

DIRECTOR'S OFFICE

NATIONAL OPTICAL ASTRONOMY OBSERVATORY

Building the System from the Ground Up— The Second Community Workshop on the O/IR System

Todd Boroson

The first Workshop on the Ground-Based O/IR System was held in October 2000, following the release of the McKee-Taylor decadal survey by the Astronomy and Astrophysics Survey Committee (AASC). This AASC report argued for a new paradigm for establishing strategic priorities in ground-based optical/infrared (O/IR) astronomy, one that would take an inclusive perspective, creating a virtual “system” from the combination of public and private facilities. Integral to this new approach was a community-based forum to explore the concept of the system, develop priorities in the context of science goals, identify needed capabilities, and create mechanisms by which they might be developed. The first workshop report detailing these goals can be found at www.noao.edu/gateway/oir_workshop.

Since that first workshop, a number of new programs, based on recommendations from the AASC report, have enhanced the viability and the visibility of the system perspective for ground-based O/IR facilities. Initial work has begun on the two large joint-public/private telescope projects, the Giant Segmented Mirror Telescope (GSMT) and the Large Synoptic Survey Telescope (LSST). The Telescope System Instrumentation Program (TSIP), seen from the outset as a driving force that would provide incentive to participate in the system, has gone through three successful annual cycles. The Adaptive Optics Development Program (AODP), a TSIP-like grants program also advocated by the AASC report, has completed its first year. And the National Science Foundation (NSF) has recently announced PREST, a program similar to TSIP but for smaller telescopes, which, based on the large number of initial inquiries, will be extremely popular.

The motivation for a second system workshop, “Building the System from the Ground Up,” came partly from these programs, which require continuing guidance in the form of updated priorities, and partly from a desire to extend the system idea in new directions. The workshop was held in Alexandria, Virginia, on 13–14 May 2004. The workshop was attended by 63 people from 38 different institutions, including staff from the NSF astronomy division and AURA.

Workshop recommendations include the following:

- TSIP has succeeded very well in developing a system perspective around the large telescopes, and now PREST is poised to invigorate the small telescopes. TSIP rules should continue to evolve to ensure the best benefit to all users and providers within the system.
 - Specifically, eligibility as an “instrumentation proposal” should be extended to any instrument or facility improvement that results in an added or improved scientific capability or in improved efficiency.
 - Also, the category of proposal known as “improvement” should be simplified to provide a path for an observatory to sell telescope time.
- The inclusion of medium-sized (2.5- to 5-meter) telescopes in the system is essential. The TSIP program rules should be modified to be more attractive to these facilities, and institutions with telescopes of this size should be given assistance to arrange consortia and time swaps.
- Data reduction pipelines, data archives, and good community data access and support are becoming increasingly important to the system at all levels (and for all telescope sizes).
 - Data reduction pipelines and archives should be considered desirable elements of TSIP proposals—either for new or existing instruments.
 - Data and archive centers must be established to ingest, distribute, and enhance the scientific value of ground-based O/IR data. These centers will ensure compliance with VO standards and protocols.
- NOAO (by broad consensus) should become involved in providing services in developing data reduction pipelines, stewardship of public archived data, facilitating instrumentation collaborations, and enabling institutions to form telescope operating consortia.

A full report of the workshop and the recommendations of the organizing committee can be found at www.noao.edu/meetings/system2.



The NOAO Data Products Program

Todd Boroson

NOAO has recently established a new program aimed at helping the community take advantage of opportunities to use public, archived data to do forefront research. New survey databases (such as SDSS and 2MASS), new tools (such as Mirage and SkyServer), and the newly developed ability to interact with multiple archives, pioneered by the National Virtual Observatory (NVO) project, together have made possible new kinds of investigations. Ground-based optical/infrared (O/IR) facilities have lagged behind the space-based facilities and radio observatories in archiving data, but NOAO's Data Products Program (DPP) is trying to make up some of this ground in time to fully participate in the next generation of large survey programs, like the Large Synoptic Survey Telescope (LSST), which ultimately will dominate astronomical data archives.

