

Report of the Astronomy and Astrophysics Advisory Committee March 15, 2010



A computer simulation of dark matter in a galaxy like our own Milky Way. The annihilation of dark matter in a cloud-like halo around the galaxy should produce a diffuse glow of gamma rays that may be detected by NASA's new Fermi telescope. (Simulation: Virgo Consortium)

March 15, 2010

SCIENTIFIC DEPARTMENTS

The Observatories

PASADENA, CALIFORNIA AND
LAS CAMPANAS, CHILE

Embryology

BALTIMORE, MARYLAND

Geophysical Laboratory

WASHINGTON, DC

Global Ecology

STANFORD, CALIFORNIA

Plant Biology

STANFORD, CALIFORNIA

Terrestrial Magnetism

WASHINGTON, DC

**Carnegie Academy for
Science Education**

WASHINGTON, DC

Dr. Arden L. Bement, Jr., Director
National Science Foundation
4201 Wilson Blvd., Suite 1205
Arlington, VA 22230

Mr. Charles F. Bolden, Jr., Administrator
Office of the Administrator
NASA Headquarters
Washington, DC 20546-0001

Dr. Steven Chu, Secretary of Energy
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585

The Honorable Bart Gordon, Chairman
Committee on Science and Technology
House of Representatives
Washington, DC 20515

The Honorable John D. Rockefeller, IV, Chairman
Committee on Commerce, Science and Transportation
United States Senate
Washington, DC 20510

The Honorable Tom Harkin, Chairman
Committee on Health, Education, Labor and Pensions
United States Senate
Washington, DC 20510

Dear Dr. Bement, Mr. Bolden, Secretary Chu, Chairman Gordon,
Chairman Rockefeller, and Chairman Harkin:

I am pleased to transmit to you the annual report of the Astronomy and
Astrophysics Advisory Committee for 2009–2010.

The Astronomy and Astrophysics Advisory Committee was established under
the National Science Foundation Authorization Act of 2002 Public Law 107-368
to:

The Observatories
of the Carnegie Institution

813 Santa Barbara Street
Pasadena, CA 91101

626 577 1122 PHONE
626 795 8136 FAX

Dr. Arden L. Bement, Jr.
Mr. Charles F. Bolden, Jr.
Dr. Steven Chu
Representative Bart Gordon
Senator John D. Rockefeller, IV
Senator Tom Harkin

March 15, 2010
Page 2

- (1) assess, and make recommendations regarding, the coordination of astronomy and astrophysics programs of the Foundation and the National Aeronautics and Space Administration, and the Department of Energy;
- (2) assess, and make recommendations regarding, the status of the activities of the Foundation and the National Aeronautics and Space Administration, and the Department of Energy as they relate to the recommendations contained in the National Research Council's 2001 report entitled *Astronomy and Astrophysics in the New Millennium*, and the recommendations contained in subsequent National Research Council reports of a similar nature;
- (3) not later than March 15 of each year, transmit a report to the Director, the Administrator of the National Aeronautics and Space Administration, the Secretary of Energy and the Committee on Science of the House of Representatives, the Committee on Commerce, Science, and Transportation of the Senate, and the Committee on Health, Education, Labor, and Pensions of the Senate on the Advisory Committee's findings and recommendations under paragraphs (1) and (2).

The attached document is the seventh such report. The executive summary is followed by the report, with recommendations for NSF, NASA and DOE regarding their support of the nation's astronomy and astrophysics research enterprise.

I would be glad to provide you with a personal briefing if you so desire.

Sincerely yours, on behalf of the Committee,



Wendy L. Freedman
Chair, Astronomy and Astrophysics Advisory Committee

cc: Representative Ralph Hall, Ranking Member, Committee on Science and Technology, House of Representatives
Senator Kay Bailey Hutchison, Ranking Member, Committee on Commerce, Science and Transportation, United States Senate
Senator Michael Enzi, Ranking Member, Committee on Health, Education, Labor and Pensions, United States Senate

Dr. Arden L. Bement, Jr.
Mr. Charles F. Bolden, Jr.
Dr. Steven Chu
Representative Bart Gordon
Senator John D. Rockefeller, IV
Senator Tom Harkin

March 15, 2010
Page 3

Senator Barbara Mikulski, Chairwoman, Subcommittee on Commerce, Justice, Science, and Related Agencies, Committee on Appropriations, United States Senate

Senator Richard Shelby, Ranking Member, Subcommittee on Commerce, Justice, Science, and Related Agencies, Committee on Appropriations, United States Senate

Senator Byron Dorgan, Chairman, Subcommittee on Energy and Water Development, Committee on Appropriations, United States Senate

Senator Robert Bennett, Ranking Member, Subcommittee on Energy and Water Development, Committee on Appropriations, United States Senate

