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House Committee on Science and Technology
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Introduction

Mr. Chairman, Ranking Minority member, and members of the Committee, I want to thank you for the opportunity today to address key issues that face the NASA science enterprise. I want specifically to address the impacts of the proposed FY2008 budget on the NASA Heliophysics program. My name is Daniel Baker and I am a professor of astrophysical and planetary sciences at the University of Colorado. I am also the Director of the Laboratory for Atmospheric and Space Physics at CU-Boulder. The Laboratory is a research institute that has over 60 teaching and research faculty in the several disciplines of space and Earth sciences. My institute, which we call LASP for short, receives some $50-$60 million per year to support experimental, theoretical, and data analysis programs in the Space and Earth Sciences. The vast majority of these resources come from NASA. Other strong support comes from NSF, NOAA, and other federal agencies. LASP presently supports some 120 engineers, dozens of highly skilled technicians, and over 20 key support personnel. We are very proud, as well, that LASP has over 60 graduate students and another 60 undergraduate students who are pursuing education and training goals in space science and engineering.

I myself am a space plasma physicist and I have served as a principal investigator on several scientific programs of NASA. I am now a lead investigator in the upcoming Radiation Belt Storm Probe (RBSP) mission that is part of NASA's Living With a Star program. I am also an investigator on NASA's Cluster, Polar, MESSENGER, and Magnetospheric Multi-Scale (MMS) missions. Presently, I serve as Chair of the National Research Council's Committee on Solar and Space Physics. By virtue of that position, I also am a member of the Space Studies Board, chaired by my colleague, Dr. Len Fisk. The views I am presenting here are my own, however.

First, and foremost, I would like to begin by commending the American people, and you as their representatives, for the significant investment made in NASA science. The scientific community is well aware of how difficult it has become to find funding for the many worthy programs that you must consider. We sincerely appreciate continued support from Congress and from the American public. It is a major and lasting achievement of our nation that it finds the means and the will to look beyond the pressure of present-day concerns, to focus on questions about humanity's place in the universe, our relationship to our Sun and the nearby planets, how the Earth and its environment have functioned in the past, and how they may change in the future. I believe – as do you, I suspect – that the United States has benefited greatly from investment in space research. Not only is the technological base of our country strengthened by NASA innovations, but our prestige and competitiveness in the world and our educational investment in the future technical workforce are greatly enhanced by NASA science leadership.

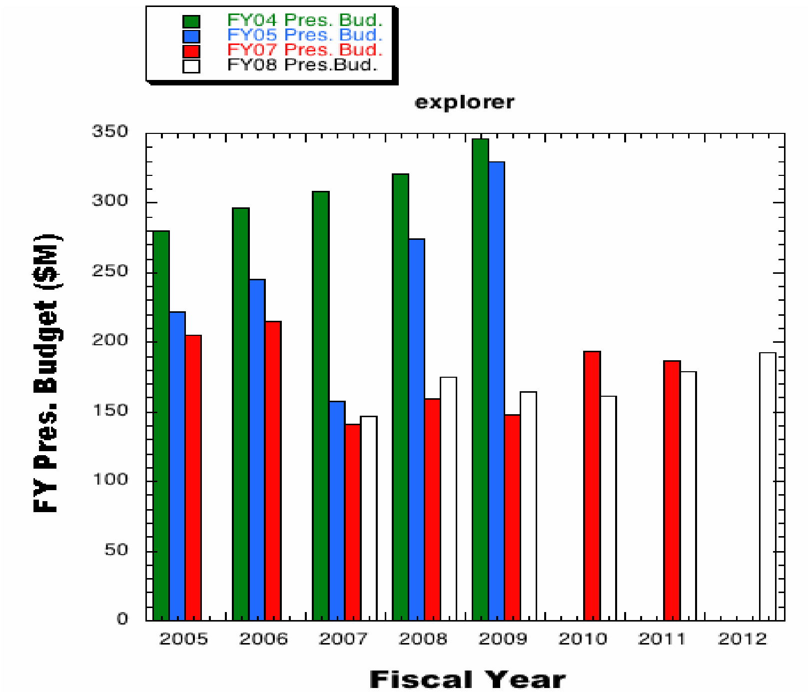
Overview of FY2008 Budget Impacts to the Heliophysics Program

