LOUISIANA STATE UNIVERSITY
AND AGRICULTURAL AND MECHANICAL COLLEGE
Department of Physics & Astronomy

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Dr. Anne Kinney
Director, Universe Division
Science Mission Directorate
NASA Headquarters
Washington, DC 20546-0001

cc: Dr. Hashima Hasan

Dear Anne,

The Universe Working Group met at Headquarters on Sept. 15-16. Despite the change in date, Steve Boggs, Supriya Chakrabarti, Mike Cherry, Stephane Coutu, Jennifer Dooley, Lee Lindblom, Steve Meyer, Steve Ritz, Ken Sembach, David Weinberg, and Adolf Witt were able to attend. Hashima Hasan acted as the primary Headquarters liaison.

We were reminded that this is a tremendously exciting scientific time for astrophysics: HST, Chandra, Spitzer, GALEX, XTE, Swift, and other missions are providing superb science and exciting Science Updates; SOFIA will soon have its first test flights; and GLAST is moving toward launch. Despite the superb science, though, the Universe Division's program is under severe stress: Budget pressures are intense; R&A programs are seeing oversubscription rates as high as 10:1; the schedules for LISA, Con-X, the Beyond Einstein Probes, and the Vision missions have been pushed out to the far future; funding for instrument and technology development has been cut significantly; and the future of the Explorer program is uncertain.

The Explorer program does not fall directly under the purview of this committee. Nevertheless, the concerns about Explorers epitomize many of our broader concerns. As a result, much of our discussion was strongly colored by concerns over the Explorer program's short-term and long-term status. ***This committee (and, we think, most of the astronomical community) considers the Explorer program vital to the NASA Universe program, in part because it leads to outstanding science that takes advantage of the best ideas and responds to new opportunities, and in part because it is a crucial mechanism for developing the technology required for strategic missions and for maintaining research groups that are capable of developing and implementing this technology. The future health of the Universe Division's programs requires that instrument and technology development efforts and the training of future scientists and engineers must continue. <u>Especially</u> if budget pressures force a substantial slowdown of the Explorer program, then the R&A program must be the vehicle that***

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provides suborbital flight opportunities and the funding for the community to continue building for the future. There is a strong case to be made for augmenting the R&A program, if it can be done in a manner that is not immediately vulnerable to cuts, to mitigate the potentially devastating effects of repeated Explorer AO delays.

The Universe Division has a number of tremendously exciting missions identified for the future. JWST, SIM, and TPF, however, are examples of extremely expensive programs. It is not clear that the Division can continue to support so much future mission activity at this level without eating its seed corn. As pointed out in the community's recent Strategic Roadmap document, "*NASA's science engine is driven by the creativity, risk-taking, and innovation of its scientists. The focus of the agency's Universe roadmap is necessarily on its large flagship missions, and much of the supporting research and technology must be tied to those missions. Nevertheless, the roadmap priorities must allow for rapid and flexible response to new discoveries, and encouragement must be given to nurturing the new ideas and concepts which will be the basis of tomorrow's priorities. The Research and Development Program cultivates the seed corn which is responsible for the success of today's missions and guarantees the continued vitality of future missions. The highly competed R&A program supports a mix of focused research directed at specific missions in the roadmap, together with broad-based work needed for the future. In a 2000 report, the Association of American Universities described the R&A line as 'one of the most efficiently used funding lines in space science research.' "*

The R&A program does not produce as many Science Updates as do the large missions; neither does it provide the specific goal-oriented focus that a single mission does. Nevertheless, the R&A program is essential to the Division's program and must be protected. For example, with additional support for payload development, the balloon program could replace some of the lost scientific, technology development, and training opportunities. Jerry Edelstein's presentation of results from the SPEAR mission, which has achieved impressive scientific return and made substantial contributions to student and postdoc training at remarkably low cost to NASA, demonstrated another approach. In a tight budget environment, opportunities to fly NASA-supported payloads on non-NASA carriers must be encouraged, and R&A support for technology development will be essential for maintaining capabilities in the UV and X-ray communities, for example, and for moving technologies to higher readiness levels in preparation for future missions.

