solar wind prediction to be used in near-real-time space weather forecasts.

In addition to the instrument fabrication and calibration roles, Co-Is from Stanford and LMSAL will also have code provision roles. These include Dr. R. Bogart and Dr. J. Beck who will provide large scale flow analysis code from ring and time-distance methods; Dr. J. Schou who will provide p-mode frequency determination code; Dr. X. Zhao who will provide coronal field estimating code used in several higher level pipes; Dr. Y. Liu who will assist in vector field calibrations and coronal field models; Dr. A. Kosovichev who will provide time-distance inversion code; and Dr. T. Duvall (GSFC) who will continue to be in residence at Stanford and will provide time-distance time-delay measurement and inversion code. From LMSAL, Dr. T. Metcalf and Dr. T. Berger will provide vector field analysis code.

E.2 Management Implementation

The management approach for HMI is one that has evolved over several decades of developing instruments as an integral part of conducting scientific investigations. Foundations of the approach are:

- Clearly stated and documented requirements that flow down from the measurements necessary to achieve the scientific goals.
- A program structure consistent with requirements, and resources allocated to the elements of that structure.
- Continual evaluation of the matching of the resources to the requirements and the adjustment of requirements to minimize risks and maximize scientific return for resources expended.

This is done in an environment where scientists, engineers, technicians, and support personnel from not only Stanford University and LMSAL but from all of the involved institutions interact in an open and continuous process. A chain of very successful programs that have functioned in this manner validates our approach.

E.2.1 Requirements Management

The science objectives described in Section C of the proposal are the primary drivers for the HMI instrument design. The flow from science objectives to top-level instrument requirements that has begun with this proposal will be captured in an Instrument Performance Specification (IPS) document developed by the HMI team under the leadership of the PI during Phase A of the program. We have demonstrated on the MDI and TRACE programs that a living IPS document provides the necessary bridge from the science requirements to the instrument specifications, and is crucial to assuring that optimal tradeoff decisions are made throughout the instrument development.

In the IPS, the system and subsystem requirements are traced back to an underlying mission, instrument, or derived requirement. The IPS will receive modifications as the program evolves. A set of Engineering Design Notes contains the details of individual hardware and software items, including the motivation for the approach being implemented to achieve the required performance. At these lower levels, the specifications are expanded to address the performance, the allocated resources and the interfaces to other subsystems.

During Phase B, the engineering staff under the direction of the Chief Systems Engineer will flow these requirements down to assemblies and subassemblies. With the oversight of the Mission Assurance organization, we will develop verification plans for various levels of assembly, flowing up from the responsible engineers to the Lead Engineers and the Instrument Scientists for review. The requirements traceability matrix will evolve to include the verification criteria for all requirements. An overall Verification Plan covering all levels of hardware and software will result from this process. As the requirements and designs for subsystems and assemblies solidify, the methods for verifying performance are established and documented by the responsible engineers.

Elements of HMI being developed by our UK partners are treated in a manner similar to those being developed at LMSAL. The ground data system requirements will also be documented in a manner analogous to the instrumental requirements. Our experiences on prior programs have demonstrated the effectiveness of this approach wherein all members of the team work with documentation that clearly shows the paths being taken.

E.2.2 Communications and Meetings

Continuous and open communications are inherent in our management approach. Although decisions are made in a structured manner, ideas are shared openly. The decisions are documented in meeting summary minutes and technical memos and then incorporated into the appropriate documents such as the IPS. The Stanford University and LMSAL groups are within a ten-minute drive, and the scientists, engineers, technicians and support personnel interact on an informal basis. In addition, everyone is tightly linked via e-mail and Web sites.

A one-hour, all hands, weekly meeting is an important aspect of our internal communications. At this meeting, each engineer reports on status, plans, and concerns. Focused meetings are then scheduled to resolve concerns or review designs in depth. The results of both the focused meetings and the weekly meeting are posted on the Web. Routine telecons are held with all major subcontractors and vendors to recognize and solve problems early and (especially) to include them as an integral part of the HMI team. Periodic visits are made to the subcontractor and vendor locations for the same reasons.

