This issue of E-News is full of information, but none more anticipated than this: the President's 2014 budget for U.S. federal expenditures was submitted to Congress on April 10, 2013. Included in that budget is $27.5M for the start of LSST construction in the 2014 fiscal year. See http://www.nsf.gov/about/budget/fy2014/pdf/26_fy2014.pdf.

This amount is consistent with our baseline plan for construction. The budget request is an important and necessary step in the U.S. funding process for Major Research Equipment and Facility Construction Projects at the NSF.

The U.S. Congress must act on appropriations for FY 2014 before any funding becomes available. If funds for LSST are appropriated and if we successfully pass a number of upcoming critical reviews, then our baseline plan calls for initiation of construction in the summer of 2014. This budget announcement will trigger the final steps in the process of establishing construction readiness. We will continue to work with our NSF Program Officer to complete all of the programmatic and technical requirements for a construction authorization.

Sidney Wolff, LSST Director and Victor Krabbendam, LSST Project Manager

NEW LSST DIRECTOR, DR. STEVEN M. KAHN

AURA announced on March 12, 2013, that Dr. Steven M. Kahn will assume the role of Director of the LSST Project effective July 1, 2013, succeeding Dr. Sidney C. Wolff. Steve was in Tucson March 13, 2013, and shared the following thoughts with staff informally over lunch.

"First, let me thank you all for joining me today, especially on such short notice. The deliberations over the choice of the next LSST Director have been going on for some time now. We were only

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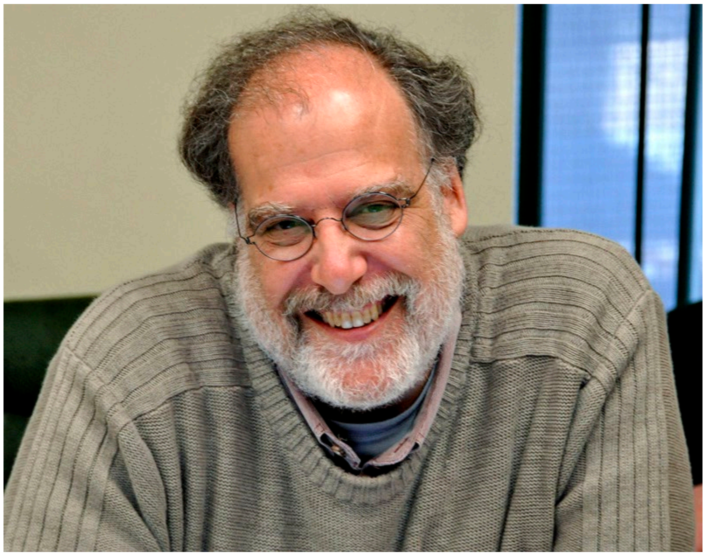

Dr. Steven M. Kahn. Image credit: LSSTC

notified late on Monday that the decision could now be announced, so I wanted to hold an impromptu 'all hands meeting' with project staff as soon as possible just to fill you in on what has been happening, and how I see us moving forward toward the future.

"I think most of you know me, or are at least aware that I have been actively working on LSST, and committed to the success of this project for a very long time. I came to SLAC and Stanford in 2003, with the express purpose of getting personally involved in LSST, and initiating a DOE and SLAC role in the development of the camera. I first learned about this project when I was a member of the previous decadal survey committee, the McKee-Taylor committee, which reported out in 2000. My attraction to LSST was motivated by the very broad range of science that a facility like this can enable. Since I have become involved, I have concentrated mainly on dark energy research, but I have always felt that the importance of LSST is manifest in the full spectrum of science that it will perform. There is tremendous discovery space in a project like this, and the most significant discoveries are likely to be associated with questions we have not yet even known to ask ourselves. I have said publicly that I believe that LSST may eventually be recognized as one of the most important scientific experiments in human history. It will be a tremendous honor to lead the construction effort, and I am honored to have all of you as colleagues in helping to bring this project into fruition.