We heard presentations from a number of headquarters staff and appreciate the time they spent with us explaining both the abundant successes and the stresses under which they are laboring. This is a difficult time for headquarters staff, and we tremendously appreciate the absolutely essential and difficult job they are doing. The committee especially notes the energy provided by the steady stream of visiting scientists at headquarters; this provides new blood and close contact with the community. The evolving headquarters organization raised questions from members of the UWG; we would appreciate seeing an organizational chart as soon as one is available, and look forward to seeing a new advisory committee structure established. Several of our questions concerned inconsistencies in the ways information was presented; before the next UWG meeting, we will discuss with Hashima ways in which the information

presented can be made more consistent and understandable. We comment here about some particular issues:

CMBpol Detector Technology

While the R&A program provides support for the development of CMB detectors, the task of developing massive bolometer arrays to the readiness level required to start a CMBpol mission is probably beyond the scope of the R&A program in its current form. Virendra Sarohia presented a novel proposal aimed at the thorny problem of shepherding the maturation of CMB detector technology through to the level needed to allow a start for CMBpol early in the next decade. This proposal was intended to inform the NASA portion of the tri-agency (NASA, NSF, DOE) response to the recommendations of the CMB task force (the Weiss committee). Since the UWG and its predecessors have struggled for many years with the question of how to get crucial technologies through the middle stages of development, we applaud the effort to take an innovative approach to this problem. However, we have three serious concerns with the specifics of the proposed approach: the appearance of "picking the winners in advance" instead of through peer review, the risk of freezing out other groups with alternative technical ideas, and the lack of independent oversight. ***We encourage NASA to work with NSF and DOE to develop a mechanism that retains the positive aspects of this proposal but avoids these potential pitfalls***. Such a mechanism might, for example, involve encouraging groups to consider forming consortia when applying to a peer reviewed competition, or sponsoring workshops to foster communication and collaboration in advance of a funding competition. Another approach, which has been successful in the past, would be to establish a small mission formulation office to direct and manage the technology development, guided by advice from a community-based Facility Science Definition Team chosen by the three agencies.

R&A Road-Mapping

Hashima Hasan again raised the issue of the advisability of a road-mapping effort applied to the Laboratory Astrophysics Program. She suggested that a science requirements flow-down diagram, linking major science goals defined in the strategic Universe Roadmap with specific implications and needs in the areas of laboratory astrophysics be produced, and she exhibited an example in which major science goals were connected to requirements in measurement capabilities, engineering developments, and key technologies. UWG agreed that the brief statement concerning related R&A needs appearing in the Universe Roadmap, while supportive, does not provide sufficient guidance to allow prioritization of these needs. However, as before, ***UWG was hesitant to provide such prioritization, suggesting instead that the customary meetings of panel chairs at annual proposal evaluations or panel discussions at targeted workshops might be more appropriate ways of identifying priorities and imbalances. For example, the planned Laboratory Astrophysics Workshop in February, 2006, might provide a suitable way to arrive at a roadmap for laboratory astrophysics***. It was pointed out after the meeting that missions under development could be queried about their R&A needs, and these needs could be called out in the context of existing NRAs and annual

solicitations and then be reviewed by the peer panels. This would be similar to the approach taken by TPF in connection with ongoing Origins of Solar Systems competitions, and would allow peer panels to attempt to balance mission needs with their other recommendations.

In view of likely budgetary restrictions, UWG discussed the advisability of flat across-the-board cuts vs. targeted cuts based on some prioritization plan for R&A activities. Flat cuts are more readily restored, if and when conditions improve, while cuts based on prioritization may lead to eliminations of programs, which may be difficult or impossible to restore in the future. However, flat cuts may have a more devastating effect on some sub-disciplines than on others, depending on their relative health. Some attention must be given to minimize long-term damage.

