



Association of Universities for Research in Astronomy

Prof. Roger Blandford
Chair Astro2010 Decadal Survey Committee
Stanford University
SLAC M/S 75
2575 Sand Hill Road
Menlo Park, California 94025

March 31, 2009

Dear Prof. Blandford,

We are submitting on behalf of the Association of Universities for Research in Astronomy (AURA) summary documents that incorporate an important cross-section of community views on the landscape and priorities for ground-based O/IR night-time and solar astronomy, UV/O astronomy from space. These documents are the product of working groups we have established in these areas which each have had extensive interactions with the broader community. In addition, AURA has sponsored a workshop on UV/O *and* IR from space held at the Space Telescope Science Institute, and a meeting of the solar community in conjunction with the Ft. Lauderdale AGU meeting.

We want to stress that the Decadal Survey should, above all, adopt a sense of advocacy for the interests of the astronomical community. The U.S. community will achieve its aspirations through leadership, both in national programs and through international collaborations. These must be adequately funded and supported over a long time period. This sense of advocacy should be emphasized in all of your deliberations and adopted by the funding agencies in executing this plan.

AURA Decadal Steering Committee – Ground-Based OIR Astronomy and the System

In the report *Science and the Ground-based Optical/Infrared Telescope System*¹ the AURA Decadal Steering Committee has laid out an ambitious set of goals that would maximize the productivity of US ground-based OIR astronomy. These recommendations

¹ http://www.aura-astronomy.org/nv/Astro2010PanelDocs/Science%20for%20the%20DSC%20Report_V4_7.pdf

emphasize achieving the goals of the 2000 Decadal Survey and propose actions that would more fully implement them. Key recommendations include:

Support for NOAO's leadership role in the in the US OIR System

The Committee encouraged the US OIR System concept, its continued growth and evolution, and NOAO's leadership role in it. As the National Observatory, NOAO has the responsibility for a balanced, properly resourced, observatory system that includes both public and independent telescopes. Implicit in this and other community based assessments² is that NOAO has emerged as an effective national organization.

Establishing a robust System of 1 to 6 m telescopes

The Committee strongly endorsed the need to fund the present ReSTAR proposal which would enhance the scientific capabilities of the current system of small to intermediate size telescopes, and ensure that they will fully complement existing 6 to 10 meter ones as well as contribute to the scientific productivity of the next generation of telescopes such as the LSST and the GSMT. The ReSTAR proposal will also capitalize on the ability of a network of small telescopes to more fully explore the time domain.

Acquiring additional community time on existing 6 to 10 m telescopes.

The Committee recommended that the approach must be balanced and include both additional time on independent telescopes through the Telescope System Instrumentation Program (TSIP), and also additional Gemini time. We emphasize that a successful implementation of the System can only come from capitalizing on both capabilities. A successful implementation of the recommendations contained in the report would result in up to 150 additional nights of 6 to 10 m telescope access per year.

The Committee recognized the growing US community's concern and interest in improving the instrumentation on Gemini and streamlining the observation preparation process. In addition, the report addressed the need to improve the U.S. community representation on the Gemini Board and Gemini Science Committee and the need for a clearer path for community input.

We also call attention to AURA's Decadal Steering Committee's recognition of some of the benefits of international collaboration which, in the case of Gemini, were a major rationale in gaining NSF and Congressional support. As the Managing Organization for Gemini, AURA advocates changes that best meet the needs of the entire partnership. The report makes the point that some improvements advocated by the US community would also benefit other partners.

² <http://www.aura-astronomy.org/nv/FutureNOAO-WhitePaper-Final.pdf>

Acquiring a public share of U.S. Giant Segmented Mirror Telescopes.

The Committee reaffirmed the high priority of GSMT and recommends public partnering on one or two U.S. telescopes. A share of both telescopes would have the most benefit from a System standpoint. Clearly, the ability of the NSF to achieve this will be contingent on the budget available, but no option should be closed off at this time. Structuring these partnerships could be done within the construction phase, but more likely as an operations commitment. AURA has also proposed the establishment of a TSIP-like program in which the Government funds the development of instruments for the GSMTs in exchange for access.³

The Committee considered one area of technology in detail, adaptive optics (AO). AO is essential to the success of future ELTs and can greatly enhance the scientific capabilities of telescopes of all sizes. Thus the need to establish a robust national AO program extends beyond what the present ELT projects envision. We particularly point out the growing disparity between US investment in AO and that of ESO – ESO investment in AO, both R&D and enabling facility instruments is nearing three to four times that of the *total* investment in AO in the US, public and private. The committee urged a significant investment in AO by the NSF at least at the level recommended in the recent AO Roadmap Report.

Finally, we point out that, as was the case in the 2000 Decadal Survey, it is important to establish the US national strategy within the global context. The ESO EELT has made rapid progress during its design phase and appears likely to secure significant funding. This makes it especially important to define a coherent US program that preserves all possible options.

Initiating the Large Synoptic Survey Telescope program

Survey telescopes such as Pan-STARRS and LSST, a public-private partnership which includes AURA, promise a robust exploitation of the time domain and will address a variety of scientific problems that have grown in importance since the 2000 Decadal Survey. In addition, a strong case can be made for the complementarity of LSST with other major facilities including ALMA, JWST, and GSMT.