"As you know, my technical involvements in this project have mostly been concentrated in the camera. In my initial months as Director, I will make a particular point of trying to better familiarize myself with the other subsystems: the Telescope and Site, the Data Management, and the Education and Public Outreach aspects of the Project. I will make personal visits to several of the most important institutions that are collaborating on these elements: Seattle, Princeton, Urbana-Champaign, and also to Chile.

"My position as Director will be joint between AURA and SLAC. I will retain my Stanford affiliation, and SLAC will continue to pay half of my salary. I intend to divide my time roughly equally between Tucson and the Bay Area, and will establish a second residence down here so that my wife and I feel at home in both places. We are hopeful that having a single Director, who is responsible to both NSF and DOE, and is affiliated with both AURA and SLAC, will help to unify our efforts as one project with common goals and procedures. There will always be differences between the ways that NSF and DOE manage their major projects. I believe I understand those differences and will respect them, so that our subsequent reviews are successful on all fronts. There are many challenges ahead, but we have a first-rate team, and I am confident we can work together to achieve our goals.

"In the course of the selection process for the new Director, we were asked to provide updated organization charts, and to outline a vision for how AURA will manage the NSF construction project, with me as the lead responsible official. The org charts that we submitted will not look surprising to any of you - they are basically the org charts that we have previously presented in the NSF proposal and in the various reviews that we have held to

date. However, what has evolved, is our understanding of the different roles and responsibilities of the individuals named on those charts. As this project matures, we are transitioning from what was primarily a design and development effort to a full-on construction project. My appointment as Director comes right around the time that transition will take effect. It is important that we all understand the differences between these two kinds of efforts, and how those differences affect the jobs that you hold. I will work with all of you to help us make the appropriate transitions.

"As you know, I currently hold the title of Deputy Director, where that title has formerly been assigned to the leader of the camera project at SLAC. When I become Director, the Deputy position will become vacant, and the definition of its role will change. Per an agreement reached with NSF, the individual who will eventually be appointed to that job will be a prominent astronomer with scientific interests that are complementary to mine. We have some financial constraints leading up to construction but we will conduct a broad and open search to attract an outstanding candidate to join the team as soon as possible.

"Although I will remain 50% at SLAC, and will continue to serve as the leader of the LSST project at the Laboratory, it is clear that the attention I will be able to devote specifically to the camera effort will be diminished compared to what it has been up to now. Therefore, we will elevate the position of Camera Project Scientist to one with significant oversight responsibility, in parallel to that of the Camera Project Manager, and we may recruit a new individual to carry out that role. The precise mechanism for that is still being worked on, but we hope to begin that process very soon.

"Finally, let me close by pointing out that I plan to officially take up my post as LSST Director on July 1. Until that time, Sidney Wolff will remain the Director and the key spokesperson for the LSST Project. There will be only one Director at any given time, and until July 1, that is still Sidney. After I assume the position, we are hopeful that Sidney will stay on for a while in her capacity as President of LSSTC."

SCIENCE COLLABORATION CHAIRS MEETING

More than 40 members of LSST science collaborations met in Tucson March 14 & 15, 2013, at a meeting hosted jointly by NOAO and LSST. The purpose of the meeting was to discuss the next steps for the science collaborations as the project prepares to transition to construction and to define the relationship between the science collaborations and the LSST Project going forward.

The construction project, as defined in the proposal submitted to NSF, is focused on building the LSST facilities and data management system. Leadership for using LSST data to do science must come from the science community. This meeting of the science collaboration chairs was the first step toward enabling this activity, bringing together the relevant community of scientists.

Since their inception in 2005, the science collaborations have been largely focused on what they can do for the Project. Contributions from science collaborations, in particular the 2009 LSST Science Book, have provided invaluable input in defining the science requirements to the Project. Going forward, there will be an increasing focus on how scientists can prepare themselves to do science when LSST data begin to flow (and beforehand, with precursor data).