The National Research Council's (NRC's) 2003 Solar and Space Physics (SSP) Decadal Survey, *The Sun to the Earth – and Beyond: A Decadal Strategy for Solar and Space Physics*, laid out a clear, prudent, and effective program of basic and applied research. The envisioned program would address key science objectives such as: understanding magnetic reconnection – the physical process underlying much of space physics; discovering the mechanisms that drive the Sun's activity and produce energetic particle storms in the heliosphere; determining the physical interactions of the Earth's ionosphere with the atmosphere and magnetosphere; as well as addressing a host of other questions that are essential to understanding our local space environment. The Decadal Plan would also have allowed an end-to-end view of the connected Sun-Earth system through NASA's Living With a Star (LWS) program, thereby enhancing greatly the ability to provide realistic specification and forecasts of space weather. Through both its basic research component and its applied component, the Heliophysics Program would therefore contribute substantially and directly to national needs and to the Vision for Space Exploration.

At present, the Heliophysics Division (HPD) of NASA has a number of exciting projects that have been launched or are ready for launch. The dual-spacecraft STEREO mission is being commissioned and is returning amazing new 3-dimensional views of the Heliosphere. Detailed images of the Sun are also being provided by the newly-launched Hinode mission, a joint Japan-U.S. venture. The five-spacecraft THEMIS mission was successfully launched in February 2007 and is already providing remarkable multi-point measurements in Earth's magnetosphere. Because of our large role in the program, we at LASP are very excited about the successful launch just last week of the upper atmospheric AIM spacecraft as part of the Explorer program. The first LWS mission, Solar Dynamics Observatory (SDO), is well into development preparing for launch in 2008. Thus, the HPD program has several highly capable new space assets that are joining the Heliophysics Great Observatory constellation of operating spacecraft.

Beyond this good news, however, there are significant concerns. Beginning with the FY2005 NASA budget plan, and continuing through the FY2008 budget and its 5-year run-out, the future Heliophysics program has been significantly compromised. The Solar-Terrestrial Probes (STP) line of missions has had over half of its budget content removed, resulting in at least a 6-year gap in STP launches. Within the current NASA budget horizon extending to 2015, the STP line is now down to a single mission launch, the Magnetospheric Multi-Scale (MMS) mission. The venerable and highly successful Explorer mission line (managed by HPD for all of NASA) has had over $1 billion of budget authority removed in the run-out from FY2005 onward. As shown in the figure below, the

Explorer budgets in the FY2008 and its run-out are about half of what they would have been expected to be based on the FY2004 budget and its run-out.



As Principal Investigator (PI)-led missions with a rapid development time, Explorers have proven invaluable for investigating the broad range of Heliophysics science. The drastic funding reduction in this line has greatly reduced HPD's ability to respond effectively to new science/technology advances. The sounding rocket program (and, indeed, the entire suborbital program) is at a dangerously low, bare-bones resource level. The Research and Analysis (R&A) program was deeply cut last year and no funding restorations seem likely at present. The impact of these cuts will be felt for many years since R&A, Explorers, and Suborbital programs are key elements in capitalizing on the investments that have already been made and for attracting and training the next generation of space scientists and engineers. Moreover, the high priority "Flagship" mission for Heliophysics, the Solar Probe Mission, is not presently contained in NASA's plan.[1]

The other major component of the Heliophysics program is Living with a Star (LWS). The funding profile for LWS as defined by the FY2005 and FY2006 budgets allowed for a robust program. In the FY2008 budget plans, however, LWS funding is stretched out so that simultaneity between missions such as Radiation Belt Storm Probes (RBSP) and Ionosphere-Thermosphere Storm Probes is lost. Alarmingly, and rather inexplicably, the previously-budgeted funding for the RBSP Missions of Opportunity is eliminated from the FY2008 plan. Such reductions to LWS are threatening the success of the immediate program as well as the timely implementation of missions such as Sentinels, which are necessary to fulfill the President's 2004 Vision for Space Exploration. These reductions are impeding progress in understanding the origins of the severe space weather events that have the potential to disrupt civil and military satellite communications, applications that rely on the Global Positioning System (GPS), and power generation and transmission systems. Given the large investments that NASA will make to fulfill the Vision for Space Exploration and the investments that the nation, as a whole, is increasingly making in space-based technology, it seems ill-considered to decrease support for LWS, the NASA program that is most closely directed toward protecting those investments.[2]