Senator Bill Nelson, Chairman, Subcommittee on Science and Space, Committee on Commerce, Science and Transportation, United States Senate

Senator David Vitter, Ranking Member, Subcommittee on Science and Space, Committee on Commerce, Science and Transportation, United States Senate

Representative Alan B. Mollohan, Chairman, Subcommittee on Commerce, Justice, Science, and Related Agencies, Committee on Appropriations, House of Representatives

Representative Frank R. Wolf, Ranking Member, Subcommittee on Commerce, Justice, Science and Related Agencies, Committee on Appropriations, House of Representatives

Representative Peter J. Visclosky, Chairman, Subcommittee on Energy and Water Development, Committee on Appropriations, House of Representatives

Representative Rodney Frelinghuysen, Ranking Member, Subcommittee on Energy and Water Development, Committee on Appropriations, House of Representatives

Representative Daniel Lipinski, Chairman, Subcommittee on Research and Science Education, Committee on Science and Technology, House of Representatives

Representative Vernon Ehlers, Ranking Member, Subcommittee on Research and Science Education, Committee on Science and Technology, House of Representatives

Representative Gabrielle Giffords, Chairman, Subcommittee on Space and Aeronautics, Committee on Science and Technology, House of Representatives

Representative Pete Olson, Ranking Member, Subcommittee on Space and Aeronautics, Committee on Science and Technology, House of Representatives

Dr. Kimberly Briggman, Senior Policy Analyst, Office of Science and Technology Policy, Executive Office of the President

Dr. Arden L. Bement, Jr.
Mr. Charles F. Bolden, Jr.
Dr. Steven Chu
Representative Bart Gordon
Senator John D. Rockefeller, IV
Senator Tom Harkin

March 15, 2010
Page 4

Dr. Tom Kalil, Deputy Director for Policy, Office of Science and Technology
Policy, Executive Office of the President
Ms. Amy Kaminski, Program Examiner, NASA, Office of Management and
Budget
Dr. Joel Parriott, Program Examiner, NSF, Office of Management and
Budget
Dr. J.D. Kundu, Program Examiner, DOE, Office of Management and
Budget
Dr. Cora Marrett, Acting Deputy Director, National Science Foundation
Dr. Harry E. Seidel, Acting Assistant Director, Directorate for Mathematical
and Physical Sciences, National Science Foundation
Dr. James Ulvestad, Division Director, Division of Astronomical Sciences,
National Science Foundation
Dr. Craig B. Foltz, Program Director, Division of Astronomical Sciences,
National Science Foundation
Dr. Philip J. Puxley, Program Director, Division of Astronomical Sciences,
National Science Foundation
Dr. Ed Weiler, Associate Administrator for the Science Mission Directorate,
National Aeronautics and Space Administration
Mr. Chuck Gay, Deputy Associate Administrator for the Science Mission
Directorate, National Aeronautics and Space Administration
Dr. Paul Hertz, Chief Scientist, Science Mission Directorate, National
Aeronautics and Space Administration
Dr. Jon Morse, Director, Astrophysics Division, Science Mission
Directorate, National Aeronautics and Space Administration
Dr. Richard Howard, Deputy Director, Astrophysics Division, Science
Mission Directorate, National Aeronautics and Space Administration
Dr. Michael Salamon, Astrophysics Division, Science Mission Directorate,
National Aeronautics and Space Administration
Dr. Eric Smith, Astrophysics Division, Science Mission Directorate,
National Aeronautics and Space Administration
Dr. William Brinkman, Director, Office of Science, U.S. Department of
Energy
Dr. Dennis Kovar, Acting Associate Director, Office of High Energy Physics,
U.S. Department of Energy
Dr. Kathleen Turner, Program Manager, Office of High Energy Physics,
U.S. Department of Energy
Dr. Charles Elachi, Director, NASA Jet Propulsion Laboratory
Dr. Robert D. Strain, Director, NASA Goddard Space Flight Center
Mr. Louis Finkel, Chief of Staff, Committee on Science and Technology, House
of Representatives
Ms. Janet Poppleton, Ranking Chief of Staff, Committee on Science and
Technology, House of Representatives

Dr. Arden L. Bement, Jr.
Mr. Charles F. Bolden, Jr.
Dr. Steven Chu
Representative Bart Gordon
Senator John D. Rockefeller, IV
Senator Tom Harkin

March 15, 2010
Page 5

Astronomy and Astrophysics Advisory Committee Members:

Dr. Bruce Balick, University of Washington
Dr. Sarah Church, Stanford University
Dr. Wendy Freedman (Chair), Observatories of the Carnegie Institution
of Washington
Dr. Kim Griest, University of California, San Diego
Dr. Jacqueline Hewitt, Massachusetts Institute of Technology
Dr. David Koo, University of California, Santa Cruz
Dr. Rocky Kolb (Vice-chair), University of Chicago
Dr. Gregory Laughlin, University of California, Santa Cruz
Dr. Douglas O. Richstone, University of Michigan
Dr. Christopher Stubbs, Harvard University
Dr. John Wefel, Louisiana State University
Dr. Brian Winer, The Ohio State University
Dr. Charles Woodward, University of Minnesota