It would be difficult or impossible to define a global "metric" for quantifying the relative contribution of different R&A activities to NASA's overall goals because they are so different in kind and because each program usually has multiple objectives. However, regular presentations to UWG from program scientists about the health and contributions of their programs remain a valuable way of assessing their vitality and their relevance to NASA objectives. At present, all of the R&A programs appear to be receiving more first-rate proposals than they can fund.

Laboratory Astrophysics Workshop

Adolf Witt reported on the background and preparations for the next Laboratory Astrophysics Workshop, planned for Las Vegas in February, 2006. This workshop, organized under the chairmanship of Steven Federman, follows two previous NASA Laboratory Astrophysics Workshops in a regular 4-year interval. In addition to providing an essential venue for direct communication between data users (observational astrophysicists and model builders) and data providers from a range of scientific disciplines (physics, chemistry, mineralogy, physical chemistry, and materials science), ***the workshop will produce a White Paper identifying the laboratory data needed to support current and future NASA space missions and programs***. Given that some of these needs overlap with those envisioned by NSF-supported activities, e.g. ALMA, joint NASA/NSF sponsorship for the workshop is being sought by the organizers. ***UWG urges the workshop organizers to include in their report a tabulation of significant astronomical results which have depended critically on data from laboratory astrophysics.*** Furthermore, UWG would be interested in seeing the impact of ongoing laboratory astrophysics efforts (e.g., as documented by citations as an indication of the extent to which the data are being used by astrophysicists). Finally, a science requirements flow down map linking the major science goals of the Universe Roadmap with specific laboratory astrophysics data needs would be an important component of a White Paper. ***UWG looks forward to seeing the Laboratory Astrophysics White Paper at its next meeting in April, 2006.***

Optical Interferometers

Stephen Ridgway presented a summary status of optical interferometers and the

development of space interferometers. The technology test-bed comes from the ground based Keck-Keck interferometer and Large Binocular Telescope Interferometer (LBTI). Keck has recently achieved a milestone by producing a phase null on stars with a nulling ratio of 100:1. LBTI will have two telescopes in 2008. The Space Interferometry Mission (SIM) is the nearest term space mission, with the Terrestrial Planet Finder IR Interferometer (TPF-I) being a decade or more in the future. SIM, which had some technical and budgetary problems earlier this year, has now undertaken a replan and is within the specified budget. SIM technology is rated at TRL 6. All the major interferometry efforts are now being delayed because of insufficient funding rather than technical problems.

High Energy Astrophysics: X-Rays

Wilt Sanders reported on the status of X-ray investigations. Of note is the recent launch of the Suzaku satellite, followed early in the mission by the highly unfortunate failure of its X-Ray Spectrometer (XRS), leaving only the X-ray Imaging Spectrometer (XIS) and Hard X-ray Detector (HXD) operational. Given the importance of the XRS to the mission and its role as a showcase for technology development for an eventual Constellation X mission, this was a major loss. We believe the steps taken by NASA to restart the guest observer proposal cycle to reflect the new state of the mission were appropriate. ***The field of X-ray astronomy will continue to produce world-class science for the next several years with RXTE, XMM-Newton, Chandra, and partial Suzaku instruments in operation. However, the future is highly uncertain with the status of NuSTAR unresolved and the prospects for Constellation X only in the very remote future. US leadership in the development of X-ray instrumentation is at great risk of disappearing. For the near future, the US community will need to participate in international partnerships in order to stay active in X-ray astronomy.***

Sounding Rocket Program

Cheryl Yuhas presented a status report on the sounding rocket program. The current budget supports about 15 launches per year, and the program currently has an inventory of Black Brant motors sufficient to perform launches on this schedule through September 2006. The Black Brant launch failure of March 2005 has been extensively investigated; the technical failure has been identified; new igniters are being designed which should solve the problem; and new design review and risk management procedures have been implemented to reduce the probability of future failures of this kind. ***New Black Brant motor components should be available for regular flights by September 2006. No delays in the flight schedule of the sounding rocket program are currently anticipated as a result of this failure, although the inventory of available motors decreases to just one***. The UWG commends the management of the sounding rocket program for aggressively addressing this problem. The UWG encourages the sounding rocket program management to continue their efforts to ensure the continued availability of Black Brant motors, and to continue an uninterrupted sounding rocket launch schedule.

