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Subject: IMPACT Monthly Technical Progress Report, Contract NAS5-00133

Lil:

Enclosed is the monthly technical progress report for the STEREO IMPACT project for the month of July 2003.

Sincerely,

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CC:

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IMPACT Team

1. IMPACT Overview

This report is presented in sections by institution. Section 1 is an IMPACT Project Manager / System Engineer's overview.

1.1. *Contracting / Funding*

Funding through the end of FY03 is in place. Because of pipe-line delays in the system through to the subcontractors (Caltech and UMd) it is important that IMPACT be funded somewhat in advance of expected spending.

A budget re-planning exercise is in progress. This plan will take into account some recent unanticipated expenditures and over-budget items in the IMPACT boom area at UCB. It will also address how schedule delays in the IMPACT development will impact manpower requirements and hence funding.

1.2. *Significant System-Level Accomplishments*

- Participated in EMC and Contamination Control Committee telecons
- Participated in MAG workshop
- Held a number of Parts Control Board meetings to review and approve parts lists for boards ready for flight build
- Held flight software reviews for HET/SIT (GSFC) and LET/SEP Central (Caltech)

1.3. *System Design Updates*

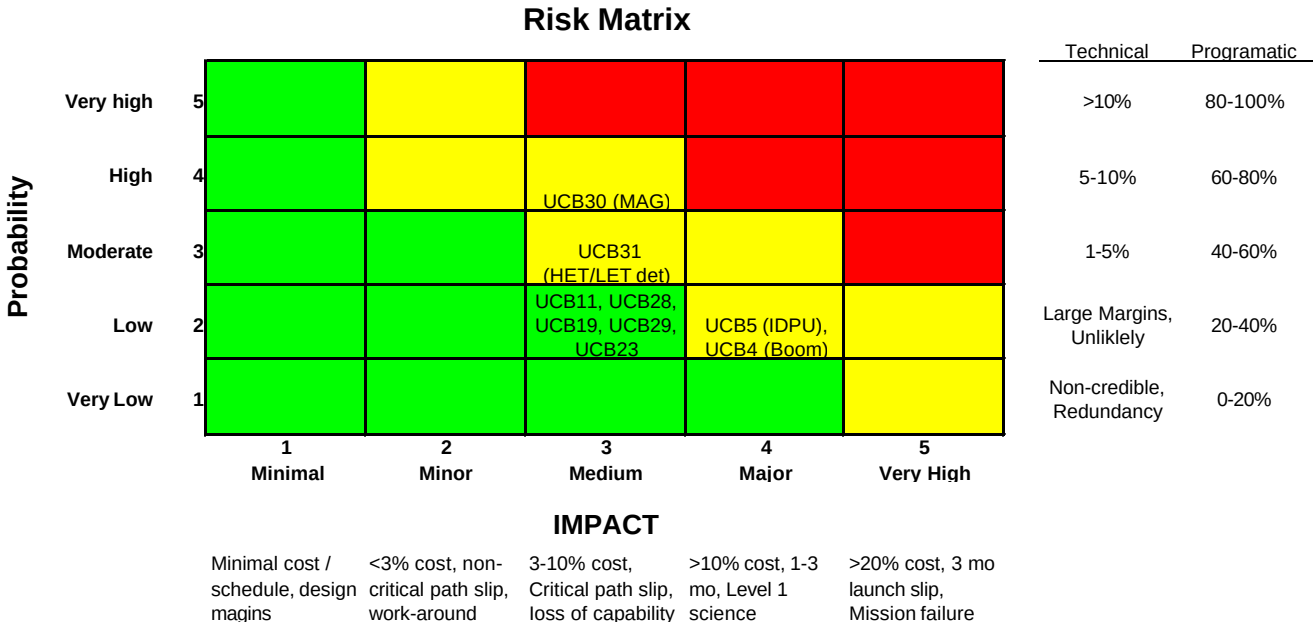
- None

1.4. *System Outstanding Issues*

- New boom cork contamination waiver submitted, pending test results.

1.5. *Top 10 Risks*

Top 10 risks are attached. No change from last month. Note that we do not consider the Actel current spike issue a sufficiently high risk to make the top 10 since we understand the problem and we have a solution planned.