To be sure, some of the fiscal problems in Heliophysics and elsewhere are related to mission cost growth. Much of this problem, however, lies in non-technical issues that the science community and the Decadal Survey could not have anticipated, including substantial increases in launch vehicle costs, the effects of full-cost accounting, and mandates for

[1] The Solar Probe mission was the highest priority large-class mission in the NRC solar and space physics decadal survey. An early start of Solar Probe would have required resources beyond those anticipated at the time the survey was completed; however, the anticipated budgets supported a start in FY2010. Long a priority of the heliophysics community, the Solar Probe mission promises to revolutionize our knowledge of the physics of the origin and evolution of the solar wind. Moreover, by making the only direct, in-situ measurements of the region where some of the deadliest solar energetic particles are energized, Solar Probe would make unique and fundamental contributions to our ability to characterize and forecast the radiation environment in which future space explorers will work and live.

[2] For example, in 2004, it was reported the economic benefits of providing reliable warnings of geomagnetic storms to the electric power industry alone were approximately $450 million over three years. See, "Solar Storms Cause Significant Economic and other Impacts on Earth," and references therein, in NOAA Magazine, available on the internet at: <http://www.magazine.noaa.gov/stories/mag131.htm>.

additional layers of oversight and review. As noted above, the problems with the Heliophysics program started well before the FY2008 budget plan, but the trends have been perpetuated in the FY2008 budget and its 5-year run-out.

Specific Questions Concerning Heliophysics

I present here my detailed answers to the questions addressed to me by the Chairman in his letter of 11 April 2007:

1. Perspective on the balance of the NASA Heliophysics program and its mix of program elements.

Considerable anxiety is being caused in the science community due to the anticipated and extraordinary reductions in the smaller mission opportunities and sustaining research programs that form the support for much of the university-based research (in which students and early-career scientist are involved). Small missions, such as those in the Explorer and Earth System Science Pathfinders programs, provide projects in which new concepts are tested for a modest investment and where students first learn the space science and engineering trade. This particularly applies to sounding rockets, balloons, and aircraft flights that provide opportunities on a time scale that falls within the educational horizon of a graduate student. Since 2000, the historical sounding rocket launch rate has dropped more than half (from about 30 to 10 missions per year), with anticipated further reductions as a result of the FY2008 budget. The present run-out budget places even the regular launch facilities, such as those at Poker Flat in Alaska, in danger by 2008. Staff reductions may be necessary at the Wallops Island Flight Facility in a matter of months if additional funds are not forthcoming to the sounding rocket program. I am delighted that Dr. Alan Stern, the new Science Mission Directorate (SMD) Associate Administrator, is taking actions now to remedy the suborbital situation.

The Explorer program is another prime example of the severe impacts in the Heliophysics program. Explorers are the original science missions of NASA, dating back to the very first U.S. satellite, Explorer I. They are universally recognized as the most successful science projects at NASA, providing insights into both the most remote parts of our universe and the detailed dynamics of our local space environment. The Advanced Composition Explorer (ACE) now stands as our sentinel to measure, in-situ, large mass ejections from the Sun and the energetic particles that are a danger to humans in space. Two relatively recent Explorers, TRACE and RHESSI, study the dynamics of the solar corona where large solar storms originate, storms that often threaten satellites and other technological assets on which we depend. The recently launched THEMIS constellation and the AIM mission were both done under the Explorer program aegis. Explorers are among the most competitive solicitations in NASA science, and offer opportunities for all researchers to propose new and exciting ideas that are selected on the basis of science content, relation to overall NASA strategic goals, and feasibility of execution. As noted in the figure above, the FY2008 proposed run-out for Explorers will mean a program that is reduced by over half from its proposed FY2004 guidelines. I am again encouraged by the fact that a new Announcement of Opportunity for Small Explorers will be released, thanks to Dr. Stern, by October 2007.