Executive Summary

The Astronomy and Astrophysics Advisory Committee (AAAC) advises the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), and the U.S. Department of Energy (DOE) on selected issues within the fields of astronomy and astrophysics that are of mutual interest and concern to the agencies. Established in the NSF Authorization Act of 2002, the AAAC is chartered to assess and make recommendations regarding coordination of astronomy programs of the NSF, DOE, and NASA, to assess and make recommendations regarding the activities of the agencies related to National Research Council Astronomy Surveys, and to report their assessments and recommendations annually to the NSF Director, the NASA Administrator, the Secretary of Energy, and relevant committees in the House and Senate.

This communication represents our annual report. Our findings and recommendations related to our charter are given below.

Preparation for the Decadal Survey

The Decadal Survey for Astronomy and Astrophysics, Astro2010, is in process and is expected to be public by September, 2010. Since this will be the last AAAC report of this decade, our recommendations are designed to help in the implementation of the Astro2010 recommendations.

We anticipate that substantial effort by the Decadal Survey will go into making a prioritized list of projects, and the agencies need to be prepared to address that list with plan of how to implement them. To execute better the goals of Astro2010, we recommend several immediate steps in preparation of receipt of the report (currently anticipated to be September 2010):

1. *For the AAAC meeting immediately following the publication of the Astro2010 report, we recommend that the agencies should be prepared to lay out an outline for a plan that will identify challenges, critical path issues, and the procedure to take projects from their present state to completion.*
2. *Where interagency cooperation or coordination is required, we recommend that, upon receipt of the report, the relevant agencies should identify a lead agency and the structure(s) necessary for the execution of relevant projects.*
3. *We note that execution of priority projects in Astro2010 will be a very long process. For large, highly-ranked projects, we recommend that the agencies identify a person whose primary role will be to shepherd such projects through this long process.*
4. *We recommend that engagement of the agency heads for the top-ranked projects commence shortly after the report is issued. The goal should be facilitating concrete implementation plans to be delivered to the Office of Management and Budget for the highly ranked programs.*

5. *We recommend that some individuals who served on the Astro2010 Survey Committee be appointed to the AAAC to ensure that knowledge of the deliberations of the Decadal Survey process and goals can be folded into future AAAC discussions.*
6. *We recommend that the agencies plan for a range of budget support levels over the coming decades.*

Given the anticipated timescale for publication of the Astro2010 report, we expect that it will be too early to have a fully-developed plan by the fall of this year. We therefore request that at the first meeting of the AAAC following publication of the Astro2010 report, the agencies provide an outline for how they will address the above recommendations and develop a long-term implementation plan. This meeting is currently anticipated to be the October 2010 meeting. By the time of the February 2011 meeting, implementation plans should be presented. OMB and OSTP will need to be engaged fully in this process.

Update on Task Force Reports

- *The AAAC previously commissioned reports from task forces in four areas: the Cosmic Microwave Background, Dark Energy, Dark Matter and Exoplanets. These reports have served to help articulate and to prioritize the science and techniques spanning across the agencies. Beginning with the Task Force report on the Cosmic Microwave Background, we recommend that all of the Task Force reports be re-visited by the AAAC after a period of about 5 years.*

Interagency Coordination for Decadal Survey Projects

- *We recommend that engagement of the agency heads for the top-ranked projects commence shortly after the report is issued. The goal should be facilitating a concrete implementation plan to be delivered to the Office of Management and Budget for the highly ranked programs.*

Astronomy and Astrophysics Advisory Committee Report
March 15, 2010

The following constitutes the annual report of the Astronomy and Astrophysics Advisory Committee (AAAC) for 2009-2010. The role of the AAAC is 1) to monitor the coordination of astronomy and astrophysics across three agencies: DOE, NASA and NSF, 2) to monitor the status of activities contained in the relevant National Research Council (NRC) decadal survey reports, and 3) to report on our findings by March 15 each year.¹

Our report this year (the seventh such report) is deliberately short, reflecting the fact that the Astro2010 Decadal Survey (hereafter, Astro2010) report is expected to be published in early fall of this year. We have sought to avoid interference with this upcoming report. At the same time, the AAAC is prepared to support and coordinate the recommendations of Astro2010 among the federal agencies, the Office of Management and Budget (OMB) and the Office of Science and Technology Policy (OSTP).