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Meeting of the LSST Science Collaboration Chairs, March 15 & 16th, 2013, in Tucson, AZ. Front Row (L-R): K. Covey, K. Borne, M. Wood-Vasey, K. Olsen, B. Willman, A. Mahabal, S. Wolff, T. Lauer. Remaining Row(s) (L-R): M. Dickinson, R. Seaman, M. Juric, R. Kessler, C. Schafer, D. Bard, M. Strauss, P. Marshall (on iPad), X. Fan, Z. Ivezic, S. Nissanke, G. Dubois-Felsmann, T. Tyson, C. Claver, S. Kahn, E. Gawiser, H. Ferguson, L. Walkowicz, D. Shaw, A. Abate, T. Matheson. Image credit: LSSTC

LSST Project Scientist for Data Management Mario Juric led a discussion on the software effort, describing the three Levels of processing that will be done on the data.

- Level 1 (nightly processing) will issue alerts of transients and variables. The alert will characterize each transient, i.e., it will describe the observed properties. It will not attempt to classify the object, i.e., determine the nature of the source. Groups interested in following up on alerts will likely want to establish an "event broker" to sort through the large number of events observed each night to select ones of interest to particular science projects.
- Level 2 (annual data releases) will aim to allow most science to be done at the catalog level. A detailed document is being prepared describing the outputs. The algorithms and outputs will at a minimum be at the level of SDSS, although we anticipate significantly more sophistication in things like galaxy shape measurements. The Level 2 processing will include artificial sources introduced into the data stream.
- Level 3 data products will be developed by the science community. Computing resources provided within the project for community use in developing Level 3 products will be limited to about 10% of the overall processing power of the project. National supercomputer centers can provide additional computing resources. For example, the NCSA is designing its next-generation machine and is interested in projects the science collaborations would like to do with this resource in 2015-2020 (i.e., during LSST construction in preparation for the start of the survey).

NOAO Scientist Steve Ridgway led a discussion of the LSST Observing Cadence. Scientists were particularly interested in observing sequences with faster cadence on a smaller area of sky at a time, as opposed to focusing on covering the largest solid angle each night.

There is also interest in writing roadmaps for the activities of the science collaborations:

- To organize and map out the activities of those collaborations;
- To identify technical needs common to two or more of the collaborations;

- To help make the case for funding of science activities in preparation for the start of the survey.

It is challenging to find ways of providing ongoing support to the science community as they prepare to use LSST data. Such support cannot be covered by the NSF MREFC request. Discussion at the Science Collaboration Chairs meeting identified several high priority items that would be of immediate benefit, including making the Operations Simulations user-friendly to explore cadence issues, distributing the reprocessed SDSS Stripe 82 data with user-friendly documentation, and developing an Event Broker to handle LSST alerts. LSSTC will be working with its member institutions, including especially NOAO and SLAC, to identify ways to support community preparations for LSST.

Next steps include leveraging the communication opportunities this meeting established; developing roadmaps for each science collaboration; identifying software tools needed by multiple collaborations, including informatics tools for mining catalogs and images; exploring plans for an Event Broker for LSST alerts; and the continuation of development and distribution of a strawman commissioning plan to inspire community comment.

Article written by S. Jacoby, M. Strauss, S. Wolff

A ROOM WITH A VIEW ON CERRO PACHÓN

As LSST moves closer to construction, the need for a shelter of some sort on Cerro Pachón has gained in importance. The "Summit Hut" was moved into position in March 2013, to serve as a meeting place to coordinate site activities as well as safe cover for visitors. The hut is an 8' by 20' shipping container, modestly furnished and offering a 12 VDC electrical fixture thanks to a solar power kit. The Summit Hut will remain on the site throughout construction, to offer a warm welcome and, of course, spectacular views.