A specific continuing concern to university-based scientists is the impact on the sustaining Research and Analysis (R&A) budgets. The R&A program initiates many of the new, small scientific efforts that eventually lead to the major missions that NASA pursues. R&A grants are highly competitive, maximize the science investment of on-going missions by allowing all scientists to use available data, and are heavily geared toward student and young faculty participation. These are moderate-duration efforts, usually lasting three to four years, where new hardware and theoretical approaches are explored. NASA was forced last year by budget realties to propose an across-the-board reduction of 15% in these programs. This may not appear catastrophic at first sight, but a sudden reduction in such a long-term program can have huge effects. If the budget were allowed to grow once again, the R&A program would slowly recover over the next few years. However, with the present budget prospects, there is skepticism about such future restoration. There is widespread recognition that these realities will inevitably reduce the number of new students who enter university programs such as mine.

2. Does the Heliophysics program reflect the priorities of the NRC Decadal Survey in solar and space physics?

Whereas NASA is attempting to implement some of the highest priority programs from the NRC's 2003 Decadal Survey, the pace and balance of activities seems highly unlikely to achieve the Decadal goals. In 2004, an NRC committee was tasked to assess the role of solar and space physics in the Vision for Space Exploration — *Solar and Space Physics and Its Role in Space Exploration*. This committee stated that:

> NASA's Heliophysics program depends upon a balanced portfolio of space-flight missions and of supporting programs and infrastructure. There are two strategic mission lines – Living With a Star (LWS) and Solar-Terrestrial Probes (STP) – and a coordinated set of supporting programs. LWS missions focus on observing the solar activity, from short-term dynamics to long-term evolution, that can affect the Earth, as well as astronauts working and living in a near-Earth space environment. Solar-Terrestrial Probes are focused on exploring the fundamental physical processes of plasma interactions in the solar system.

Solar and Space Physics and Its Role in Exploration examined the 2003 Decadal Survey and made the following three recommendations:

1. To achieve the goals of the exploration vision there must be a robust program, including both the LWS and the STP mission lines, that studies the heliospheric system as a whole and that incorporates a balance of applied and basic science.
2. The programs that underpin the LWS and STP mission lines – MO&DA [Mission Operations and Data Analysis], Explorers, the suborbital program, and SR&T [Supporting Research and Technology] – should continue at a pace and level that will ensure that they can fill their vital roles in Heliophysics research.

3. The near-term priority and sequence of solar, heliospheric, and geospace missions should be maintained as recommended in the Decadal Survey report both for scientific reasons and for the purposes of the exploration vision.

These recommendations remain valid today and the mission priorities within the basic (STP) and applied (LWS) science mission lines as listed in the original Decadal Survey are basically reflected in the Heliophysics budgets for these two mission lines. Where NASA has deviated from the Decadal Survey is in putting greater weight on Living With a Star missions and losing the balance between applied and basic science. Such a priority of emphasizing short-term capability of predicting space weather over the long-term goal of understanding the underlying physical principles may have some practical expedience. A more critical issue, however, is the fact that small missions and supporting research have not kept pace. If these budgets are allowed to decline greatly, Heliophysics will quickly cease to be a robust, viable discipline. It now appears that with mission cost growth and reduced Heliophysics funding, it is very unlikely that most Decadal Survey missions will be completed within the decadal window.

The Sun to the Earth – and Beyond was the first Decadal Survey conducted by the solar and space physics community. The Decadal Survey involved hundreds of scientists in discussions that spanned nearly two years. The scientific priorities set out in the survey remain valid today and there is no community movement to change them. But Decadal Surveys are not just a list of science priorities. To design a coherent program across a decade it is essential to have a realistic budget profile as well as reasonably accurate estimates of both technical readiness and costs of each mission. The Decadal Survey committee worked hard with engineers and NASA management to develop realistic mission costs and a program architecture that fit within budget profiles anticipated in the FY2003 budget. But changes to the budget profile beginning in FY2005 necessitated a substantial stretching of the mission schedule. Furthermore, under-costing of just a few missions wreak havoc with even the best-laid plans. The scientific community needs to work with NASA to find ways to cost missions accurately, particularly large missions (for example, by applying lessons learned from management of smaller, PI-led missions as appropriate, and insisting upon greater accountability).