We anticipate having weekly telecons with the GSFC project management team, and will participate in routine telecons with all SDO projects. We will support appropriate engineering peer reviews, and the normal series of formal reviews (Conceptual, Preliminary Design, Critical Design, Pre-Environmental, Pre-Ship, Launch Readiness, etc.). Co-Investigator and community-wide science meetings held at six to twelve month intervals complete the review process. Often some of the most critical and helpful comments come from our scientific peers at these meetings.

Event	Date
Phase A	1 Sep 2002 to 31 May 2003
Initial Confirmation Review	15 May 2003
Bridge Phase	1 Jun 2003 to 31 Aug 2003
Phase B (includes Bridge)	1 Jun 2003 to 31 Dec 2003
Preliminary Design Review	15 Oct 2003
Confirmation Review	15 Dec 2003
Phase C/D	1 Jan 2004 to 31 Aug 2007
HMI Delivery	1 Jun 2006
Integration	1 Jun 2006 to 31 Jul 2007
Launch	1 Aug 2007
HMI Commissioning	1 Aug 2007 to 31 Aug 2007
Phase E	1 Sep 2007 to 31 Aug 2013

Table E.1 - HMI Critical Dates

A narrative monthly progress report will be provided to NASA and all team members. Besides providing program status, these reports discuss problem/risk areas, proposed solutions, and specific activities planned for the next month. The reports include information from our partners in a manner equivalent to that from the subsystem leads. Like almost all documentation, the reports are posted on the Web for archival use.

E.2.3 Cost and Schedule Control

The keys to controlling cost and schedule include (1) having a clearly defined set of requirements/tasks, (2) making accurate original cost estimates, (3) continual review of all requirements and interfaces, (4) making early and firm decisions based on these reviews, (5) replanning as the program evolves, and (6) using management tools that provide clear visibility into the status of the program. These features have been fine tuned on prior successful programs of this nature with the constant realization that the available resources only allow a task to be completed "well enough".

During the preparation of this proposal, the program was defined by the scientists and engineers in a coordinated manner and documented in a detailed WBS, schedule, and cost estimates. These will be refined during Phase A of the program, resulting in a formal proposal to NASA, and kept current thereafter. Monthly and quarterly financial reports will be provided to NASA in the standard 533M and 533Q formats, and the schedule will be