The DPP is an outgrowth of the Image Reduction and Analysis Facility (IRAF) group, which now includes 12 software developers and eight scientists, divided between Tucson and La Serena. While this group continues to support IRAF, and to build new data reduction tools for new instruments, including those at Gemini (see the March 2004 *Newsletter*), its principal focus is now on archives, automatic data reduction pipelines, new tools for "VO" research, and infrastructure to enable the flow of data from NOAO facilities.

The NOAO Science Archive was launched in April 2002 as a repository for the data sets that were produced by the projects that make up the NOAO Survey Program. The next release, due in late 2005, will see a dramatic shift in emphasis to serving data from all NOAO telescopes. This will initially be raw data, available to everyone after the 18-month proprietary period—or less, if proposers choose that option—but with links to all necessary metadata and

calibration information. This new arrangement will also replace Save-the-Bits, the tape-based backup system that allows observers to recover lost data. Future developments will include a "virtual workspace," where archive users can process or analyze data without downloading it, and tools to work on catalogs, images, time series, and spectra in an integrated manner.

The most obvious evolution for expertise in data reduction algorithms is to incorporate them into automatic data reduction pipelines. Instruments are becoming more complex and focal plane formats are becoming larger. New instruments, such as the wide-field IR imager NEWFIRM, will come with data reduction pipelines as integral parts of their data flow, but even the first generation CCD mosaic imagers will benefit from the development of pipelines. Thus, the pipeline group within DPP is working on these two projects, with the intent of providing pipeline-reduced data to observers and the public through the archive.

Other parts of DPP are engaged in other pieces of this system, including the management of data transport, archive and pipeline operations, and support for the LSST and NVO projects. If all of these activities suggest that this group is spread pretty thin, it is important to note that a critical factor in our approach is to develop partnerships that will help us to accomplish more. One of these is with the National Center for Supercomputing Applications (NCSA) in Illinois, with whom we are working to develop a method for providing interface and support services to a remote data repository. It is an exciting time in this field, and we look forward to being an integral part of the development effort that will allow new kinds of astronomical research.

Guest Column

Politics and Science in a Complex World

If the last 12 months presage the future, we can certainly expect interesting times ahead. When President George W. Bush first announced his new vision for NASA last winter, most professional astronomers held their breath. NASA's resources are limited, and the relatively small proportion that funds astronomy research could easily be lost in a major redirection of the agency. The President

directed NASA to shift its focus from a human presence in low-Earth orbit to the exploration of the Moon, Mars, and beyond, using both crewed and robotic spacecraft. Shortly thereafter, NASA Administrator Sean O'Keefe announced his decision to terminate Hubble Space Telescope (HST) Servicing Mission 4 (SM4).

continued



Politics and Science in a Complex World continued

These two announcements, occurring so close in time, left the astronomical community in shock. The last decade has been, without doubt, a "golden age" for astronomy. The discoveries and new paradigms from the past 10 years are well known to all of us, and the coming decades are ripe with promise for fundamental new discoveries. The President's and Administrator's decisions, motivated not from scientific priorities but from other rationales, could have a profound impact on the progress of science.

We began to breathe again when Administrator O'Keefe made it clear that science would continue to play a major role in NASA's future. In his thoughtful and personal remarks at the June AAS meeting in Denver, Mr. O'Keefe made several important points. He assured us that NASA would continue to conduct world-class astronomy from space, with multiple, enormously capable instruments, on a sustained basis. He assured us he would do his best to keep the HST among those capabilities. Finally he assured us that NASA's space astronomy activities beyond the solar system are integral to the President's vision of exploration. The full text of Mr. O'Keefe's remarks is available at www.nasa.gov/audience/formedia/speeches/ok_astronomical_060104.html.

Mr. O'Keefe reviewed his reasons for terminating SM4, including both the need for diligence about mission safety, and the dangerous schedule pressure that could arise from the need to fly SM4 before HST ceases to function, but before safety requirements could be met.

Instead, he asked us to consider the possibility of telerobotic servicing of HST, and described to us the progress in recent months as NASA engineers, with industry and academia, have evaluated the feasibility of robotic servicing. The results are so promising that Mr. O'Keefe announced the release of a call for proposals for a robotic servicing capability, with a mission before the end of 2007. He also stressed the central benefit of the development of robotic technology, in combination with a human presence in space, to open the way for the assembly and servicing of future large space instruments.