3. What are the three top risks facing the Heliophysics program over the next 5 years?

Heliophysics, like most of the NASA science enterprise, is significantly affected by some very basic, systemic issues. These issues spread throughout all programs, projects, and missions. A continued forward propagation of these problems ultimately represents a huge level of risk for the sub-disciplines of the SMD and for the Agency as a whole:

- **Prudent Management of Risk**. Getting into space, working in space (either for humans or for machines), and returning appropriate data from space is an inherently "risky" business. Despite highly competent people exercising all sensible and prudent care, there can be failures of space missions. For those programs involving humans and human life, truly heroic measures must be employed and extraordinary efforts must be extended to assure that missions do not fail: In the human space flight realm, failure is not an option.

In the robotic exploration realm, there are a wide range of mission sizes and costs. Very large, high-profile missions of great complexity, international prominence, and resource investment may have to be safeguarded by many levels of review and hardware redundancy. Such approaches tend to drive up program costs tremendously. However, for smaller missions, there is a proper level of redundancy, scrutiny, and oversight that matches the program scale. To do more than this "due diligence" drives costs for even small-end missions to extraordinary levels. Such fear of failure, or undue "risk aversion" is having very detrimental effects on Heliophysics missions.

What we really need to focus on is the management of risk. Since the first Explorer, almost 50 years ago, NASA science projects have been extraordinarily successful. But over the years, the management procedures and quality assurance burden for robotic science projects has grown to an almost unsustainable level — commensurate with human spaceflight missions — without any quantifiable impact on improving the ultimate reliability of science missions (as far as many scientists can discern). In my view, the American people accept the idea that the space business is risky, especially during launch and re-entry. Given launch risks, it makes no sense to spend hundreds of millions of dollars on procedures that might improve the reliability of payloads far beyond, say, the 98% or 99% reliability level.

There is considerable debate whether present reliability approaches are actually achieving more assurance than this. We have all learned that unnecessary risk in human spaceflight programs has tragic consequences and clearly more must be done to minimize that risk. It is equally true that *not* taking risks in leading-edge robotic science projects has undesirable results. Not only must science continue to push the technological envelope where failure is a risk that accompanies new ideas, but these projects provide opportunities for training staff and students in an environment where failure is not life-threatening, and where a student can gain hands-on experience in the real work of building state-of-the art instrumentation. Having gained this expertise, these students can go on to form the workforce of future operational robotic science missions and human spaceflight missions.

- **Lack of affordable access to space.** A major hallmark of the past science program of NASA has been the regular, frequent launches of a balanced portfolio of small, medium, and large missions to address key science questions and to test new enabling technologies. "Balance" in this context does not mean equal dollars in all mission categories, but rather it means appropriate investment in small-end missions targeted toward specific science questions and toward workforce development, as well as investments in major flagship programs. In my view, there should be heavy emphasis on smaller spacecraft and suborbital missions. (This idea has been endorsed by last year's NRC report *An Assessment of Balance in NASA's Science Programs*).

Unfortunately, the cost of launching missions into space has grown out of all proportion to the cost of small scientific satellites and payloads. This imbalance between payloads and launch costs is destroying the ability of the Heliophysics Division to develop and maintain its regular, frequent launches of Small Explorers, University-Class Explorers, and even Solar-Terrestrial Probe missions. The risks associated with increasing costs of access to space, in my view, are threatening to sink the entire carefully-laid plans for Heliophysics science.

There are some disturbing recent signs in the access to space arena. One of the longest-serving launch vehicles for NASA missions, the Boeing Delta II vehicle, is being eliminated as an option for future science programs. Much of the NASA medium-lift needs for Earth-orbiting and planetary missions was carried out using the Delta II. Losing the "sweet spot" around which so many NASA launches were planned will, I fear, propagate in highly detrimental ways throughout the space science enterprise.