Bill Gressler, LSST Project Manager for Telescope & Site, makes good use of the Summit Hut with a recent group of visitors. Image credit: LSSTC/NOAO

Dan Phillips, NOAO/LSST Civil Engineer, stands in the doorway of the Pachón Summit Hut, with electricity provided by a 12 VDC solar power kit. Image credit: LSSTC/NOAO

Looking out the front door, toward the future location of LSST (poster at center marks the spot). Image credit: LSSTC/NOAO

SYSTEMS ENGINEERING STAFFS UP

LSST Systems Engineering Team (L-R): C. Claver, G. Angeli, B. Selvy. Image credit: LSSTC

The LSST Systems Engineering team at the project office has tripled in size recently, as Systems Engineering Manager George Angeli and Senior Systems Engineer Brian Selvy join LSST Systems Scientist Chuck Claver to define, integrate, and validate the incredibly complex subsystems and elements of LSST into a cohesive operational observing facility.

For over 5 years, Chuck Claver has been the LSST Systems Engineer and alone has accomplished much, deserving credit for many aspects of the project's success over the years. Chuck will continue his work with the LSST Systems Engineering team as the LSST Systems Scientist.

In December 2012, Brian Selvy joined the Systems Engineering team. Brian is a Senior Systems Engineer with experience using the many tools and processes required to manage the technical aspects of the LSST systems development, integration, and verification. Brian's previous experience is in aerospace; he spent 10 years at several companies including Space Exploration Technologies (SpaceX), Pratt & Whitney Rocketdyne, and Paragon Space Development Corporation working on the development of launch vehicles, rocket engines, and environmental control and life support systems.

In January 2013, LSST welcomed George Angeli to the Systems Engineering team. George is the LSST Systems Engineering Manager and joins Chuck Claver and Brian Selvy in leading the Systems Engineering effort for the LSST Project. George has a strong technical background with his most recent experience as the Head of Systems Engineering for the TMT Project. Formerly he led AURA's integrated modeling team supporting the development of a 30-meter class telescope concept. At WYKO he was the project manager of a team developing real time, phase shifting interferometers for optical testing.

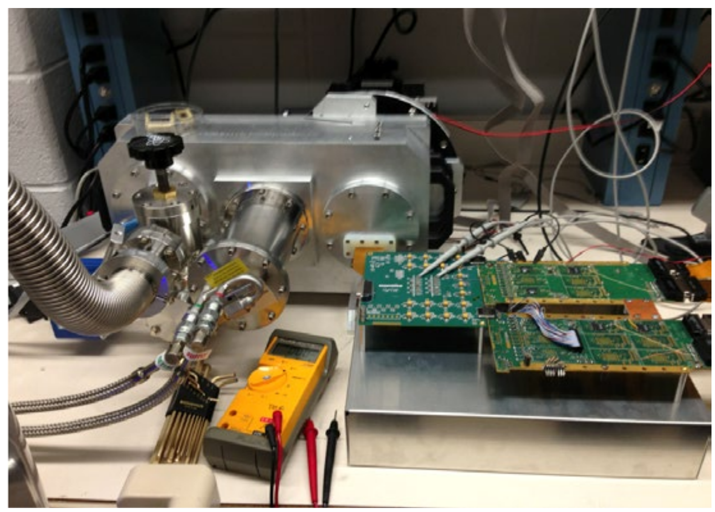
The Systems Engineering challenge is to manage the complexity of the LSST system by properly defining it as well-specified building blocks and then assembling the pieces in a way that will achieve the objectives of the science community. Taken individually, the camera, telescope, data management, and observatory control systems are very complex projects on their own. That makes ensuring the overall observatory meets all of its requirements very challenging, putting additional importance from a Systems Engineering perspective on interface management and verification planning. Complex systems have a tendency to develop “emergent behavior” – system performance or operational characteristics that are not apparent when just evaluating the parts individually or in small groups. Fully understanding all of the interfaces and conducting realistic simulations are critical to helping minimize the unintended emergent behaviors within LSST.