Just a couple of weeks earlier, I had visited NASA's Goddard Space Flight Center and taken the opportunity to view firsthand the progress being made toward robotic servicing of HST. I came away with great enthusiasm for this approach, both because I was convinced that teleoperated robots could indeed install new instruments as well as new batteries and gyroscopes, and because of the creativity and dedication to success I found in the engineering team.

The events of early 2004, as dramatic as they were, are part of a much broader process that shapes the priorities and progress of astronomy. Among the scientific disciplines, astronomy

is unusual in undertaking each decade a broad review of the state of the field, an evaluation of opportunities for the future, and a determination of priorities for new directions and initiatives. The familiar process of the decadal survey has led us to think we operate in an orderly world where scientific priorities are set based on science goals determined by a consensus of scientists, operating only under the constraints of funding. But the world we live in is not so simple, and we must learn to participate in a more complex process that incorporates the broader goals and needs of our society, our nation, and our world. We must actively engage in a wider debate about the value of astronomical exploration and discovery.

All of us have a role to play in sustaining the high priority of research in astronomy and astrophysics at the national level. It is a fine line we must walk, between asking Congress to take sides in our own debates on the priorities of astronomy missions, projects, and research, and making sure a bigger message about why the priorities we set through our community processes are important to the nation is delivered successfully. While it seems a simple task, writing our Members of Congress about the importance of what we do is a powerful tool, and one we need to use more effectively.

Catherine A. Pilachowski
Indiana University
Astronomy Department
catyp@astro.indiana.edu



(Cathy Pilachowski holds the Kirkwood Chair in Astronomy at Indiana University in Bloomington, and she is the past president of the American Astronomical Society (AAS). Previously, she served as a member of the NOAO scientific staff for more than 20 years.)



Director's Office



Mark Dickinson
Associate Astronomer

One of the newest members of the NOAO scientific staff, Mark Dickinson is the principal investigator for the Great Observatories Origins Deep Survey (GOODS) Spitzer Legacy Science Program, a major multiwavelength, multi-observatory survey of the Hubble Deep Field-North and the Chandra Deep Field-South fields using the Hubble Space Telescope, Spitzer Space Telescope and both NOAO 4-meter telescopes, among others.

Dickinson earned his undergraduate degree at Princeton University, working with Richard Gott, and his doctorate from the University of California at Berkeley, working with Hiram Spinrad on the clustering evolution of radio galaxies. He then went to the Space Telescope Science Institute (STScI) as an AURA fellow, and returned there after a subsequent fellowship at Johns Hopkins University.

Dickinson, 41, and his spouse, Letizia Stanghellini, moved from STScI to join the NOAO scientific staff in April 2004.



Q: Why did you decide to come to NOAO?

NOAO is a place that I've known and loved for my whole astronomical career. I've been observing here since I was a young graduate student, and I've been a regular visitor and user of NOAO observing time. I've also had many friends and collaborators here on the scientific staff. It is one of the institutions that I feel I

know best in astronomy, and that I feel most comfortable with. It was a very natural decision and an excellent match with the research that I do.

Q: How would you describe the current view of NOAO in the general astronomical community?

I would say that when I started looking recently at new opportunities, I had every impression of NOAO as an organization and an observatory on the upswing, with a growing science staff, several exciting projects on the horizon, and a lot of current activity in research that appealed to me.

Q. What are the roots of the GOODS Survey? How did such a large, multi-observatory project get approved?

GOODS has its roots in the Hubble Deep Field (HDF). I was very fortunate to arrive at STScI just after the first Hubble servicing mission. In that first year, I did the deepest observation with Hubble to date, looking at a galaxy cluster (3C-324) that I had discovered at Kitt Peak. This got people

excited about a very deep field program, which was initiated by then-STScI director Bob Williams.

The great things about the HDF were that it was a public data set, and it became a magnet for other work in the same observing field—nearly everybody with a telescope trained their facilities on it, and most of that data was then made public. It really showed us the potential of combining multiwavelength observations and spectroscopy on a common area to understand galaxy evolution and much more.

But the HDF had its limitations—it was a very small field, in only one hemisphere, and it had some wavelength gaps, particularly in the near- and far-infrared.