I have also mentioned above the removal of funding for the RBSP Missions of Opportunity. It is hard to imagine a more cost-effective investment that NASA can make than to launch instruments on commercial or partner-nation spacecraft. For a relatively small NASA investment, the science enterprise gains access to a highly leveraged program and can often provide a complementary science capability that lends a robustness and insurance that could not be afforded any other way. I am very encouraged that Dr. Stern has voiced strong public support for MoOs.

- **Erosion of trained workforce**. A key to the success of NASA as a whole, and Heliophysics in particular, is the availability of hardware-educated scientists and "hands-on" trained engineers. Nearly all space projects require a great deal of technical competence, and a correspondingly competent workforce. There has been a steady erosion of that workforce, not only at NASA but across the entire country, and this fact has been decried from many quarters. The NRC report, "*Rising Above the Gathering Storm*," makes this case most emphatically. Other technical industries have been able to compensate somewhat by tapping the pool of highly-trained immigrants and foreign students, and they often outsource work abroad. But spacecraft are ITAR sensitive items, so this pool is not available to NASA or to its outside space-enterprise partners, even to universities, because of the constraints of the law. All the space programs at NASA, DOE, NOAA, and the DOD feel this shortage acutely. And the situation will probably just get worse unless something is done.

NASA commissioned the NRC to study how the workforce necessary to carry out the Vision for Space Exploration can be maintained given the impending retirement of much technical talent. The report, released earlier this week, cites the need for more highly skilled program and project managers and systems engineers who have acquired substantial experience in space systems development, and identifies limited opportunities for junior specialists to obtain hands-on space project experience as one of the impediments to NASA's ability to execute the Vision. The report recommends that NASA place a high priority on recruiting, training and retaining skilled program and project managers and systems engineers, and that it provide hands-on training and development opportunities for younger and junior personnel (*Building a Better NASA Workforce: Meeting the Workforce Needs for the National Vision for Space Exploration*, p. 7).

It is clear that there is a shortage of engineers and scientists who have actually built space hardware, and know how that hardware can be integrated and function within larger, more complex systems. NASA science programs are a critical source of this needed native talent, whether they remain in NASA science programs or move out into the larger industrial base. Education at its very best is a process of discovery and of trial-and-error: the efficacy of learning- by-doing has been proven over many years.

NASA needs to maintain its investment in space science programs that allow universities to attract and engage undergraduate and graduate students in all aspects of mission development and deployment – from proof of concept studies, to proposal submittal, to prototype development, to launch, data analysis, and publication. Whether these programs have short or long time horizons, there are ways to allow the next generation of space scientists to participate in all aspects of an exciting NASA mission.

4. *What would be the top three investments that could be made to benefit the Heliophysics program over the long-term?*

The Heliophysics Division would benefit substantially in the long-term from several immediate investments. These include not only dollars, but "intellectual capital" and renewed commitments to a properly balanced experimental, theoretical, and modeling program.

- **Lower cost and frequent access to space**. In my view, the single greatest impediment to a healthy and vigorous Heliophysics program is the uncertainty and cost of getting spacecraft and suborbital missions launched. Obviously, the Heliophysics Division cannot, and should not, pay for developing new launch vehicles. But HPD, NASA in general, the Congress, and other stakeholders should work together to make sure that every avenue for launching space hardware is made readily available to research teams. This should include less expensive domestic launch vehicles, "military" launchers (such as the Minotaur rocket), secondary launch capabilities on commercial and U.S. military vehicles, and unfettered access to non-U.S. launch vehicles. In the latter category are launches on European, Indian, Japanese, and other launch systems that can offer very attractive prices for access to space. A secondary launch on an Ariane 5 vehicle, for example, could be obtained for as little as $1 million or so.

In this category of access to space, I would also place Missions of Opportunity (MoOs). Launching NASA instruments or payload suites on commercial or military vehicles, or onboard foreign spacecraft, can provide tremendous "bang for the buck." I know from public statements by Dr. Stern that he recognizes the power and benefits of MoOs and I hope this avenue to space can be pursued aggressively. The MoO component should certainly be restored explicitly to the Radiation Belt Storm Probe program.