LSST is more than just the next “big machine” exploring the Universe; it is going to be one of the most important scientific experiments of our time. Leading the technical development of such an experiment is a challenge for which this Systems Engineering team is well suited.

Article written by S. Jacoby and the Systems Engineering Team

LSST CAMERA TEAM SUCCESSFULLY TESTS ELECTRONICS CHAIN

A far-flung team of LSST researchers has recorded a significant milestone in the development of the Raft Tower Modules, the core component of the Camera focal plane. For the first time, a pre-production prototype of the 4K x 4K science CCD has been controlled and read out by a full “vertical slice” of the complete electronics chain. The compact and low-power front end electronics is made possible by a custom-designed CMOS chip set designed by engineers at the IN2P3 labs in France and at the University of Tennessee. The other components of the electronics chain in this mini-systems test come from SLAC (data acquisition system), Harvard (digitizer boards), the University of Pennsylvania (front end analog boards), IN2P3 (firmware), and BNL (cryostat, optics, systems integration, control software).



“Vertical Slice Test” hardware at Brookhaven National Laboratory (BNL)

Leading up to this demonstration were many months spent designing, fabricating, and testing the individual components. The CCD, in particular, has been the focus of a seven-year development program with several manufacturers. The custom ASIC (Application-Specific Integrated Circuit) development started in 2007, and LSST will be the first astronomical camera to use ASIC-based readout. This gives LSST the highly-parallel readout structure that enables the fast cadence on the sky, and at the same time provides a readout chain compact and low-power enough to be housed in a compact enclosure in the shadow of the sensor array.

The current test underway at BNL (above) involves a single CCD in a small cryostat and a 16-channel readout system at room temperature. The next steps will involve detailed analysis and optimization of the performance to meet the stringent requirements of LSST. In the months to come, the work will continue with several

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planned revisions to the chips and boards. Then the team plans to expand the scope of the tests to include multiple CCDs, more electronics channels, enhanced software, and tests of the integrated thermal management system that maintains the CCD at a temperature of -100C. By this phased development approach we will be able to exercise the full functionality of the science raft well in advance of building the first production unit.

Article written by Andrei Nomerotski, Joe Mead, and Paul O'Connor, BNL

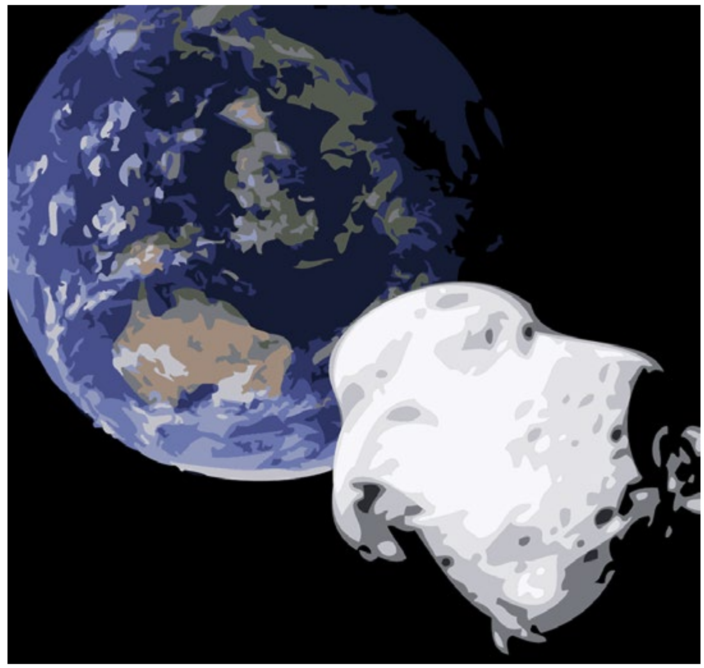
LSST'S ROLE IN PLANETARY DEFENSE

As the recent Russian Chelyabinsk meteor impact and (unrelated) close passing of Asteroid 2012 DA14 remind us, the Earth shares its Solar System neighborhood with many other moving objects, some of which are potentially harmful to our planet. LSST will play a significant role in planetary defense against these objects. Its large-diameter optics, 3200Mpix camera, and sophisticated data processing system will provide both early detection and orbit determination for fainter and smaller objects at greater distances than currently possible.

