

SPACE SCIENCE AND ENGINEERING DIVISION

SUN-EARTH CONNECTION ADVISORY SUBCOMMITTEE

11 November 2003

Dr. Andy Christensen, Chair
Space Science Advisory Committee

RE: SECAS Meeting, 4-6 November 2003

Dear Andy,

The Sun-Earth Connection Advisory Subcommittee (SECAS) was happy to meet and review the state of the Office of Space Science (OSS) Sun-Earth Connection (SEC) Division and theme in Washington D.C. on 4-6 November 2003. We were delighted to find that SEC continues to be generally healthy as it aggressively pursues a broad-based range of research and flight programs aimed at understanding fundamental space physics phenomena from the interior of the Sun to beyond the outer reaches of the heliosphere: a program that is not only developing a great many new insights into these fundamental phenomena, but also discovering their effects on life and society.

In keeping with our previous reports, this letter will focus only on the top few issues that need special or urgent attention. We hope that this format of highlighting the most crucial areas that come out of each meeting spotlights their importance and helps OSS and SEC focus their limited resources on these most critical areas.

HST Transition and Explorer Program

SECAS has carefully reviewed and affirms the essential importance of the Explorer program to SEC disciplines. This position is further supported by OSS's own 2003 Space Science Enterprise Strategy that states: **"NASA's Explorer Program is an example of the mission lines that are vital to realizing the Enterprise's science objectives."** (NASA Space Science Enterprise Strategy, Oct. 2003, p. 14) In addition the current Strategic Plan makes explicit that *The Explorer Program offers frequent opportunities to carry out small- and medium-sized community-based missions (SMEX and MIDEX) that can be developed and launched in a short (approximately four year) timeframe.* (Strategic Plan, op cit, p. 14)

SECAS is incredulous that the HST-JWST Transition Panel Report could suggest options for additional HST servicing that would involve diverting the entire Explorer line for a significant time, thus subverting the critical and unique role of the Explorer Program. Further, SECAS finds that any disruption of Explorer program resources, as in HST servicing options that place a single very large mission in competition with the fundamentally different intent of the line of



Explorers, would have a drastic negative impact on the SEC program. In our view, such options are in stark conflict with past practice (including, we believe, congressional intent), as well as with the just published OSS Enterprise Strategy.

Further, SECAS notes that:

(1) SEC Explorers are responsible for major scientific achievements that have profoundly transformed understanding of the Sun-Earth system. Some highlights include: visualization of the global dynamics of the geospace system by IMAGE, the multidimensional views of solar activity by RHESSI, discovery of coronal magnetic complexity by TRACE, discovery of trapped anomalous cosmic rays in Earth's magnetosphere by SAMPEX, and discovery of fine scale nonlinear kinetic auroral structures by FAST.

(2) Cost-effective Explorers are an integral part of a distributed fleet of spacecraft needed for study of SEC science. The assumption of a vital Explorer program is so fundamental (see Solar and Space Physics (SSP) Survey, Figure ES.1-ES.2, p. 8-9) in planning SEC science that the SSP survey committee declined to prioritize a mission if it was "gauged to be feasible within the resources of the Explorer program" (SSP Survey, p. 58). Consequently, phasing and planning of SEC missions would be severely disrupted if the Explorer budget is diverted in any significant way.

(3) The recurring opportunity to develop Explorer missions is an essential part of the SEC science strategy and provides creative input into the Space Physics Enterprise that cannot be anticipated in strategic mission lines. The SSP Survey Committee recognizes this, stating, "The Explorer program has long provided the opportunity for targeted investigations, which can complement the larger initiatives recommended by the committee." (SSP Survey, p. 62). The SSP Panel Reports (in press) echo this priority, for example, the Atmosphere-Ionosphere Magnetosphere (AIM) Panel recommends that "SMEX and MIDEX programs should be vigorously maintained". (SSP AIM Report, Rec. #2).