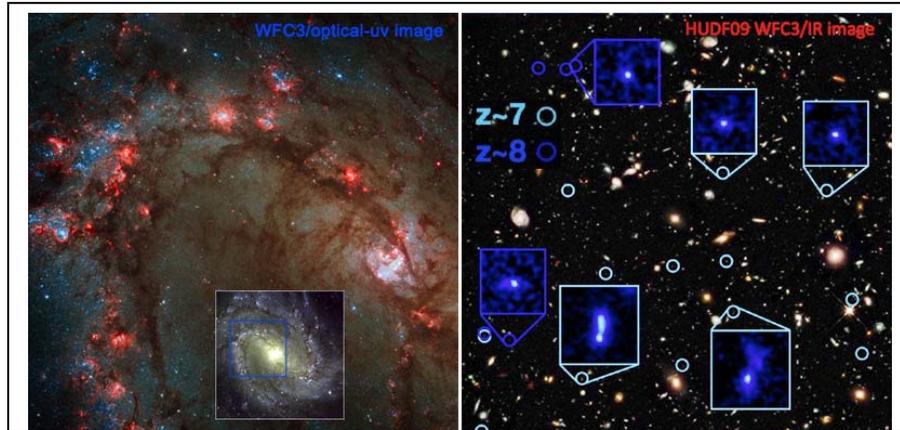
It is the role of advisory committees to call attention to problems and recommend actions to mitigate them. As discussed in our 2008-2009 AAAC report, few projects from the 2000 decadal survey have been completed, and the reasons for this situation are complex. At the same time, we also recognize that the last decade has been remarkably rich with astronomical discoveries. Here we would like to point out three significant accomplishments in just the last year:

- 1) The Wide Field Camera 3 (WFC3) was successfully installed on the Hubble Space Telescope. Within a month WFC3 was taking its first images, and science-quality images started in July. One of the exciting first results was the discovery of the most distant -- and youngest -- galaxies ever observed. The search was designed to uncover some of the earliest galaxies to form a mere 600 to 800 million years into the history of the Universe, or 0.5% of its present age (comparable to 4-5 months into a human lifetime). These galaxies almost certainly shine by the light of the first stars ever to form. The strikingly blue colors of the newly detected galaxies confirm that the light detected by Hubble comes from extremely massive, luminous stars that survive only briefly and formed out of primeval material consisting only of hydrogen and helium, the only elements that could have survived the fury of the Big Bang.

- 2) The Fermi Gamma-Ray Space Telescope (FGST) entered its second year of operation. It continues to explore the highest energy phenomena of the cosmos. More than 1400 astrophysical high-energy gamma-ray sources have been cataloged by FGST, including 73 pulsars shown in the figure below. The locations of the pulsars are superimposed on a Fermi all-sky image showing the

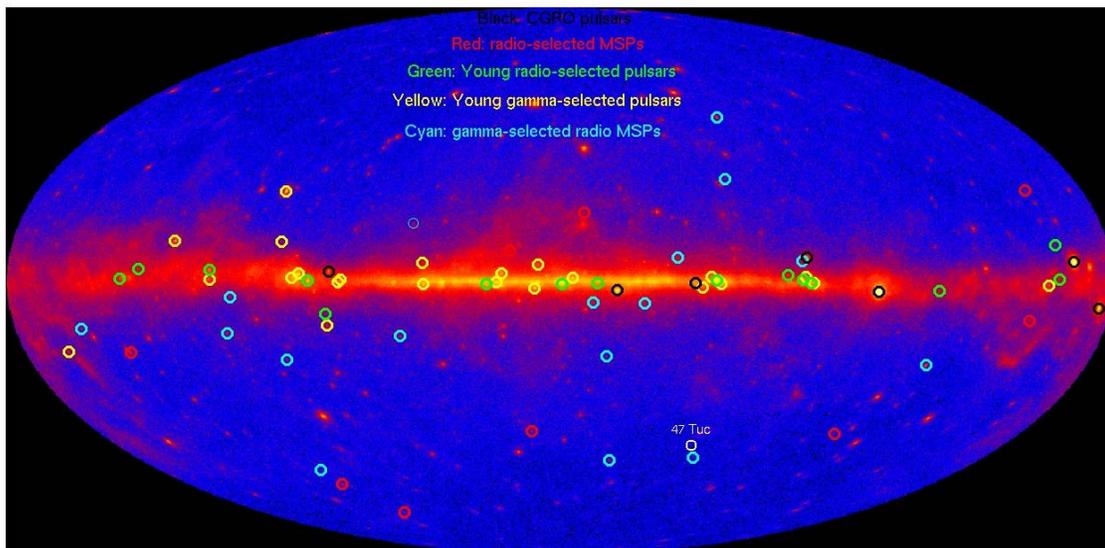
¹ The complete AAAC charter is reproduced in Appendix A.

glowing gases of the Milky Way. In addition, the observatory detected more than 350 powerful astronomical explosions known as gamma-ray bursts (GRBs). (GRBs are the most powerful explosions since the Big Bang.) One of these was an energetic and distant GRB that provided a unique test of the variation of the