Risk Matrix
Probability
Very high 5
High 4
Moderate 3
Low 2
Very Low 1
UCB30 (MAG)
UCB31 (HET/LET det)
UCB11, UCB28, UCB19, UCB29, UCB23
UCB5 (IDPU), UCB4 (Boom)
1 Minimal
2 Minor
3 Medium
4 Major
5 Very High
IMPACT
Technical
Programatic
>10% 80-100%
5-10% 60-80%
1-5% 40-60%
Large Margins, Unliklely 20-40%
Non-credible, Redundancy 0-20%
Minimal cost / schedule, design magins
<3% cost, non-critical path slip, work-around
3-10% cost, Critical path slip, loss of capability
>10% cost, 1-3 mo, Level 1 science
>20% cost, 3 mo launch slip, Mission failure

IMPACT Top Ten Risks 4/2003

No.	Risk Item	Score	Mitigation	Mitigation Schedule						
				PDR	EM Test	CDR	Sub-system Test	System Test	Env test	Early Orbit Test
UCB_5	IMPACT boom is a new design. Failure could affect Imager pointing requirements as well as boom-mounted instruments.	MEDIUM	Design for reliability. Early prototype testing. Adequate force margins.	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW
UCB_30	SECCHI magnetics (especially filter wheen motor) may exceed magnetics requirement, impacting MAG science	MEDIUM	Test to evaluate possible screening techniques; evaluate modeling capability if screening fails	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW
UCB_4	The IDPU is a single point failure mechanisim for the IMPACT suite and PLASTIC	MEDIUM	IDPU is a simple, reliable system. Extra attention will be paid to ensuring its reliability, minimizing the risk of fault propagation. Early prototype testing; extensive FM testing	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
UCB_31	HET/LET ETU detector mounting difficulties impacting schedule	MEDIUM	Idnetify and solve problems; bring in outside experts to evaluate process, continue with flight detector fab in parallel	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW
UCB_23	Non-standard parts qualification failure could impact delivery schedule	LOW	Early parts selection and screening	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW
UCB_27	Actel timing differences between flight & ETU parts may cause failures late in testing impacting delivery schedule	LOW	Do FM Thermal Vac early to allow time for finding and fixing timing problems; for designs on the critical path, consider installing a flight Actel in the ETU & thermal cycle.	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW
UCB_11	Stringent EMI requirements may delay schedule if testing fails	LOW	Careful design, ETU power converter testing, early system testing	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW
UCB_28	Thermal limitations of detectors result in a low bakeout temperature which might require a very long bakeout impacting delivery schedule	LOW	Bakeout subsystems prior to detector integration to reduce time of instrument-level bakeout; early bakeout	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW
UCB_19	Concern about fragility of ITO surfaces required to meet ESC requirements; failure will impact SWEA science	LOW	Replace ITO with more robust solution where possible; test ITO surfaces during I&T and replace when required	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW	LOW
UCB_29	LVPS behind schedule, on critical path; further slipping could delay delivery to spacecraft	LOW	Add manpower to LVPS task to avoid further slippage	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW	LOW	LOW

2. Berkeley Status

2.1. *Summary of Status*

Schedule status through June has been provided separately.

2.2. *Major Accomplishments*

SWEA/STE:

- Integrated and tested the full ETU SWEA/STE/Interface/LVPS unit.
- Performed vacuum calibration tests on the combined stack
- Discovered a problem with the LVPS at high temperature; rework to fix the problem in progress (not a significant change)
- Working on the modifications to the layouts in the interface and STE boards for flight.

IDPU:

- Flight Software: Working on Build 3 for IMPACT.
- PLASTIC software Build #2.3 in progress, with a target delivery date of August for the IDPU/PLASTIC ETU interface test.

LVPS/HVPS:

- SIT HVPS FM #1 build near completion (problem with shield wall PWB fixed)
- SWEA/STE LVPS ETU delivered, tested with SWEA/STE interface
- PLASTIC LVPS ETU tested, delivered to UNH.
- SEP LVPS ETU build in progress, partially completed LVPS in test
- Working to add power sequencing to Actel supplies in SEP and IDPU LVPS

Boom:

- Qual Boom vibration test, preliminary alignment test, stiffness tests complete
- Thermal vacuum tank completed and tested. An anomaly with a heater during test resulted in over-heating and contamination of the tank. Heaters reworked to fix the problem and cleaning in progress (holding up start of thermal vac tests on the qual unit).

GSE:

- Continued additions to C&T GSE, SWEA/STE GSE.

2.3. *Design Updates*

- None.

2.4. *Outstanding Problems*

2.5. *New Problems*

2.6. *Top Risks.*

- LVPS schedule tight

2.7. *Problem/Failure Quick Look*

None.