(4) Explorers provide hands-on training of instrumentalists, both scientists and engineers, thus enabling SEC strategic missions, and directly contributing to the Agency Mission "to inspire the next generation of explorers". Interrupting the program would cause a future shortage of required expertise. The SSP Survey assumes that the Explorer program will be maintained, and in addition recommends "Revitalization of University-Class Explorer program for more frequent access to space for focused research projects". (SSP Survey, p. 7)

(5) Managing cost-constrained missions such as Explorers requires specialized expertise and continuity of experience that would be disrupted, SECAS believes permanently, by the interruption of the Explorer program.

(6) According to the SSP Survey Committee (p. 156), the PI class Explorer is a model for efficient, rapidly deployed, smaller scale space science missions.

The above conclusions are strongly held in the SEC community as exemplified by recent MOWG findings. The LWS MOWG "finds that it would be unwise to use Explorer budgetary

authority to pay for Hubble Space Telescope refurbishment or mission extension”. The Geospace MOWG opposes reallocation of Explorer funds across Divisions, and warns that “the consequences of executing the extended HST mission instead of several Explorer missions are severe” and would lead to a “high level of risk to a very productive program”. Likewise, the Solar and Heliospheric MOWG finds that “the particular approach of competing the (HST) servicing mission against the line of future Explorer missions does not, in the view of the SH-MOWG, constitute such (an acceptable) solution”.

Finally, spectacular recent results from WMAP and other missions show that the value and public visibility of Explorers are not limited to SEC science but apply broadly across astrophysics and space science. Therefore, we suggest that it is in the interest of NASA strategic goals across the disciplines, to protect, and if anything expand, the resources available for the Explorer program.

Resolving the ST-5 Flight Crisis

SECAS continues to endorse strongly the ST-5 project as a vital path-finding flight program for Sun-Earth connection missions requiring resource-limited satellites. The three-spacecraft ST-5 flight mission will validate mission-critical elements needed urgently for Magnetospheric Constellation and the many other multi-spacecraft SEC missions in the STP queue, as well as those being developed as PI-class Explorer missions. Prompt flight validation of ST-5 is required in order to provide timely and vital risk reduction for SEC missions now in pre-formulation.

ST-5 will demonstrate that:

1. Resource-limited satellites, employing and validating new technologies and capable of research-quality measurements, can be designed, built, and flown;
2. Economy of scale in the fabrication of multiple, small satellites can be established credibly;
3. Technical issues associated with the operation of a trail-blazing constellation can be explored and assessed in flight.

When ST-5 was selected in 1999, the hope was that a very inexpensive ride-of-opportunity could be found to assure a flight validation by 2004. Despite due diligence by program officials, no such ride has been identified, thus now putting the important ST-5 flight validation at serious risk. We note that all ST flight projects beyond ST-5 have baselined the cost of an appropriate launcher into their budget to ensure flight validation. Specifically, adequate resources for access to space are committed for ST-6, ST-8, and ST-9. However, ST-5 presently has no budget to purchase such access to space, leaving its flight validation in limbo and jeopardizing future missions dependent upon its completion. We believe this inequity is unjustifiable.

To ensure the realization of critical SEC-mission-enabling goals, SECAS reaffirms its earlier strong recommendations (August 2001 and February 2003) to complete the ST-5 flight project and recommends that NMP immediately purchase a dedicated Pegasus launch in order to assure that critical SEC technologies will be validated promptly. As a result of this rebudgeting, SECAS considers the consequential delays of ST-10 and ST-11, each by one year, to be an acceptable and equitable programmatic trade.