NASA's NEOWISE survey indicates that there are about 20,000 near-Earth asteroids (NEAs) with sizes of 100-1000 meters, only 22% of which have already been catalogued. Asteroid 2012 DA14 (~46m) is even smaller, and there are potentially millions of uncharted NEAs that size or larger. Fewer than 10,000 NEAs of all sizes have been identified to date through the efforts of ground-based observatories and space missions.

During its 10-year survey, LSST will provide orbital parameters for more than 100,000 of these NEAs allowing us to be better prepared for the potentially devastating events that are sure to come in the future.

The warning time before impact depends on the asteroid's size, its orbit, and the cadence and sensitivity of the observing system. For 45m objects, the LSST warning time would be about 1-3 months, depending on their orbits. Note that LSST could also detect such an object during three prior close approaches. As an example of a very different hazardous object – the 3 km large comet C/1996 B2 Hyakutake, which passed within 0.10 AU from Earth in 1996, LSST could provide a warning time of 8 years, with over 500 observations over that period.



Artist's conception of a Potentially Hazardous Asteroid. Image credit E. Acosta/LSSTC

The chances of an object that caused the 1908 Tunguska event impacting Earth are about once every 100 years. But probability can be misleading: such an improbable event could happen next year. LSST will help assess the hazard to Earth from asteroid impacts by constraining the orbital and size distribution of the near-Earth population, allowing concrete estimates of the impact frequency as a function of size. LSST's ground-based optical observations complement potential space observations in the infrared, helping us determine more accurate sizes and composition of these objects. LSST will also identify potential targets for spacecraft missions, searching for objects with small relative velocities to Earth.

A recent National Research Council report[1] found that LSST is the most cost effective way of detecting the most likely and potentially most damaging Earth threatening objects. Simulations show that the planned ten years of operation of the LSST survey with our baseline cadence, which was designed to optimize observations for a diverse set of science goals, will yield orbits for 50% of PHAs with diameters D=140m. With modifications of this baseline cadence and some improvements to software, LSST could reach completeness of about 70% by the end of its 10-year survey.

It is much more difficult to improve the completeness from 70% to 90% than from 50% to 70%. To reach 90% completeness, LSST would have to run for 12 years, with more significant modifications of its cadence, and there would be additional required software improvements. The incremental cost of achieving this level of completeness would be dominated by the operations costs for two additional years of surveying.

[1]National Research Council. Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies. Washington, DC: The National Academies Press, 2010.

BILL GRESSLER: SEEKING THRILLS WITH ROLLER COASTERS, FLY BALLS, AND LSST

The fateful discovery of the "Institute of Optics" page in the University of Rochester Catalog transformed aspiring biomedical engineer William Gressler into an optical engineer and eventually LSST's Telescope and Site subsystem manager. "The irony is that if the pages had been stuck together or I had missed that page," Bill said, "who knows where I'd be now."

Without that moment of serendipity, he wouldn't be leading the team responsible for design and fabrication of the LSST observatory facilities and hardware that will capture the light, control the survey, calibrate conditions, and support all LSST summit and base operations. He certainly wouldn't have met Mick Jagger, to whom he gave a late night tour of the Hobby Eberly Telescope (HET) while working at that facility.

"Who knows who I'll meet as LSST moves along?" Bill said. "I find it fascinating to look back and realize that a kid from Mohawk, New York, population 2,700 with all

LSST's Telescope and Site subsystem manager, William Gressler. Image credit: LSSTC

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of three traffic lights, can work his way up to participating in such an important science project as the LSST."

