

MONTHLY STATUS REPORT
NOVEMBER, 1998
Solar Terrestrial Relations Observatory (STEREO)

SYSTEM

The APL STEREO team expanded this month with the inclusion of new tasks in the Pre-Phase A statement of work. A lead-engineer costing exercise will start in December as the conceptual design firms.

MISSION DESIGN AND NAVIGATION

Performed analysis of leading trajectories to evaluate impact of trajectory selection on telecommunication system design. Developed a family of leading planar 30 deg. per year drift rate trajectories to evaluate the effect of the escape direction on the Sun-Probe-Earth angle evolution. The Sun-Probe-Earth angle evolution is a driver for the telecommunication systems. A second family of planar trajectories, using constant launch energy, with drift rates from 10 to 30 deg. per year was developed for use in selection of the desired mission orbit configuration by the science team. Initiated development of non-planar trajectories. Continued analysis of navigation techniques.

MECHANICAL DESIGN

Development of the STEREO payload configuration for the Athena II launch vehicle (Lunar Prospector) continued during the reporting period. Attitude control and momentum dumping components were relocated on the payload to enhance the spacecraft pointing capability. Fanbeam mid-gain and low-gain RF antennas were located on the payload.

Held a technical meeting with United Space Alliance (USA) and Thiokol personnel to discuss the use of the Shuttle for STEREO spacecraft launch. Interface requirements with the STAR 48 solid rocket motor (for Shuttle launch) and the STAR 37 solid rocket motor (for Athena II launch) were discussed with Thiokol personnel.

Vendor discussions were held with ASTRO Aerospace Corporation concerning candidate booms and masts for use with the magnetometer.

We also had vendor discussions with BEI Sensors and Systems Company, Techstar Electro Systems and Honeywell Electro Components concerning candidate gimbal drives for the high gain antenna.

STRUCTURE

Performed preliminary mass properties calculations for STEREO orbit configurations. These calculations were delivered to Guidance and Control for use in their modeling effort.

SOFTWARE

Minor changes were made to the proposed spacecraft-instrument interface document in response to comments from GSFC.

A preliminary estimate of time and memory margins was made for each processor based on TIMED statistics and projected STEREO requirements. The C&DH processor appears to have plenty of margin, but the G&C processors (particularly the AIE) may be nearing its limits. Alternative G&C processor architectures that reduce AIE loading, as well as more capable main guidance computers (faster Mongoose or RAD6000) are being investigated.

A study is under way to assess the impact of implementing variable length CCSDS telemetry packets, including hardware and software considerations.

Preliminary investigations are under way to insert new technology for the use of a commercial file system to help manage the solid state recorder and non-volatile memory. A proposal is being prepared in response to a NASA Research Announcement for additional funding for this investigation.

C&DH software impacts of supporting the one-way Doppler navigation technology insertion have been addressed and are being included in the STEREO software requirement baseline.

The flight software data flow architecture is being planned in coordination with mission operations. A meeting is planned with GSFC science operations planners to discuss the overall mission concept of operations and to define preliminary interfaces between science operations, mission operations, and flight software.

COMMAND AND DATA HANDLING

The Command & Data Handling (C&DH) system baseline configuration was presented at the team meeting on 11/5/98. Work has continued in the costing effort in an attempt to obtain TIMED Integrated Electronics Module (IEM) and Attitude Flight Computer (AFC) development numbers. Cost estimates from vendors for the solid state recorder and for components such as radiation tolerant Field-Programmable Gate Arrays are also being pursued.

A baseline design for the AFC and Attitude Interface Electronics (AIE) predicated upon the TIMED design, was presented at the team meeting on 11/19/98. Alternatives with regard to attitude processor upgrades and reduction of system complexity, for both hardware and software, are continuing to be studied.

POWER

Following a tradeoff study given current mission design parameters, the baseline power system architecture has been selected as a pseudo peak power tracking design, based on the TIMED architecture. Load budgets are being refined from original engineering estimates. The effects of penumbral eclipse have been evaluated resulting in a need for minimal need for active load management. A first-order battery analysis has been done to evaluate battery performance for all launch scenarios presented to date. Load reduction in the launch profile or restriction of the launch profile will be required to keep the baseline 9 Amp-Hr battery design.

TELECOMMUNICATION

The baseline HGA dish size is now 1.1m (limited by the fairing envelope). Work is continuing on refining the requirements for the receiver and transmitter cards (based on TIMED design concepts) and determining changes required, starting with the receive card. The science data X-band link performance, using the existing and future upgraded DSN 34m BWG systems, has been calculated for various dish sizes and transmitter powers. The results were presented during the Nov 12 sponsor meeting. Potential X-band amplifiers are being evaluated. Work has started on analyzing the performance obtainable for a Ka-band science downlink and determining available Ka-band amplifiers. Presently there is only one DSN station equipped to support a Ka-band downlink (Goldstone DSS 25), the other stations are planned to be upgraded starting in Sept 2001 with the last station completed Sept 2004.

GUIDANCE AND CONTROL

Contacted OSC and Ithaco and obtained reaction wheel data. It appears that the TRACE/SWAS wheels would be a good candidate for STEREO; Ithaco also has higher torque versions of the NEAR/TIMED wheels. It appears likely that at least 0.14 Nm of torque should be available, in a reasonably sized wheel. This in conjunction with new inertia estimates from the Mechanical group suggests we can expect a control bandwidth of order 1 Hz.

Pointing accuracy during momentum dumping was analyzed, and could in theory be as good as 10 microrad, which easily exceeds the requirements. So, there should not be a problem meeting the 0.1 deg desire for HGA pointing while thrusting.

Adcole was contacted for sun sensor information, including some fine resolution sun sensors. Contacted Litton for gyro information. Met with mechanical group and worked out a layout and arrangement of wheels and IMU that should be much better for jitter.

INSTRUMENT INTERFACE

Work began on a conceptual design for a multi-instrument Data Processing Unit (DPU). This unit would be an option for interfacing the smaller science instruments. A presentation of the work to date is scheduled for 12/3/98.

GROUND SYSTEM, I&T & MISSION OPS

Details are being worked for the I&T, launch operations, and flight operations for dealing with the two STEREO spacecraft. Material is being prepared for presentation to the program on December 10.

In the area of I&T the TIMED I&T schedules and test plans have been obtained. Review of MIL-STD-1540B &C, SDO 2387-1, and NASA -STD-5001 was conducted in preparation for the STEREO I&T plans.

Discussions with Goddard personnel concerning the Science Data Center are being initiated.

PRODUCT ASSURANCE

Initial study of the STEREO radiation environment was completed by Janet Barth of NASA GSFC. APL has reviewed this study and recommended the values of 10 Krads (Si) for the three year total dose hardness level inside or beneath 75 mils of aluminum anywhere on the spacecraft and $5.2E10$ protons/cm² (>10 MeV) for the three year solar array fluence. These values need to be reviewed by Janet Barth before official publication.

Notes are being compiled for PA Plan tailoring.