LSST has evolved to a high state of project maturity within the NSF and DOE and is ready for the construction phase. Given the increased scientific role now seen for LSST compared to its original ranking, and its present state of maturity, AURA recommends that the project proceed at the earliest possible time.

³ This approach is characterized in the State of the Profession paper by Elias entitled *GSMT: The Case for Community Access to an Extremely Large Telescope* and a notice of intent submitted by Smith, Silva, Elias and Blum entitled *Options for Federal Support of a Giant Segmented Mirror Telescope Including a Dedicated Instrumentation Support Program*.

AURA Decadal Steering Committee and AURA Workshop on UV/OIR Astronomy from Space

AURA's Decadal Steering Committee and AURA's workshop on UV/OIR from space identified key science goals for future space missions and general characteristics that these missions must have that are driven by the science goals⁴. We do not prioritize or select among the many individual missions with almost as many diverse goals.

Most presentations emphasized new UV/O missions with possible extension to the non-thermal IR. This preference was jointly based on the performance expectations of JWST for the IR, as well as concern about the potential gap that will exist in our ability to make ultraviolet and optical observations from space. This gap will be between the end of HST's mission, 5 to 10 years after SM4, and the time when major new missions could be approved and built. There was also concern expressed about finding the proper balance between "flagship" missions and smaller missions that can be carried out on shorter time scales with lower cost.

Science Goals: The discovery and characterization of exo-planets and search for bio-signatures received considerable emphasis⁵. At the other extreme of space and time, a second key goal that emerged was the mapping of the cosmic web and intervening galaxy halos over as wide a range of red-shifts as possible. A third key science goal is to study the formation and evolution of galaxies and their stellar populations.

Science Drivers: The two most important science drivers are significant gains in spatial resolution and sensitivity over what is now available. These suggest a telescope with at least three times the aperture of HST for work in the UV/O. These characteristics need to be accompanied by fields of view of about one arc-minute, spectral resolutions on the order of 10^4 , photometric stability, high temporal resolution, high dynamic range, and solar blind capability.

In order to address these future missions, especially ambitious flagship missions, the role of institutions such as the Space Telescope Science Institute are paramount. There is ample evidence that such major missions and their respective institutions have played a powerful role in supporting the health of the general astronomical community.

⁴ <http://www.aura-astronomy.org/nv/Astro2010PanelDocs/AURA%20workshop%20summary-final.pdf> and <http://www.aura-astronomy.org/nv/Astro2010PanelDocs/AURA-space.pdf>

⁵ An important aspect of this is understanding the range of solar variability under which life has survived on Earth.

Future of Ground Based Solar Physics: A Report of the AURA Solar Decadal Committee

In the report *Future of Ground-based Solar Physics*⁶ the AURA Solar Decadal Committee identified three major science drivers for the next Decade: the origin and emergence of solar magnetic fields; understanding the solar chromosphere; and observations of the coronal magnetic field. All of these are linked to the need to provide direct observational tests of solar magnetohydrodynamics and reach an understanding of the role of coronal magnetism.

Planned facilities such as the Advanced Technology Solar Telescope (ATST) are key to making progress on these three science drivers and to the future of solar astronomy in the US. AURA has recommended that ATST has reached a sufficient state of design maturity that construction should be started in the FY10 budget cycle.

The Committee also stressed the need for maintaining and expanding complementary full sun and synoptic observations that have been carried out by the National Solar Observatory and the High Altitude Observatory. Finally the Committee addressed infrastructure requirements that must underlie this strategy. Among these are investments in new instrumentation, theory, and capitalizing on the synergies between ground and space-based observations.

We draw attention to the Committee's discussion of the structural problems that affect the conduct of solar astronomy and the ultimate success of the Decadal Survey. That is, in addition to the division of responsibilities between the NSF and NASA, the separation of responsibilities within the NSF leads to difficulties in achieving a well-integrated set of priorities. Indeed, the Astro2010 Decadal Survey itself is structured to address only a part of the overall multi-disciplinary field⁷.

As a result of the last Decadal Survey, AURA has worked to establish the National Solar Observatory as a stand-alone organization capable of taking on a major community leadership role. It is important to capitalize on this and identify the best overall organization both within and outside the Federal Government for the conduct of solar astronomy and solar physics. The need to maintain the important connections to the astrophysical, geospace, and space weather communities should be paramount. Any reorganization of management roles should be science driven and should be guided by a community-based process.

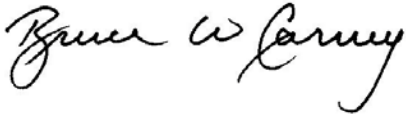
We would be happy to discuss these issues with the Astro2010 Panel in more depth. The respective chairs of the committees we have asked to develop these recommendations and the Directors of our observatories, the National Optical Astronomy Observatory, the

⁶ <http://www.aura-astronomy.org/nv/Future%20of%20Ground%20Based%20Solar%20Physics.pdf>

⁷ The NASA and NSF/ATM portion will be addressed in a separate Space Physics Decadal Survey.

National Solar Observatory, the Space Telescope Science Institute, and the Gemini Observatory can provide additional insights that would be of value to your deliberations.

Sincerely,

Handwritten signature of Bruce W. Carney in cursive script.

Bruce Carney
Chair
AURA Board of Directors

Handwritten signature of William S. Smith in cursive script.

William S. Smith
President
Association of Universities for
Research in Astronomy