Cosmic Ray Program and the HQ View of Ballooning.

Vernon Jones gave the UWG a Cosmic Ray update and the HQ perspective on the balloon program. The Cosmic Ray program has been trimmed to the point where a successful ongoing project, TIGER, has now been cancelled in order to enable at least one new project. ***The program is still in a situation where a new payload project can be initiated only every 3-4 years. This implies that, if a single project lasts typically 10 years, then only ~3-4 separate projects can be supported. This raises concerns about the long-term prospects of this vital component of the R&A program and the impact that limited resources have had on the cosmic ray community.***

The balloon program is implementing a Northern Hemisphere polar capability which will allow 21-day flights with international over-flights. The 2005 flight program was completed with one ops failure which was immediately corrected with a second launch and one science payload failure out of 18 planned launches. Nineteen launches are scheduled for FY 2006. The ULDB program plans to demonstrate a 1 ton capability at 110 kft. The sophistication of the ULDB engineering has been increased to overcome the mixed success of the ULDB testing to date. ***Development of trajectory control, higher float altitudes, and increased payload capacity are very important.***

David Pierce reported on the balloon program's response to the independent review report. We are pleased that the review happened and that the balloon program office appears to be taking its findings seriously and responding to them. Many of our discussions of balloons centered on the balance between the LDB and ULDB programs. ULDBs clearly add valuable new capabilities, and if the budget for balloon payloads grows (through something like the "Pioneer" program or perhaps as a temporary compensation for reductions in the Explorer program), then it should be possible to take great advantage of these new capabilities. However, if the budget for balloon payloads is flat or declining, then the best balance between LDB and ULDB flights is far from clear. Given the increasing durations and performance of LDB flights and the need to support technological development for future space missions, it may be that the greater frequency of flight opportunities with the less expensive LDB payloads is a decisive consideration. ***We encourage the Balloon Working Group to discuss the issues of the balance between LDB and ULDB and the need to provide adequate support for the LDB program in a period of flat budgets at best, and we will be interested in hearing the results of this discussion.***

Capability Roadmaps: Technology

Harley Thronson reported on the current state of the technology development program. The budget dedicated to instrument and detector technology development has been reduced to about $2M in the current year budget and further cuts are anticipated. The capability roadmap will be completed shortly, and high priority technology needs have been identified for development if and when funds become available. ***The UWG appreciates the usefulness of the technology capability road map and the prioritized list***

of needed technologies but is extremely disappointed that there appears to be little prospect for an appropriate level of technology development funding.

Conclusion

The UWG is encouraged to see the scientific output of the Universe Division flourishing despite the challenging budgetary environment. We applaud your and the Division's efforts to protect the R&A program in this time of serious budgetary cuts for science at NASA. We understand the budgetary pressures that required a $7M budget hit to the R&A program, which was mitigated by using reserves, and are encouraged by the Universe Division's commitments to safeguard the R&A program. We stress, however, that in these times of budgetary constraints it is crucial that the Universe Division not only protect the R&A program, but build upon it. While we understand that it is difficult to expand any program in this budgetary environment, the pressures on the R&A program will continue to increase as budgets for strategic missions and Explorers diminish and more researchers are forced to seek funding through the R&A program. We are extremely concerned that NASA is currently risking the loss of an entire generation of young space scientists and engineers. The R&A program is the crucial foundation of NASA's science mission, not only to develop the next generation of scientific instrumentation, but also to nurture young and future scientists. While we understand that everyone must share the burden in this time of scientific funding cuts, the R&A program is a crucial path for scientific progress over the coming decade.

Sincerely,

Michael Cherry, Chair
Universe Working Group