Bill took over as LSST Telescope and Site manager in July 2012, just as the subsystem began preparing for early procurements in advance of LSST's construction start. Along with ongoing LSST mirror fabrication at the Steward Observatory Mirror Lab, the recently awarded M2 polishing and cell assembly contract was the culmination of Bill's nearly seven years as lead optical systems engineer before assuming his current position. He joined the LSST project in 2005 following a stint at Kodak/ITT in New York. Before that he worked with LSST Project Manager Victor Krabbendam on the Hobby-Eberly Telescope (HET) in west Texas.

"These telescope projects are interesting and rewarding," Bill said. "While the LSST Project dwarfs the HET in its size, cost, and significance, the approaches to leading a lean team to design, fabricate, assemble, and demonstrate performance of a telescope system are similar. They provide a unique opportunity to produce a tangible legacy for future scientific discovery."

Bill takes pride in the role his discipline plays in enabling amazing science through the provision of telescope capabilities.

"Just as images, alerts, and catalog data will benefit astronomy and astrophysics, innovations in the LSST telescope system will benefit future telescope and camera design engineers," he said.

Many of the basic technologies such as active optics, hexapod positioning, and wavefront reconstruction have been demonstrated on previous telescopes, but LSST is pushing the envelope through the melding of many of these features into a unique implementation.

"Our combined M1/M3 (primary/tertiary mirror) design is truly state of the art. The extremely fast optical system prescription and wide field of view combine to provide an unmatched collection capability. Our cadence is very demanding given the size and mass of the optical system, which required re-design of legacy support systems."

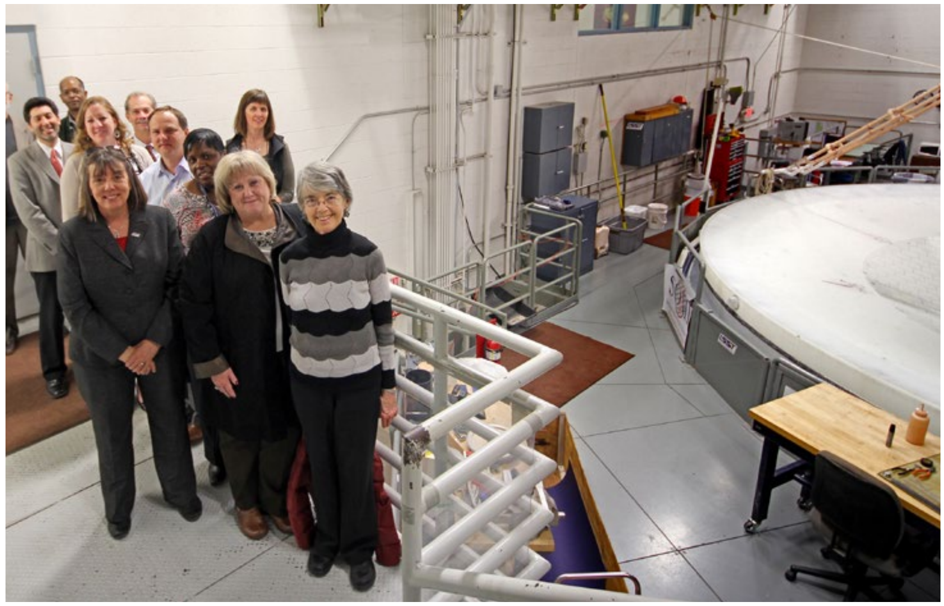
In his free time, Bill enjoys baseball, traveling, and spending time with his wife, two kids and "super dog" Tanner. Over three years of going to Arizona Diamondbacks games, he and his family have accumulated six foul balls, including two in one game (one in the mitt!). While on vacation this past summer in San Antonio, he experienced his first "big dose" of amusement park rides at Six Flags over Texas. Bill said he barely made it through the Rattler, a nearly mile-long wooden roller coaster that starts with a 166-foot drop, has a top speed of 65 mph, and pulls riders with up to 3.5 g through its curves. The Rattler closed for good shortly after the Gressler family vacation. As far as we know, there is no direct connection. Bill looks forward to its replacement with the Iron Rattler, a taller, faster metal roller coaster that will be the first of its kind with a completely inverted barrel roll.

