Large Synoptic Survey Telescope
E-News

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The heat is on, from both Tucson's hot summer season and the increasing intensity of activity as LSST moves forward in the process of seeking construction support. The news this quarter is best told in the pictures and captions below...

Project Manager Transition

Don Sweeney (left) congratulates his successor Victor Krabbendam on his appointment as the new LSST Project Manager. (Image Credit: LSST Corporation)

Victor Krabbendam, current LSST Deputy Project Manager and Telescope and Site Subsystem Manager, has been named as LSST's new Project Manager. The long-planned transition officially takes effect July 1, 2012. Victor replaces Don Sweeney, whose hard work and dedication as LSST's first and, until now, only project manager has shepherded the crucial design and development phase. Don is taking a well-deserved break from nine plus years of commuting, but he will continue working with the project in a smaller, part-time role. Victor has a 26 year career focused on the development, construction, and management of large optical systems for both ground and space applications. Prior to joining LSST in 2004, he was a lead engineer and manager for the Hobby Eberly and SOAR telescopes. Victor's appointment ensures consistency and a smooth transition as the project continues preparing for construction.

Reviews

Members of the NSF Cost Review committee and LSST team members look over the LSST primary/tertiary mirror blank while touring the Steward Observatory Mirror Lab. (Photo by Don Sweeney)

Understandably, funding agencies want a large project like LSST to be fully vetted by external non-advocates as well as the agencies themselves before funding is recommended. This process of assessment has made Spring the review season. Both an NSF Cost Review and Joint (DOE/NSF) Interface and Management review took place in May. Also in April, the Summit Facility 90% review took place, where the sleek, aerodynamic structure that will house the LSST on Cerro Pachón was reviewed in the final stages of specification. Following a review last November, in April 2012 the LSST camera received "Critical Decision 1" approval by the U.S. Department of Energy to move into the next stage of the project. This milestone, along with the successful NSF Preliminary Design Review in September, gives the Project good momentum as we continue to move through the carefully structured process that we hope will ultimately result in construction funding.

In This Issue

Washington

LSST team members prepare to meet Congressional staffers at the AAS-sponsored Congressional Visits Day in Washington DC. (Image credit: LSST Corporation)

April was "LSST goes to Washington" month. Both the LSST and AURA Board Meetings took place in the capital, events which were leveraged into opportunities to increase the visibility of LSST. LSST was also an AAS-sponsored exhibitor at a Congressional Visits Day. LSST team members L. Walkowicz, W. Gressler, C. Claver, and S. Jacoby spoke with Congressional staffers at the Visit Day reception in the Rayburn Hall Foyer.

SPIE

The LSST exhibit for the SPIE meeting in Amsterdam features updates on the Camera, the Summit Facility, the Telescope, and Project status. (Graphic by Emily Acosta)

LSST will have a strong showing at the SPIE meeting in Amsterdam, with 25 papers or posters being presented and a booth in the exhibit hall. The Astronomical Telescopes and Instrumentation subgroup of the SPIE, the international society for optics and photonics, meets every two years and is the premier professional gathering for engineers in many fields. In the online agenda (http://spie.org/x13662.xml) you'll notice invited talks by Deputy Project Manager V. Krabbendam (LSST/NOAO) on The LSST Final Design Status and Data Management Deputy Project Manager M. Freemon (LSST/NCSA) on Data Management Cyberinfrastructure for LSST.

Brazil

Attendees of the Brazil LSST workshop pose in front of the meeting venue, the Hotel Orotur in Campos Do Jordão. (Photo by Don Sweeney)

In early April, ~80 attendees from the Brazilian astronomy community and 9 LSST team members met for several days in Campos Do Jordão, Brazil for the "Science with the LSST: A Brazilian/US Joint Workshop." The LSST team presented the scientific reach and status of the project. Discussions were also held to determine if and how Brazil will engage in the LSST project. Bruno Castilho, Director Laboratório Nacional de Astrofisica, and LSST Project Manager Don Sweeney organized the meeting.