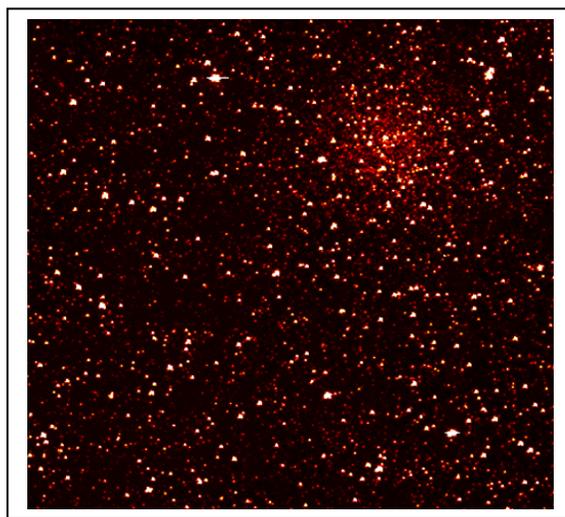
Wide-Field Camera 3 is the first Hubble camera to span the infrared-optical-ultraviolet spectrum. Two of the first images taken in the first month of WFC3's operation illustrate some of the results. On the left side is a composite optical-uv image showing the details of star birth in a spiral arm of M83, a galaxy similar to the Milky Way, but whose stellar birth rate is far more prodigious. This image will be used to find out what initially triggers and finally stops star formation. On the right is a deep infrared image in which small blue circles point to newly discovered galaxies whose light was emitted shortly after the Big Bang. Left image courtesy NASA and the WFC3 Scientific Oversight Committee. The right image is taken from a press release at the January 2010 meeting of the American Astronomical Society.

speed of light due to quantum-gravity effects. Fermi observations put us close to solving a ninety-nine year-old mystery: the nature of the cosmic accelerator that produces high-energy cosmic rays. Fermi is an inter-agency NASA-DOE project.



Seventy-three pulsars found by the Fermi Gamma-Ray Space Telescope (FGST). The locations of the pulsars are superimposed on a Fermi all-sky image showing the glowing gases of the Milky Way. Image: NASA/DOE/ International LAT Team.

- 3) The past year has also seen exciting advances in the discovery and characterization of extrasolar planets. Highlights in this rapidly evolving field include detailed near-infrared spectra of transiting Jovian planets that allow us to study the composition of the atmosphere of worlds orbiting distant stars. The discovery of atmospheric methane, water, and carbon dioxide is an important milestone in the quest to answer the question of whether there is life elsewhere in the Universe. This year also witnessed the successful launch of NASA's Kepler mission to detect potentially habitable Earth-mass planets, motivated by the realization from ground-based telescopes that more nearby stars harbor planets detectable with current observational techniques than previously recognized.



Kepler Image: The Kepler Mission, a NASA Discovery mission, is designed to survey a small region of the Milky Way galaxy to discover hundreds of Earth-size and smaller planets in or near the habitable zone, and determine the fraction of the hundreds of billions of stars in our galaxy that might have such planets. Kepler stares at this same star field for the entire mission, monitoring the brightnesses of more than 100,000 stars for the life of the mission—3.5 or more years. Based on the first 43 days of data alone, 5 more extrasolar planets were discovered, the smallest only about four times bigger than the Earth.

Purpose of This Report

In our 2008-2009 AAAC report,² written at the time that the Astro2010 process had begun, we provided an overview of the field of astronomy and astrophysics since the time of the 2001 Decadal Survey report, *Astronomy and Astrophysics in the New Millennium* (AANM), as well as an assessment of interagency cooperation for

² http://www.nsf.gov/mps/ast/aaac/reports/annual/aaac_2009_report.pdf

cooperative projects. We highlighted some steps that could be taken in anticipation of the new Astro2010 report. A brief summary of the status of the recommendations from the AANM report is given in Appendix A.

The purpose of this 2010 letter report is to sharpen some AAAC recommendations for the joint coordination of interagency projects, and to assist the agencies, the projects, and the community to be in a position to “hit the ground running” when the Astro2010 list of priorities is published.

The National Research Council (NRC) decadal surveys prioritize and make recommendations for new initiatives in astronomy. They involve significant input from the astronomical community resulting in a consensus report, and they provide advice for federal agency planning for new investments in the field. The NRC effort provides the strategic planning and setting of scientific priorities for the field. The AAAC provides a tactical approach to implementing these priorities, and is complementary in its function. It also has a unique role to play in interagency coordination, and it is a Federal Advisory Committee Act (FACA) committee. The NRC Committee on Astronomy and Astrophysics (CAA), which stepped down during the Astro2010 deliberations, has had primary responsibility for shepherding the Decadal Survey recommendations. Presumably it will be re-constituted after the Astro2010 report has been published, and resume its role in this capacity. It is important to ensure that the roles of the AAAC and the CAA remain complementary.