As exciting as Bill may find catching foul balls and thrill rides to be, he is equally excited about LSST's promise of discovery.

"I find the scale of the Universe to be a little incomprehensible quite frankly," Bill said. "As an engineer, I cannot fully appreciate the magnitude or enormity of data we'll collect, but I can relate to this fact: by the third night, LSST will have captured as much data as has been produced to date by the Hubble telescope. That's pretty mind boggling. And I expect we'll make thrilling discoveries that will draw the same gasps as those amazing deep-field images from Hubble."

Article written by Robert McKercher and Bill Gressler.

AURA Workforce Diversity Committee Meets in Tucson



AURA WDC Committee Chair Bernice Durand (University of Wisconsin) is on the right with AURA Center Diversity Advocates and Committee members behind her: S. Bruff (STScI), S. Jacoby (LSST), D. Williams (NOAO), N. Barker (Gemini), M. Hanson (U. Cincinnati), N. Reich (AURA), W. Smith (AURA), K. Stassun (Vanderbilt/Fisk), A. Evans (U. Virginia), and J. Leibacher (NSO). Image credit: LSSTC

Members of the AURA Workforce Diversity Committee (WDC) met in Tucson December 11 & 12, 2012. Here, committee members tour the Steward Observatory Mirror Lab and see the LSST primary/tertiary mirror (M1/M3) on the polishing machine; the M1 and M3 surfaces are clearly distinguishable. The overall goal of the Committee is to strengthen AURA's role in providing opportunities for underrepresented groups, institutions, and geographic areas to contribute to AURA's mission and the overall field of astronomy. This will support AURA's and its funding agencies' objective of preparing a diverse, globally engaged science, technology, engineering, and mathematics (STEM) workforce. The WDC meets twice a year face-to-face. K. Stassun will take over as Chair at the April 2013 meeting in Nashville. More information is available on AURA's website.

LSST Camera Meeting

The LSST Camera subsystem hosted a team-wide workshop at SLAC in early November. These semi-regular workshops provide the distributed camera team with the opportunity for in-depth, face-to-face discussions of programmatic and technical issues. A variety of technical topics was covered at the meeting, highlighting those which are especially relevant to the "critical path" for the camera development, or represent areas of residual "high risk" in the camera design.

The LSST Camera Team meeting provided a panoramic big picture through focus on critical path issues and exposure of residual risks. Image credit: E. Acosta/LSSTC

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Adler Planetarium; Argonne National Laboratory; Brookhaven National Laboratory (BNL); California Institute of Technology; Carnegie Mellon University; Chile; Cornell University; Drexel University; Fermi National Accelerator Laboratory; George Mason University; Google, Inc.; Harvard-Smithsonian Center for Astrophysics; Institut de Physique Nucleaire et de Physique des Particules (IN2P3); Johns Hopkins University; Kavli Institute for Particle Astrophysics and Cosmology (KIPAC) - Stanford University; Las Cumbres Observatory Global Telescope Network, Inc.; Lawrence Livermore National Laboratory (LLNL); Los Alamos National Laboratory (LANL); National Optical Astronomy Observatory; National Radio Astronomy Observatory; Princeton University; Purdue University; Research Corporation for Science Advancement; Rutgers University; SLAC National Accelerator Laboratory; Space Telescope Science Institute; Texas A & M University; The Institute of Physics of the Academy of Sciences of the Czech Republic; The Pennsylvania State University; The University of Arizona; University of California at Davis; University of California at Irvine; University of Illinois at Urbana-Champaign; University of Michigan; University of Pennsylvania; University of Pittsburgh; University of Washington; Vanderbilt and Fisk Universities

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Large Synoptic Survey Telescope