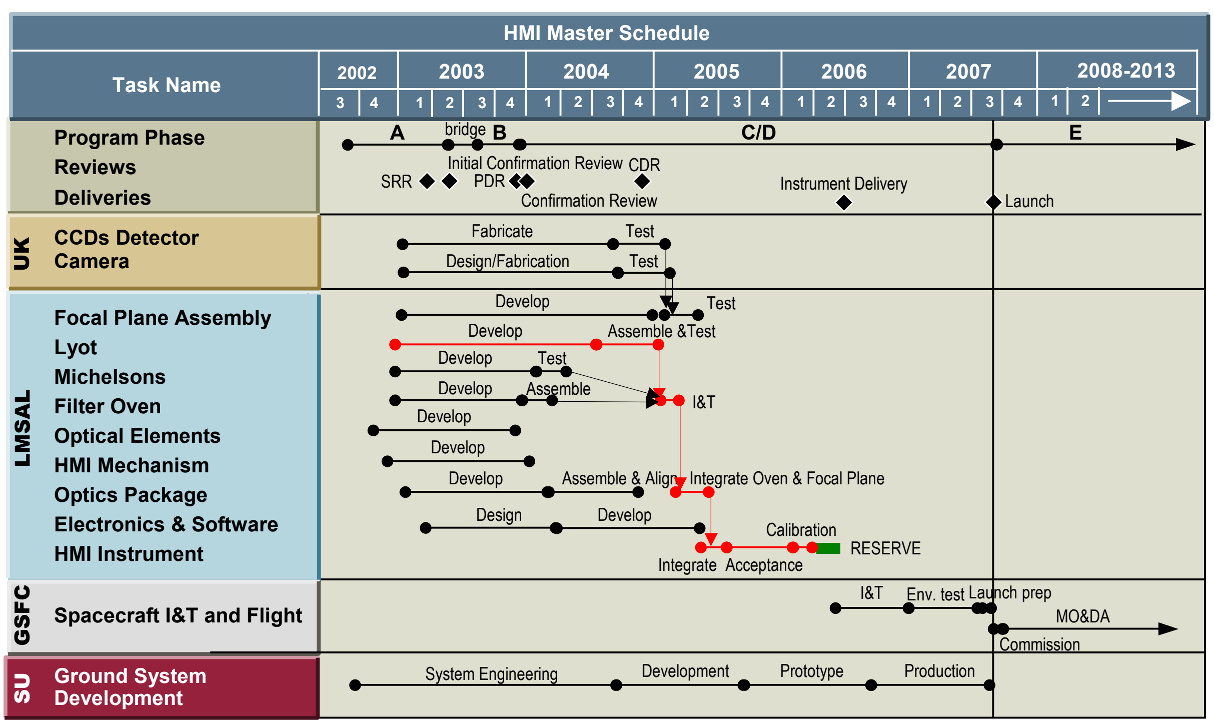

Figure E.4: The top-level HMI schedule shows key links, milestones, and the location of the activities. The EPO activities begin in Phase A and continue throughout the program. Funded reserves are shown in green; the critical path shows in red.

provided monthly using Microsoft Project.

E2.4 Schedule

Table E.1 shows our interpretation of the AO dates, and **Figure E.4** shows the top-level program schedule with major reviews. The total time span is consistent with our experiences on prior programs. The expenditure of about 6% of the contract funds during Phase A of the program will enable us to ramp up immediately after contract award in order to position ourselves for meeting the remainder of the schedule. The LMSAL experience on the TRACE program provides confidence that because the spacecraft will be built in-house at GSFC, detailed spacecraft interfaces and resource allocations can be established rapidly, a necessary feature to minimizing schedule and cost risk. We have already made a much more detailed schedule than that shown in **Figure E.4**. It will be revised during Phase A of the program with each responsible engineer creating a subsystem schedule, iterating it with the PM, "signing up to it", and reviewing it with the PM and Resource Manager at least monthly.

The E/PO program described in section D.1 will begin as quickly as possibly to have materials and training complete well before the flight phase of the mission.

E.2.5 Risk Management Plan

The HMI risk management approach has developed from the LMSAL involvement in a series major space programs, most recently the Solar-B and STEREO programs. By conceiving an instrument with extensive heritage and little new technology, we begin the program with minimal intrinsic risk. This will be further aided by beginning work early on elements that are likely to consume the most time. All members of the HMI team will be made fully aware that early identification of possible risks is an important component of their responsibilities.

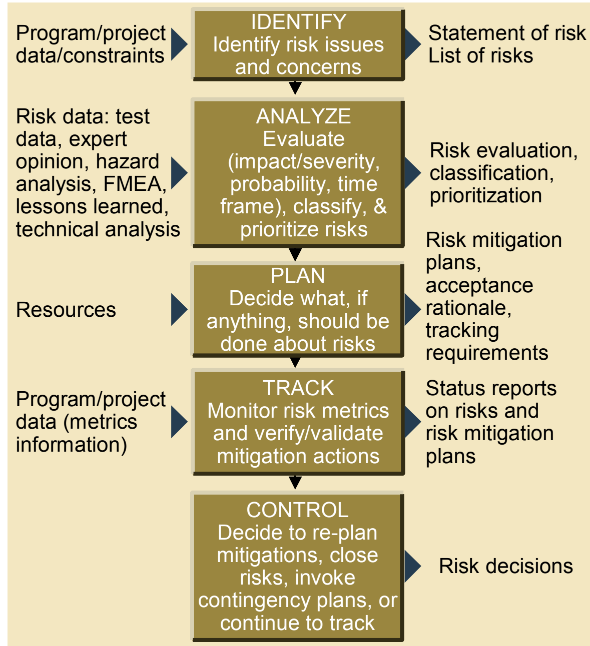

Figure E.5: Risk mitigation is a continuous process throughout the product lifecycle with the results integrated into the HMI development plan.