GOODS was planned to be multiwavelength in two fields (the HDF-North and the Chandra Deep Field-South) from the very beginning, with the wavelength gap filled by the new capabilities of Spitzer. The opportunity arose from the Spitzer Science Center's decision to have data from the first year of Spitzer operations go to Legacy projects, and we proposed successfully.

There are many scientific motivations, but the ones that drive me are the formation and mass assembly history of galaxies through most of cosmic time. GOODS is uniquely powerful for redshifts from one to six.

Q. What is the status of GOODS?

Because of the Spitzer launch delay, we completed all of the Hubble observations first, and those data are fully released to the community. We are now exactly in the middle of the Spitzer observations—they started in February 2004 and run through November.

continued



Q&A continued

We issued some initial results at the June AAS meeting in Denver, and are working on more. We are also building up ground-based observations in the near-infrared, and conducting a large campaign of spectroscopy with the Very Large Telescope (VLT).

The quality of the Spitzer data is totally remarkable. By and large, the IRAC instrument observations have exceeded our expectations—it is amazing how deep and how fast you can go with an 85-centimeter infrared telescope in space, it is really staggering.

We are seeing mid-infrared light from ordinary galaxies out to a redshift of six, and we think we are seeing a substantial population of evolved galaxies out to a redshift of three that we don't see even in the Hubble Ultra-Deep Field. We may even have some examples of extremely high redshift objects, which we need to confirm.

The first public release of Spitzer GOODS data will be later this year, in time for the Spitzer General Observer Cycle 2 call for proposals.

Q. What have you learned about organizing and leading big observing projects?

For better or worse, the boundaries of GOODS are not that well-defined. The original proposal had 41 coinvestigators, which is already huge. It has now become more of an anthology than a tightly defined program. The people involved have not always been the same, and they change over time, and that is just fine. These are data for the community, and people can do very different things with it. For example, a group at the Keck Observatory carried out a large redshift survey of the GOODS-North field, published on their own, and made their data public.

Because of the size and heterogeneous nature of GOODS, it would be very hard to rule with an "iron fist." I'm fortunate to have worked with people who work well together and have great enthusiasm. My role has been more coordination; it's really been quite spontaneous and productive. But I do think that I will swear off telecons for at least two years when GOODS is finished.

Q. What next? Could Gemini play a role in future observations?

The follow-up observations, such as targeted infrared spectroscopy, will continue for a while. Then there will be a period of time when the data is in the public domain, where we and others will explore them, perhaps at a more leisurely pace.

GNIRS and FLAMINGOS-2 on Gemini South will really open things up in the near-infrared. I expect that we will be proposing to use Gemini more. Several other groups have been awarded significant amounts of Gemini South observing time for GMOS follow-up in the GOODS-South field. Again, those efforts were essentially independent of the GOODS team.

There are lots of these large sky surveys going on, including many supported by NOAO, but there has not been much work done to synthesize what we have learned from all of them. I'm looking forward to some time to systematically explore them. This is one reason I was excited to come to NOAO, to collaborate with groups like the NOAO Deep Wide-Field Survey. That is really essential to build a complete picture, which should eventually represent a real maturation of what we can learn from observational cosmology.

Q. How do you find life in Tucson? Was it difficult for you and Letizia to find a single place to meet both of your professional and personal goals?

I've been coming to Tucson for more than 15 years, so it is a familiar place. We are living in town and are very happy with that. I can bike to work and walk to movie theaters and stores, but can go up on our deck to enjoy the visual spectacle of the sky, clouds, and mountains. I loved living in Baltimore, but the sky was not something you paid a lot of attention to! And I have been pleasantly surprised that the summer heat has not been as unbearable as expected. We haven't had any poisonous animals in our backyard...yet.

Letizia was part of the European Space Agency employment system at STScI, and we wanted to be part of one system. NOAO presented a great opportunity. It is large enough that we could both find positions where we can work productively on our science—she studies planetary nebulae—and contribute to the observatory in its role as a national facility.

My service duties will involve working for the NOAO Data Products Program on the pipeline for data from the NEWFIRM instrument, which is a natural fit with my experience and scientific interests.

We have both found NOAO to be a very welcoming place, and we are very glad to be here.