We recommend that some individuals who served on the Astro2010 Survey Committee be appointed to the AAAC to ensure that knowledge of the deliberations of the Decadal Survey process and goals can be folded in to future AAAC discussion.

Success for joint initiatives in the next decade will require an understanding of the distinct missions and priorities, communities, budgetary and prioritization processes within each of the individual agencies, and a plan that merges the timescales/processes of each participating agency in an efficient manner. There is a broad consensus amongst the agencies that joint projects succeed best when one institution assumes the unambiguous lead. Coordination with OSTP and OMB is essential to the process. There must be recognition that there are other NRC “decadal surveys” outside of astronomy and astrophysics, other advisory FACA committees outside of the AAAC, and that the agencies must formulate their own individual prioritizations in response to advice outside of the astronomy and astrophysics decadal survey process.

As the scale of projects within the field of astronomy and astrophysics has grown larger, the cost of such projects, in comparison to the budgets of the agencies, is such that few large projects can simultaneously move forward and be completed during a decade. Budgets are under pressure and painful choices will be unavoidable. A careful, prioritized plan that is flexible enough to accommodate new emerging scientific priorities, and that can respond to changing readiness levels is essential.

We recommend that there should be a process for reevaluating and re-synchronizing priorities on timescales both shorter, and longer, than a decade.

Implementing the Decadal Survey Recommendations

The AAAC requests a briefing from the agencies at the time of the first meeting after publication of the Astro2010 report on their plans to turn the Astro2010 vision into reality. It is important for the agencies to be able to respond in a timely fashion to projects that are likely to be large in scope, to have multiple agency participation, and probably to involve substantial international partnerships. It is imperative that the agencies prepare an implementation plan for the highly ranked projects and programs. OMB and OSTP will need to be engaged in this process.

We recommend that the agencies should be prepared (for the AAAC meeting immediately following the publication of the Astro2010 report) to lay out an outline for a plan that will identify challenges, critical path issues, and the procedure to take projects from their present state to completion.

Where interagency cooperation or coordination is required, the relevant agencies should identify a lead agency and the structure(s) necessary for the execution of the project.

The committee notes that some departments are not yet fully staffed. In particular, the NSF AST Division has been without a permanent Director for almost two years. The committee was delighted to hear that James Ulvestad has now accepted this position. We would like to thank Craig Foltz for his hard work in carrying out this role in the interim period, and also we would like to acknowledge the extra effort that all program officers have made to keep the Division running smoothly. A search for the Assistant Director of Mathematical and Physical Sciences as well as the Deputy Astronomy Director are still underway. The Office of High Energy Physics at the DOE is also seeking a program officer for non-accelerator physics. These and other vacancies have left a small number of people fulfilling many important roles, and implementation of large projects is difficult if there are not sufficient human resources to carry them out.

We note that execution of priority projects in Astro2010 will be a very long process. For large, highly-ranked projects, we recommend that the agencies appoint a person whose primary role will be to shepherd such projects through this long process.

Over the years the AAAC has received reports on the progress of many interagency astro-related projects. We note some very notable successes where interagency coordination and cooperation has optimized the programs, and some notable instances where the interagency aspect seems to have slowed down progress. A common finding is that there is good coordination at the program manager level, but often lack of engagement and involvement in the upper administration

We recommend that engagement of the agency heads for the top-ranked projects commence shortly after the report is issued. The goal should be facilitating a concrete implementation plan to be delivered to the Office of Management and Budget for the highly ranked programs.

We anticipate that Astro2010 will have recommendations for a range of projects. Some of these endeavors (e.g., large telescopes or space missions) will require collaboration/coordination among several federal agencies and, often, with the international community (as discussed in last year's report). In an age of 'globalization', we are also observing an increased need to involve foreign partners in major Astronomy and Astrophysics projects. The committee applauds this trend since it can lead to more rapid execution of projects and increased scientific output, albeit with additional complexity and cost in program management. Nevertheless, the AAAC believes this is a positive trend for Astronomy and Astrophysics and is prepared to work with, and offer advice about, such collaborative projects, consistent with our charter.

Astronomy has moved definitively into the era of big science. Large-scale questions such as the nature of Dark Energy and Dark Matter, the formation of structure in the Universe, and the characterization of extrasolar planets require coordinated efforts that can take a decade or more to implement, and which can involve significant fractions of the national funding allocation for astronomy. Superimposed on this trend toward consolidation is the possibility of increased volatility in funding lines as priorities shift and evolve.

We recommend that the agencies plan for a range of budget support levels over the coming decades.