SEC Interactions with Project Prometheus

Interstellar Probe (IsP) is an extremely ambitious and compelling future SEC mission to move beyond the limits of the solar system and explore the nearby galaxy *in situ*. Dependable and cost-effective nuclear power providing comparatively large and long-duration propulsion, implemented in a straightforward manner without significantly affecting scientific measurements, would greatly facilitate bringing the IsP mission to reality. Thus, SECAS suggests the addition of IsP to the Prometheus mission line as a second mission goal after Jupiter Icy Moons Orbiter (JIMO). Further, while existing technologies are sufficient for other SEC missions such as Solar Probe and Telemachus, systems being developed by Prometheus may significantly benefit those missions by providing additional flexibility, weight and cost reductions, or systems tailored for specific mission needs. SECAS therefore recommends that the Prometheus Project explore and report how nuclear propulsion technology developments enhance planned and future notional SEC missions. Finally, although there is now an individual from the SEC community on the Prometheus MOWG, SECAS feels that additional SEC representation would greatly enhance the interactions and future collaboration between SEC missions and capabilities developed in Project Prometheus

Vigilance in Cost Control

In light of several recent examples of cost growth in NASA science missions, SECAS endorses the principles embodied in the retirement of risk (including cost risk) at an early stage of the Magnetospheric Multi-Scale (MMS) Mission by increasing the time and resources allocated for the Phase A study to enable a more accurate cost and feasibility assessment by each of the proposing teams. We also reiterate the very high importance we place on holding down program costs in the interest of maintaining a healthy cadence of missions. Maintaining the planned mission timing is particularly crucial for the LWS program, where the target system-level science requires some overlap in the operations of different satellite elements and/or a particular phasing relative to the solar cycle. We are particularly concerned about cost increases in SDO, which have placed in jeopardy both the timing of subsequent LWS missions and the accommodation of a coronagraph, which is judged by our LWS MOWG to be a very important system-level instrument. We encourage Headquarters and program management to reassess the cost drivers for SDO and to seek a mechanism to return coronagraph capability to the LWS program without increasing costs or compromising the schedule or the rest of the science measurements.

Expanded Role for the LWS MOWG

An integral component of LWS has been to enable science that cuts across disciplines and mission boundaries in order to achieve understanding of the Sun-Earth system, and to deliver scientific advances that have demonstrable relevance to life and society. SECAS asks the LWS MOWG to help oversee this activity by using its broad and diverse membership to provide system-level feedback and guidance about the LWS program, both to SECAS and to the LWS leadership in SEC. This includes examination of science objectives and key required connections. It also includes evaluation of integrated approaches that are necessary for LWS to

achieve its broad, long-term goals. Particular attention should be paid to mission architectures and to programmatic requirements.

The LWS MOWG should use the LWS Architecture Committee report as a starting point to articulate an evolving, coherent plan for LWS that is consistent with the current budget realities. The basic science objectives need to be stated in priority order, and a program plan to achieve these objectives needs to be developed. The prioritization of objectives should serve as the basis for the inevitable decisions that will be made in the LWS program. Documenting the goals and priorities of the LWS program and providing a clear exposition of the missions and integrated programs that will achieve these goals should be an ongoing process involving both the MOWG and the LWS program leadership.

Guest Investigator (GI) grants

Guest Investigator (GI) grants play a very important role in NASA's space science program by enabling studies combining data from multiple NASA missions as well as focused studies using individual data sets but undertaken by researchers outside of the original instrument teams. SECAS urges growth of this program element consistent with the constraint that science funding to individual mission teams remains adequate. Some GI funding could be channeled through individual missions if NASA sees advantage in such an implementation, as long as provision is still made for funding studies that cut across several missions, a strength of the existing GI program.

Finally, on a personal note, this was my last meeting as the Chairman of SECAS. Thus, I wanted to take this opportunity to share with the community the tremendous honor that it has been for me to have served on both SECAS and SScAC with such excellent groups of scientists and to have been able to support, in some small way, the tremendous efforts of the truly outstanding men and women serving the Space Science community at NASA Headquarters.

Sincerely yours,



David J. McComas, Chairman
Sun-Earth Connections Advisory Subcommittee

Dr. R. Fisher, NASA-SEC Director
Dr. M. Mellott, SECAS Executive Secretary
Dr. M. Allen, SScAC Executive Secretary
SECAS members