3. GSFC (SEP) Status

STEREO/IMPACT/SEP/GSFC Progress Report for July, 2003 – (von Rosenvinge, Baker, Hawk, Reames, Shuman, Wortman)

3.1. *Summary of Status*

The delivery dates of the HET flight units have been revised from 12/23/03 and 1/22/04 to 2/28/04 and 3/15/04. The new delivery dates are needed for various reasons: (1) problems with obtaining fully qualified detector mounts has slowed delivery of flight detectors, (2) additional time was needed to complete evaluation of the engineering electronics, (3) approval of the flight parts list has been slow, and (4) flight PHASICs will be delivered later than previously expected. This delay has been factored into a reorganization of the SEP I&T plan.

3.2. *Major Accomplishments*

The SIT Engineering Test Unit was delivered to Caltech by the University of Maryland for an interface test with SEP Central at the end of July. GSFC is responsible for the SIT on-board code. After a number of problems were resolved, SIT successfully completed the interface test.

Nine L2 detector mounts were shipped to Micron after two weeks of delay due to an unanticipated requirement for a written procedure for the soldering of connectors to detector mounts. A test of the cleanliness of the boards showed that the procedure leaves no measurable amount of contamination.

Twenty new H1 detector mounts have been received behind schedule. Of these, 7 have been rejected for various reasons and all 20 have a residual glue bead squeezed out in the manufacturing process. This bead needs to be removed, preferably by the manufacturer. We estimate that these will not be delivered to Micron until the end of August. We had hoped to salvage H3 detector mounts which we had received, but this was not possible. Forty new H3 detector mounts are due here on August 21.

The SEP Central outline drawings were all updated and checked in order to accelerate completion of the designs of all the SEP Central boards.

241Am spectra have been taken for all the prototype detectors. Scans of two L3 detector prototypes with an 241Am alpha source at Caltech is consistent with our measurements which showed that the middle of 3 segments has the highest depletion voltage. Apparently this is due to lower resistivity near the center of the Si boule from which the detector wafer is cut as compared to the edges.

The HET onboard penetrating particle processing algorithm and the corresponding tables were nearly completed. Continued testing of the HET ETU is also near completion.

A review of the HET and SIT software development was conducted on July 24. This revealed a large growth in the size of the LET on-board tables.

3.2.1. Next Month-

- Process new H1 and H3 detector mounts and ship to Micron. Complete the shipments of L1 and L2 detector mounts.
- Update ICD with APL to include mounting hole diameters and correct LET FOV.
- Make modifications to the LET housing to accommodate the L1 mounts.
- Update mass of SEP Main.
- Complete testing of HET ETU and continue associated software development.
- Complete approval of HET flight parts list.
- Refine the design of the HET front-end electronics. This will follow changes being made in the LET front-end electronics.
- Complete thermal blanket definition. Deliver thermal models to APL.
- Work on defining the HET and SEPT radioactive sources to be supplied by GSFC.

3.3. *Design Updates*

Need to update mass of SEP Main. This has been outstanding for a while.

3.4. *Outstanding Problems.*

3.5. *New Problems*

The choice of thermal blanket materials is being revisited because of manufacturability problems. The thermal design of the SIT sun-shade is being evolved.

3.6. *Top Risks*

No significant risks at GSFC? Need to ensure that manpower becomes available per the current plan.
We are running behind schedule with respect to detectors and the HET final electronics design. The HET delivery dates have been revised accordingly.

3.7. *Problem/Failure Quick Look*

4. Kiel/ESTEC (SEPT) Status

July 2003

4.1. *Summary of Status*

1. Kiel: Vacation time in mechanical workshop causes longer delays than anticipated, but overall delay is driven by late delivery of detectors from Canberra. The company changed their production site causing a complete shutdown of several weeks followed by a maintenance period of some more weeks. Now, detector delivery is expected in week 37.
2. ESTEC: Missing PDFE biasing resistors (see below) cause delay of beginning of the analog board tests. Total delay 2 to 3 weeks for the two first models, manufacturing of the next two models will start as soon as possible to absorb delays.
3. Costs: Budget problems with Kiel budget: need to find ways to reduce costs for forthcoming environmental tests.