The Chief Systems Engineer, working with the relevant team members, is responsible for categorizing the risks following a procedure that assigns a probability of occurrence (high, medium, or low) and impact (high or low). All significant risks are thus documented. Those with medium impact and high probability are tracked weekly and any risk with high impact and high probability receives a formal abatement plan in addition to the tracking. The abatement plan includes closure criteria, optional paths, and anticipated cost, schedule and performance hits. Reserves will be allocated as warranted to accomplish the abatement, with NASA immediately involved should the available reserves and closure criteria be incompatible with the existing contract. **Figure E.5** demonstrates the process.

A Risk Management Plan that complies with §4.2 of NPG 7120.5A, as well as with the intent of LMMS Practices P3.1.2, will be formulated during Phase A of the program, as will the initial risk matrix. The risk matrix, which includes planned mitigation measures, will be part of every monthly progress report, enabling the evolution of the risks to be easily tracked. It will also be presented at all major reviews.

E.2.6 Descope Plan

The HMI instrument is a suite as defined by the SDO AO. The "HVMI" component consists of the vector magnetic capability and is the only aspect of the HMI program that could be removed without completely incapacitating the investigation. As foreseen in the AO the vector magnetic capability is a simple enhancement of the HMI instrument. There are two aspects to this possible descope; the first is the CCD camera that is dedicated to the vector field measurements; the second is the capture, processing and distribution of the images generated by the second camera.

Removal of the second camera is estimated to reduce the instrument mass by 3.2 kg and the power by 7 W. It includes the second camera head and electronics, interface electronics, the final beamsplitter, two small flat mirrors, and a shutter. There will be additional mass savings by shrinking the Optics Package width as a result of removing the second light path. The estimated NASA cost savings, however, is only about $480K because the CCD and camera electronics are contributed by the UK. Removing the proposed polarization calibration would save an additional $200K.

The cost savings associated with reducing the ground data processing and science algorithm is harder to quantify. The basic data system is essentially unchanged except for the size of the 30-day data buffer and corresponding calibration processing. The vector field processing, however, is small compared to that required for the helioseismology processing. Reducing the ground data system hardware by 20% will save approximately $300K.

Similarly a 25% reduction in the pre-launch science operations and data analysis software development would save about $600K. Both of these savings would take place after the instrument is completed. A smaller savings would result after launch, because only the archive media costs and science analysis costs could be saved. Only two years of vector field science analysis has been provided in the proposed budget at about $600K.

The HMI instrument design and development plan as outlined in this proposal is based on the MDI instrument heritage and a simple, non-redundant design. The helioseismic and line-of-sight field component of the suite is the rest of the program and cannot be removed if any part of this proposal is selected.

E.2.7 Combined Development with the LMSAL AIA Program

LMSAL is proposing an investigation to accomplish the goals of the AIA portions of the SDO mission, with Dr. A. Title as the PI. The LMSAL AIA flight instrument, if selected, will be developed at LMSAL in collaboration with SAO. Dr. Title and others from LMSAL are Co-Investigators on HMI, and Prof. Scherrer and others from Stanford are Co-Investigators on AIA with the Stanford-Lockheed Institute for Space Research as a common element for both activities. This is the identical approach that was used on the successful MDI and TRACE programs.

If both HMI and AIA are selected, the two programs will be coordinated to eliminate duplication of effort. In addition, some hardware items will be identical, with several mechanisms being prime candidates. A common computer and software system will service both instruments and duplicate EGSE systems (hardware and software) will be used to test the instruments. The cost estimates provided in the next section of this proposal demonstrate the estimated savings that can be achieved by this synergy.

E.2.8 Mission Assurance

The HMI program will utilize the LMSAL Mission Assurance capability for flight hardware and software. The HMI mission assurance function is comprised of quality assurance (hardware and software), systems safety, reliability, EEE parts control, materials and processes, and contamination control. These combined functions work in concert to ensure that the delivered products meet all requirements with the highest practical reliability. The HMI mission assurance manager, who has a separate reporting chain in the LMSAL management structure, thereby ensuring independent oversight of these critical program aspects, manages these functions. An HMI mission assurance plan, called the PAIP (Product Assurance Implementation Plan) will be written during Phase A in accordance with the SDO specific Instrument Mission Assurance Requirements (IMAR) document.