AAAC Task Force Reports

The agencies and the community at large agree that one success of the AAAC has been the reports from the four task forces it has recommended: the Cosmic Microwave Background Task Force, the Dark Energy Task Force, the Dark Matter Task Force and the Exoplanet Task Force³. The reports from these task forces have helped the agencies understand the science needing to be done across agencies and techniques, and have helped them prioritize the various projects and proposals, which often have different costs, and are at different stages of development. They also have been of value to the

³ Cosmic Microwave Background Task Force report, http://www.nsf.gov/mps/ast/tfcr_final_report.pdf, Dark Energy Task Force report, www.nsf.gov/mps/ast/aaac/dark_energy_task_force/report/detf_final_report.pdf; Dark Matter Scientific Assessment Group, http://www.nsf.gov/mps/ast/aaac/dark_matter_scientific_assessment_group/dmsag_final_report.pdf; Extrasolar Planet Task Force report, www.nsf.gov/mps/ast/aaac/exoplanet_task_force/reports/exoptf_final_report.pdf

community at large, serving as a snapshot and status of the given field, and serving as a useful introduction to the field for scientists wanting to participate.

The first task force report, the CMB task force report, has now been out for five years, and many of the projects evaluated in it are currently in progress or have been completed. The result of these projects has been enormous progress in the field and great improvement in technology. It is now time to look again at the science goals, technology issues, and project prioritization recommended by the CMB task force. The goal is not a complete re-doing of the task force charge, but a more limited re-examination and updating of the recommendations in the light of recent progress, for the purpose of a possible mid-course correction.

Thus we recommend reconvening all or part of the original task force, perhaps adding a few new members if necessary, and giving them the limited charge of updating their report given the current state of the field. Using the original task force membership will allow the membership to come more quickly up to speed, and avoid the problem of an attempt to redo the entire evaluation from scratch. If there are some new issues, technology, or results that require additional expertise, the original membership could be slightly expanded.

While the CMB task force was the first to report, we anticipate that all of the task force reports would eventually benefit from re-visits, perhaps after a period of about 5 years.

The Very Long Baseline Array (VLBA)

The AAAC was informed that NASA is unable to sign an agreement with the NSF to provide future support for the Very Long Baseline Array (VLBA) operated by the National Radio Astronomy Observatory. Barring unexpected sources of new support, operations of the VLBA will be ramped down and terminated over the next two years. The AAAC recognizes the excellent research contributions from the national community of VLBA users on this unique facility since its completion in 1993. However, the AAAC notes that this outcome follows the 2006 recommendation of the NSF's Senior Review process regarding priorities for the operations of large nationally supported facilities in astronomy.

Relevancy of Astronomy and Astrophysics

Finally, we note briefly that as America enters a challenging fiscal landscape, with jobs, climate, and energy being major national priorities, the relevancy of astronomy and astrophysics for federal support deserves to be addressed. While the recommendations of the next astronomy and astrophysics decadal report will not be released until later 2010, we are confident that the four overriding goals that address benefits to the nation in the last decadal report of 2001 remain timely and relevant and extend well beyond basic

scientific research:

- 1. To disseminate astronomical discoveries widely and thus bring the excitement inherent in science to the American public.*
- 2. To use the excitement that astronomy engenders to increase public understanding of science and scientific methods and to make clear that science is a pathway to discovery, not just a collection of facts. This must be done at both the K-12 level and the undergraduate level.*
- 3. To capitalize on the close involvement of astronomy with technology and instrumentation to contribute to training the technical work force.*
- 4. To prepare future generations of professionals who will sustain U.S. preeminence in astronomy and will contribute to a scientifically literate nation.*

Astronomy, as the study of the Universe and thus the ultimate of an interdisciplinary science that combines physics, mathematics, chemistry, geology, atmospheric studies, biology, computer science, etc., is fortunate by being the most accessible of sciences to nonscientists. Astronomy thus serves as a powerful vehicle for education and outreach in science and technology. NASA, NSF, and DOE have all played a vital role in achieving these benefits for our nation through inter-agency astronomical programs, and with sufficient support, will continue to do so. The AAAC looks forward to assessing and supporting these efforts in alignment with the forthcoming decadal report.

APPENDIX A: PROGRESS ON PROJECTS FROM THE 2001 DECADAL SURVEY

The table below is based on Table ES.1 from the 2001 AANM report, which is a ranked list of both ground- and space-based initiatives of major to moderate scale. Also indicated is and gives the current status of those projects.