4.2. *Major Accomplishments*

a) Fabrication of flight model housing nearing completion: 25 out of 30 items complete (each item in at least 5 copies, at most 20 copies). To absorb delays, all completed items are already sent off for Alodine 1200 surface treatment.
b) PDFE flight lot delivered with data log, but some PDFE biasing resistors missing (the values are just outside the initially foreseen range). New values quoted and ordered, two weeks delivery time best case.
c) FM1 and FM2 analog board manufacturing has started on the 14th July but delay due to missing PDFE biasing resistors + high values resistors: some high value resistors used in the leakage current measurement circuitry have been accidentally mixed (they had been previously screened measured and sorted by MASER company). New measurements and sorting have been performed, leading to one week delay.
d) Engineering Model electronics test report compiled.
e) FM1 digital board tested successfully, FM2 digital board tests started.
f) GSE power supply Model 1 delivered and tested (additional software being still developed)
g) PCB part list approval:
    a. documents are still to be produced by ESTEC
    b. coax cable internal to E-box shall be replaced by a non-magnetic one provided by UCB (delivery pending). The sensor RG178 coax cable will not be changed, but sample will be sent to Mario Acuna. It will be a major concern should he disapprove!
    c. Additional test to be performed on 100 nF capacitors, AD590, screening needed for MMCX and SSMC connectors

4.3. *Design Updates*

4.4. *Outstanding Problems*

1. Procurement of the thermal coating (MSA94B) from Swales Aerospace poses still some problems. Sandy Shuman's proposal to have us send the mechanical parts to GSFC for painting was initially welcomed, but later discarded due to risks for the

magnets of extremely high remanence (needs extreme care, non-magnetic tools, special mechanical fixture for masking). Our preference: have GSFC provide the paint (about 1 Liter) to Kiel.

4.5. *New Problems*

1. Delay in detector delivery (see above).
2. Budget problem for environmental tests. The German funding agency (DLR) is informed, no answer yet. ESTEC (Trevor Sanderson) is informed, no answer yet.

4.6. *Top Risks*

4.7. *Problem/Failure Quick Look*

5. Caltech/JPL (SEP) Status

5.1. *Summary of Status*

Activities centered on detector development, electronics development, and flight and GSE software development.

5.1.1. Major Accomplishments:

A software review was held at Caltech during July.

5.1.2. Critical Milestones status:

There is some confusion about the milestone dates in some cases. We are in the process of updating the schedule. The milestone dates in the IMPACT Critical Milestone Chart of 5/31/03 don't always agree with the latest planning. So, in the below status I will call out two planned dates. The Milestone Chart date of 5/31/03 will be prefixed with the letter M. The latest schedule date will be prefixed with the letter C.

- Milestone 13 (SEP-ETU LVPS Available) has yet to be accomplished. (Planned: M 5/5/03; C 5/5/03; latest guess: 8/31/03). We have not been losing schedule time due to this late delivery as we are using bench supplies to substitute for the LVPS.
- There were no milestones in July for LET or SEP Central on the IMPACT Critical Milestones chart dated 5/31/03.

Detectors:

- The thermal-vacuum life test of six L1 detectors (3 of the membrane devices and 3 of the thick/thin version) was completed and all these detectors preformed well. A new thermal-vacuum run was started, including six more L1 detectors (again 3 membrane and 3 thick/thin), two L2 prototype detectors, and two L3 prototype detectors.
- Thickness maps were made of the three membrane-type L1 detectors that had been in the first thermal-vacuum run. All three had acceptable thickness uniformity. The absolute thicknesses, which ranged from 23 to 29 microns, were closer to the specified 18-22 microns than were the three L1 detectors previously mapped.
- Depletion characteristics of three membrane-type L1 detectors and all of the prototype L2 and L3 detectors (two each) were investigated by mapping the response to a mono-energetic alpha particle source with the alphas incident on the ohmic (back) side of the detectors. This was done at a sequence of bias voltages spanning the nominal depletion bias reported by Micron Semiconductor. All detectors had acceptable depletion voltages and alpha particle responses.

- Micron was given the go-ahead to produce flight L3 detectors using the mounts what were approved by Goddard QA after investigation of minor amounts of gold overhanging edges of some copper traces.

Electronics:

- LET rigid-flex EM board was fabricated by Pioneer Circuits and delivered one week ahead of schedule. The board is now populated and being tested. Results look very promising so far. All four PHASICs are installed and functioning. Support electronics including housekeeping ADC, series regulators, and heater circuit are checked out. Each PHASIC channel is being set up separately to operate at the intended gain and

low threshold. All the A side channels have been tested successfully except for one of the L2 channels which cannot operate at low threshold due to cross-talk from a particular digital signal to that preamp input. B-side is next.