- **Regular cadence and more frequent small-end missions**. As pointed out above, the key to a healthy, robust Heliophysics program is to have more and better opportunities for Small Explorer (SMEX), University-Class Explorer (UNEX), and suborbital missions. This emphasis is wholly consistent with the Decadal Survey recommendations and it fulfills a wide variety of programmatic, educational, and workforce training goals that I have alluded to above. The investment necessary to achieve the desired outcome in this arena could be readily accomplished (I believe) by restoring the Explorer mission line to the budgetary level that existed in the FY2004 budget plan (~$350 million per year). The combination of sound management approaches, reasonable launch costs, sensible numbers of reviews, and appropriate levels of risk tolerance would, I maintain, allow a very vigorous small-mission capability within Heliophysics for a very modest amount of new budgetary authority.

- **Improve management of mission costs**. As has been alluded to above, the Heliophysics missions – as with most of NASA programs – have increased in cost to well above the levels planned in the 2003 Decadal Survey. Much of this has been due to factors touched on earlier: access to space has become prohibitively expensive and "risk aversion" has increased mission development costs to extraordinary heights. I believe that Heliophysics should invest time and money now into developing an approach to mission management that uses prudent levels of reviews and much wiser risk mitigation strategies. Some years ago – perhaps a decade or so – "best practices" were developed for PI-led missions and I firmly believe those practices could and should still serve as the basis for managing essentially all Heliophysics instrument and spacecraft programs. A small investment now in improved management approaches both at NASA Headquarters and NASA Centers would pay tremendous future dividends.

Summary

Fortunately, smaller-end programs such as R&A, sounding rockets, and the Explorer mission line could be restored to the levels anticipated in the FY2004 budget by infusions of modest amounts of budget authority. For the larger Heliophysics programs (Solar-Terrestrial Probes and Flagship missions), comparatively higher levels of resources are required. Better management of programs and containment of cost growth is clearly necessary to stretch available dollars. However, absent a restoration of more balanced budgets to levels planned as recently as FY2004, it will not be possible to have a robust program that is capable of meeting high priority national needs.

Thank you very much for your attention.

Daniel N. Baker

Dr. Daniel Baker is Director of the Laboratory for Atmospheric and Space Physics at the University of Colorado-Boulder and is Professor of Astrophysical and Planetary Sciences there. His primary research interest is the study of plasma physical and energetic particle phenomena in planetary magnetospheres and in the Earth's vicinity. He conducts research in space instrument design, space physics data analysis, and magnetospheric modeling.

Dr. Baker obtained his Ph.D. degree with James A. Van Allen at the University of Iowa. Following postdoctoral work at the California Institute of Technology with Edward C. Stone, he joined the physics research staff at the Los Alamos National Laboratory, and became Leader of the Space Plasma Physics Group at LANL in 1981. From 1987 to 1994, he was the Chief of the Laboratory for Extraterrestrial Physics at NASA's Goddard Space Flight Center. From 1994 to present he has been at the University of Colorado.

Dr. Baker has published over 700 papers in the refereed literature and has edited five books on topics in space physics. He is a Fellow of the American Geophysical Union, the International Academy of Astronautics, and the American Association for the Advancement of Science (AAAS).

He currently is an investigator on several NASA space missions including the MESSENGER mission to Mercury, the Magnetospheric MultiScale (MMS) mission, the Radiation Belt Storm Probes (RBSP) mission, and the Canadian ORBITALS mission. He has won numerous awards for his research efforts and for his management activities including recognition by the Institute for Scientific Information as being "Highly Cited" in space science (2002), being awarded the Mindlin Foundation Lectureship at the University of Washington (2003) and being selected as a National Associate of the National Academy of Sciences (2004). Dr. Baker has been chosen as a 2007 winner of the University of Colorado's Robert L. Stearns Award for outstanding research, service, and teaching. Dr. Baker presently serves on several national and international scientific committees including the Chairmanship of the National Research Council Committee on Solar and Space Physics and membership on the Space Studies Board. Dr. Baker recently served as President of the Space Physics and Aeronomy section of the American Geophysical Union (2002-2004) and he presently serves on advisory panels of the U.S. Air Force and the National Science Foundation. He was a member of the NRC's 2003 Decadal Survey Panel for solar and space physics and he was a member of the 2006 Decadal Review of the U.S. National Space Weather Program.