From TABLE ES.1 Prioritized Initiatives (Combined Ground and Space)

Initiative	Status
Major Initiatives	
Next Generation Space Telescope (NGST) (now JWST)	Expected Launch 2014
Giant Segmented Mirror Telescope (GSMT)	Beyond 2011
Constellation-X Observatory (Con-X) (now IXO)	Beyond 2011
Expanded Very Large Array (EVLA)	Operations 3/2010
Large-aperture Synoptic Survey Telescope (LSST)	Beyond 2011
Terrestrial Planet Finder (TPF)	Beyond 2011
Single Aperture Far Infrared (SAFIR) Observatory	Beyond 2011
Moderate Initiatives	
Telescope System Instrumentation Program (TSIP)	Ongoing
Gamma-ray Large Area Space Telescope (GLAST) (now Fermi)	Launched 2008
Laser Interferometer Space Antenna (LISA)	Beyond 2011
Advanced Solar Telescope (AST)	Funded
Square Kilometer Array (SKA) technology development	Partially funded
Solar Dynamics Observatory (SDO)	Launch 2010
Combined Array for Research in Millimeter-wave Astronomy (CARMA)	Completed 2006
Energetic X-ray Imaging Survey Telescope (EXIST)	Beyond 2011
Very Energetic Radiation Imaging Telescope Array System (VERITAS)	In operation
Advanced Radio Interferometry between Space and Earth (ARISE)	Beyond 2011
Frequency Agile Solar Radio telescope (FASR)	Beyond 2011
South Pole Submillimeter-wave Telescope (SPST) (now SPT)	In operation
Small Initiatives	
National Virtual Observatory (NVO) (now VAO)	Partially funded

APPENDIX B: AAAC CHARTER

As established in SEC. 23 of P.L. 107-368 (the National Science Foundation Authorization Act of 2002) and amended by SEC. 5 of P.L. 108-423 (the Department of Energy High-End Computing Revitalization Act of 2004):

ASTRONOMY AND ASTROPHYSICS ADVISORY COMMITTEE

(a) Establishment.—The Foundation, the National Aeronautics and Space Administration, and the Department of Energy shall jointly establish an Astronomy and Astrophysics Advisory Committee (in this section referred to as the “Advisory Committee”).

(b) Duties.—The Advisory Committee shall—

- (1) assess, and make recommendations regarding, the coordination of astronomy and astrophysics programs of the Foundation, the National Aeronautics and Space Administration, and the Department of Energy;
- (2) assess, and make recommendations regarding, the status of the activities of the Foundation, the National Aeronautics and Space Administration, and the Department of Energy as they relate to the recommendations contained in the National Research Council's 2001 report entitled “Astronomy and Astrophysics in the New Millennium”, and the recommendations contained in subsequent National Research Council reports of a similar nature; and
- (3) not later than March 15 of each year, transmit a report to the Director, the Administrator of the National Aeronautics and Space Administration, the Secretary of Energy, the Committee on Science of the House of Representatives, the Committee on Commerce, Science, and Transportation of the Senate, and the Committee on Health, Education, Labor, and Pensions of the Senate on the Advisory Committee's findings and recommendations under paragraphs (1) and (2).

(c) Membership.—The Advisory Committee shall consist of 13 members, none of whom shall be a Federal employee, including—

- (1) 4 members selected by the Director;
- (2) 4 members selected by the Administrator of the National Aeronautics and Space Administration;
- (3) 3 members selected by the Secretary of Energy; and
- (4) 2 members selected by the Director of the Office of Science and Technology Policy.

- (d) Selection Process.—Initial selections under subsection (c) shall be made within 3 months after the date of the enactment of this Act. Vacancies shall be filled in the same manner as provided in subsection (c).
- (e) Chairperson.—The Advisory Committee shall select a chairperson from among its members.
- (f) Coordination.—The Advisory Committee shall coordinate with other Federal advisory committees that advise Federal agencies that engage in related research activities.
- (g) Compensation.—The members of the Advisory Committee shall serve without compensation, but shall receive travel expenses, including per diem in lieu of subsistence, in accordance with sections 5702 and 5703 of title 5, United States Code.
- (h) Meetings.—The Advisory Committee shall convene, in person or by electronic means, at least 4 times a year.
- (i) Quorum.—A majority of the members serving on the Advisory Committee shall constitute a quorum for purposes of conducting the business of the Advisory Committee.
- (j) Duration.—Section 14 of the Federal Advisory Committee Act shall not apply to the Advisory Committee.

APPENDIX C:

ASTRONOMY AND ASTROPHYSICS ADVISORY COMMITTEE MEMBERS

Dr. Bruce Balick, University of Washington
Dr. Sarah Church, Stanford University
Dr. Wendy Freedman, (Chair) Observatories of the Carnegie Institution of Washington
Dr. Kim Griest, University of California, San Diego
Dr. Jacqueline Hewitt, Massachusetts Institute of Technology
Dr. Rocky Kolb, (Vice-chair) University of Chicago
Dr. David Koo, University of California, Santa Cruz
Dr. Gregory Laughlin, University of California, Santa Cruz
Dr. Doug Richstone, University of Michigan
Dr. Christopher Stubbs, Harvard University
Dr. John Wefel, Louisiana State University
Dr. Brian Winer, The Ohio State University
Dr. Charles Woodward, University of Minnesota