- To support the testing of the LET front end/MISC board, the LET MISC ACTEL design was completed and most of the low-level flight software was written and tested (i.e. the software which interfaces directly with the PHASICs.). The LET MISC design includes a second-generation front-end control state machine optimized to perform with a hardware FIFO for minimum dead time per event. Due to the FIFO, minimum dead time for near-threshold events is near 6 usec and the time response of the MISC to event interrupts is non-critical (i.e. does not contribute to dead time). The new front-end controller flow chart was sent to GSFC.
- Also to support LET development and test, some additional S/W work was done for SEP Central. We are routinely using the SEP Central EM logic board to interface with LET (so we consider the LET I/F test to be completed). SEP Central routinely boots LET and development S/W is routinely downloaded through SEP Central, with command responses flowing back through SEP Central to a laptop GSE. Once code is verified to work properly in LET, S/W facility now exists to copy the working code from LET into SEP Central EEPROM as a bootable LET code image.
- I/F test between SIT ETU and SEP_Central electronics was successful after shipping-related solder joint repair on SIT ETU resolved initial problems. We were able to boot SIT MISC, send commands from SEP Central, and receive SIT data packets.
- SEP_Central Logic board schematics and layout were updated for flight. The location of mounting holes and D connector are the only updates remaining to be implemented before final release.
- PHASIC hybrid burn-in board layout completed and three boards fabricated. Each board will be able to accommodate nine hybrids during the burn-in test.
- Competitive quotes obtained for up-screening of heritage flight parts.
- Completed temperature tests for Analog/Post-Reg and HV Bias Supplies. Both Boards passed tests over temperature range of -40 C to +55 C.

Software:

- Prepared for flight software review.
- Worked on LET onboard event processing software.

GSE:

- Replaced the temporary data capture system with a permanent run-based logging system. The system captures and places in individual files, organized by run, the raw telemetry in the form of payload telemetry packets, the fixed SEP Housekeeping, the SEP command responses, the LET counters, and the LET events. Other data structures will be added to this list as the SEP/LET data formats are completed.
- Wrote the IDL interface routines for accessing the data structures that are currently in the run-based logging system. Interface codes for the other SEP/LET structures will be added as the data formats are completed.
- Modified the software that reads and generates telecommand packets to accommodate a checksum added to the format. Also, modified the software to drop the secondary header from real-time telecommand packets.

5.2. *Design Updates*

- Resource updates will be sent separately.

5.3. *Outstanding Problems*

- The problems with the two flight Actels are still being investigated by Actel.
- L1, L2, and L3 detector mount problems have been resolved. H1 and H3 mounts are still a problem.

5.4. *New Problems*

- None

5.5. *Top Risks.*

- The budget is very tight with no reserve being held at Caltech.

5.6. *Problem/Failure Quick Look*

- None.

6. SIT MONTHLY TECHNICAL PROGRESS REPORT
July 2003

6.1. *SUMMARY of STATUS*

a. SIT TELESCOPE - Prototype is in house and working. Flight solid state detectors are in house, awaiting test. Flight Microchannel plates are in house and are tested. Foils are at GSFC.
b. SIT TOF System - FM1 has been downgraded to ETU and returned to UMd. Work is proceeding at MPAe to generate a new FM1 and FM2.
c. SIT Energy/Logic System – ETU Energy system, ETU TOF system and the ETU motherboard have been integrated with the ETU Logic system including front-end logic and MISC. Testing is underway at Umd.
d. SIT HVPS - Flight HVPS ETU is being built at UCB.

6.1.1. Schedule Changes

The current SIT schedule is available from Jim Rogers

6.2. *MAJOR ACCOMPLISHMENTS*

6.2.1. This Month

- Energy Boards: Energy boards and parts were submitted to GSFC for flight assembly. Concerns arose on some of the parts and work was begun to resolve them.
- TOF: A PCB was held to resolve concerns about the parts lists for the analog and digital TOF boards. Considerable progress was made on the ATOF list and some progress was made on the DTOF list but remaining issues continued to be worked after the meeting.
- ETU: The assembled ETU with energy, TOF, logic board and mother board continued in troubleshooting. Non-flight code was written to verify the proper operation of MISC and ACTEL logic. The first cut at the flight code was tried and gotten to work at a basic level – packets were being generated but without data, and the command system was shown to work. The system was shipped to Caltech for interface testing. This was begun but not completed by the end of the month.
- Detectors: MCP testing finished

6.2.2. Next Month

Next month we will complete ETU I/F testing at Caltech. We will get the flight code to put out correct data and will begin verifying its full functionality. Development of non-flight code for rapid calibration and testing of the system will continue and we hope to connect the ETU to the ETU telescope and verify end-to-end function. We expect to get the flight energy boards assembled and to resolve the parts issues on the TOF system to allow MPAe to finally begin construction of the flight TOF boards.