The LMSAL mission assurance approach ensures that reliability and performance requirements are met throughout the program. A structured system of checks and balances coupled with key inspection points provides the required control. The LMSAL mission assurance personnel are key members of the HMI design team and the design process. A separate LM mission success organization is employed to review the program at critical points. The HMI mission assurance program contains the following elements, each of which will be detailed in the PAIP.

LMSAL has a quality system that is certified to the ISO-9001-1994 standard by the British Standards Institute and is moving towards the newest ISO-9001-2000 standard. Hardware and software quality engineering plays an integral role in all program aspects including the review of all engineering drawings, code design and analysis, shop paper, procurement orders, test procedures and documentation.

A quality inspection function that is staffed with trained and certified inspection personnel who have significant space flight hardware experience. The inspection aspect of the program not only consists of those detailed inspections called out by the shop paper or receiving inspection, but also comprises area surveillance.

A systems safety engineer is involved with all aspects of the design, handling equipment, and GSE reviewing them for safety issues/concerns. In the event that hazards are identified, they are put into a formal hazards analysis format and presented at all major reviews.

A reliability engineer is involved in the program at the outset to ensure that the developed designs comply with of all HMI reliability requirements. This allows reliability driven impacts to be accommodated with minimal cost and schedule impact to the program.

An EEE parts engineer works with the design engineering team, including the reliability engineer, to ensure that all EEE parts requirements are met. The parts engineer manages all aspects of EEE parts program including the generation of the EEE parts list, conducting PCB (Parts Control Board) meetings, issuing PCB minutes, performing GIDEP and internal alert searches, directing the screening of parts, and performing failure analysis on any failed parts.

An M&P (Materials and Process) engineer ensures that those materials and processes selected are qualified and meet the HMI requirements. A materials and process list developed during the design phase of the project identifies the material used, the quantity, and the assembly/drawing number.

A contamination control engineer ensures that all HMI and SDO contamination control and cleanliness requirements are identified and met by working closely with the design engineering team, including the M&P engineer. An HMI Contamination Control Plan will be written during Phase A of the program.

E.2.9 Work Breakdown Structure

A preliminary WBS is shown in **Table E.2**. It reflects the efforts to be performed and is the basis for managing cost and schedule. As a living document, it will change modestly as the program evolves.

HMI WBS
1.0 Stanford University Investigation Development
1.1 Program Management
1.2 Science Development
1.3 Instrument Development Support
1.4 Integration and Test Support
1.5 Ground Data System Development
1.6 SU Pre-launch Science Ops & DA Development
1.7 Co-I Pre-launch Science Ops & DA Development
2.0 LMSAL Instrument Development
2.1 Program Management
2.2 Systems Engineering
2.3 Mission Assurance
2.4 Instrument Subsystems
2.4.1 HMI Optics Package
2.4.1.1 Feed Telescope
2.4.1.2 Image Stabilization System
2.4.1.3 Mechanisms
2.4.1.4 Filters
2.4.1.5 Optical Elements
2.4.1.6 Filter Oven
2.4.1.7 Structure
2.4.1.8 Internal Harness
2.4.2 Camera Subsystem (UK)
2.4.2.1 CCDs (MSSL/Marconi)
2.4.2.2 Camera (RAL/MSSL)
2.4.3 Focal Plane Subsystem
2.4.4 HMI Electronics Box
2.4.5 HMI Intra-Instrument Harness
2.5 Software (flight and GSE)
2.6 Ground support equipment
2.7 Instrument I&T and Calibration
2.8 Spacecraft I&T Support
2.9 Launch Support
2.10 Pre-launch Science Ops & DA Development
2.11 Special Launch Service Costs – N/A
2.12 Special Ground Data Systems Costs – N/A
2.13 Reserves
3.0 Science Operations & Data Analysis
3.1 SU Post launch Science Operations
3.2 SU Post launch Data analysis
3.2 Co-I Post launch Data analysis
3.2 LMSAL Post launch Science Operations s
3.2 LMSAL Post launch Data analysis
4.0 Education and Public Outreach
4.1 Pre-launch E/PO
4.2 Post launch E/PO

Table E-2. Phase B/C/D/E WBS