6.3. *DESIGN UPDATES*

6.3.1. Resources

	Last Month	This Month	Change
Mass (kg) *	1.46	1.46	0
Power (W)	1.36	1.56	0.2
Telemetry (bps)	418	418	0

* Includes 200g book-kept by GSFC for SIT structure
A new estimate of Actel power for the flight units indicates that power will increase. Previous estimates had neglected the effect of the triple gates in the flight units for single-event upset protection.

6.4. *OUTSTANDING PROBLEMS*

We are continuing to work TOF parts issues.

6.5. *NEW PROBLEMS*

We are working Energy parts issues.

6.6. *NEW RISKS*

6.7. *PROBLEM/FAILURE QUICK LOOK*

Starts at first turn-on of flight hardware.

ID #	Description	Assignee	Opened	Closed

7. CESR (SWEA) Status

CESR- TOULOUSE- France **Author : Claude Aoustin / Project Manager**

SWEA PROGRESS REPORT # 22
(August 19, 2003)

July 2003

CESR is in charge of :
- Electrostatic analyzer with deflectors, grids and Retractable Cover
- Detector consisting of two MCP rings
- Amplifiers and discriminators
- 3 High voltages

7.1. *Summary of Status*

7.1.1. ETU1

Delivery to UCB was planned for 12/07/2002 : done 26/09/2002

7.1.2. ETU2

Mechanical fabrication 100 % done
Integration done for the vacuum test configuration.
Electronic boards tested (100 %).

7.1.3. FM1 / FM2

Mechanical fabrication 97 % done.
Grids for FM1 delivered on July 31. For FM2 delivery planned for mid September.
Surface treatment of the analyzer spheres done.
Surface treatment (gold, alodine) done.
Pin Puller integrated and tested.
Electronics boards fabrication :
Done for HV coupling board
Done for amplifiers board
Done for the HV board

7.2. *Major accomplishments*

Mechanical fabrication of the grids done on FM1.
Final integration of FM1 done July 31.
MCP characterization done.
Experiment fully integrated in vacuum.

7.3. *Design Updates*

Mass : 1040 g (EM is 950g without cover opening mechanism)
Power : 446 mW min ; 662 mW max

7.4. *Outstanding Problems*

Answer to comments on parts list sent. Still some answers to be clarified. Telecon planned before end of August.
Answer to comments on materials list sent. Samples of EP851 and Delrin sent to Johanne Uber.
Additional heater (0.5 watts) not needed.

7.5. *New problems*

None

7.6. *Top Risks*

7.7. *Problem Failure Quick Look*

None

8. GSFC (MAG) Status

ETU#2 MAG testing in progress; predict work on flight boards to start next month.
Flight parts procurement complete, screening to be completed next month

9. EPO at UCB

Monthly E/PO Report July, 2003

Formal Education:

We have finished the second draft of the magnetism and IMPACT boom lesson after getting feedback from several people including a California high school teacher, Tom Shefler. This draft of the lesson is now being read by people in the E/PO community and middle school teachers.

We had a Teacher PD workshop at the SSL on July 19th, following the Lawrence Hall Science GEMS workshop. 15 teachers attended the workshop from all over the country. In this workshop we taught two GEMS teacher guides (The Real Reasons for Seasons and Living with a Star), gave lectures on NASA sun-earth connection science and missions, and introduced the teachers to NASA EPO materials. We received very positive evaluations of the workshop and have sent extra materials for the teachers to use in their own teacher PD workshops and in their classrooms.

Public Outreach:

The "News and Events" 2003 IMPACT web page was updated.

With the help of I. Ruderman, L. Peticolas filmed several aspects of testing the boom. These movies have been given to J. Luhmann and P. Turin.

STEREO Mission:

The movies of the boom testing will be sent to Rachel Weintraub at the Goddard Visualization Center so that they might be included in the STEREO pre-launch visualization project. L. Peticolas has had several discussions via email with the group at Goddard regarding this project to ensure that IMPACT is represented.

Respectfully Submitted,
IMPACT E/PO scientists Nahide Craig, Laura Peticolas