All Hands Meeting

A double rainbow over the Catalina Mountains marked the end of the first day of the 2010 LSST All Hands Meeting at the Ritz-Carlton Dove Mountain resort north of Tucson. (Photo by Emily Acosta)

The 2012 All Hands Meeting will take place August 13 – 17 at the Ritz-Carlton Dove Mountain north of Tucson. We're expecting 250 scientists, engineers, and educators for 5 days of discussion and interaction. The 2010 LSST All Hands Meeting will be hard to beat. The first evening we were treated to a beautiful double rainbow and the final day we heard the Decadal Survey announcement of LSST's top priority for large ground-based facilities for the next decade. The jam-packed agenda for 2012 indicates that this year's meeting will offer many opportunities for productive interactions. It will also be the first AHM to include attendance by representatives from institutions and countries that have indicated their intention to contribute to LSST operations.

ENDANGERED SANDILLÓN CACTUS TAKES SIGNIFICANT STEP TOWARD RETURN TO CERRO PACHÓN

Sandillón (Eriocyce aurata) seedling propagated by University of La Serena as part of LSST's environmental impact mitigation efforts. The seedling has been successfully relocated to a greenhouse, where it will continue maturing before eventual transplantation on Cerro Pachón (photo by Jeff Barr)

The first specimen of the endangered cactus species, Sandillón (Eriocyce aurata), propagated in a University of La Serena laboratory as part of LSST's environmental mitigation program, has been relocated to the greenhouse on Cerro Pachón. The relocation is a significant milestone in LSST's effort to mitigate the effects of site excavation on the endangered species of Chile (LSST E-News, October 2011 Volume 4 Number 3).

"The success of this initiative is possible thanks to the work of Gina Arancio and the determined support of the LSST project," said Mario Gonzalez Kemnis, AURA Safety and Environmental Engineer.

Led by Arancio, the University of La Serena propagation program collected 300 Sandillón seeds from Cerro Pachón prior to LSST excavation work. As one of those seedlings, the relocated specimen was cultivated in the laboratory before being moved to the greenhouse on Cerro Pachón. After reaching maturity at the greenhouse, the cactus will be transplanted to the mountain. Within the next month, an additional 50 specimens will be moved to the greenhouse on Cerro Pachón.

Cultivation of a Sandillón (Eriocyce aurata) seedling by botanical specialists at the University of La Serena (photo by Mario Gonzalez Kemnis)

Article written by Robert McKercher with contributions from Mario Gonzalez Kemnis and Jeff Barr.

DRUPALCON 2012 – GOIN' MOBILE (WITH APOLOGIES TO THE WHO)

LSST web team members Iain Goodenow, Emily Acosta, and Mark Newhouse were among the more than 3,100 people who attended DrupalCon 2012 March 19-23 in Denver. DrupalCon Denver's theme, "Collaborative Publishing for Every Device," focused on Drupal's move toward supporting web access through mobile devices.

"Given that nearly half of Internet traffic now comes by way of a mobile device and that many mobile Internet users rarely or never access the web via a traditional desktop browser, LSST must take these trends into consideration as we plan for the future," Newhouse said.

This is not the web.

As LSST's web needs become more complex and its websites become more sophisticated, the skills and knowledge base of the individuals tasked with building and maintaining them must likewise become more sophisticated. Months ago, LSST converted its websites to Drupal, a free, open source content management system. LSST chose Drupal because of its flexibility and good track record among large organizations. Drupal has the additional advantages of built in security, running on off-the-shelf components, and support from a large, active and diverse community of users. Attending DrupalCon, a biannual event put on by the Drupal Association, affords the LSST web team an unparalleled opportunity for insight and skills development.

Goodenow, Acosta, and Newhouse all came away from DrupalCon Denver with the same insight: the rapid growth of mobile Internet access has profound impact on the design of LSST's websites.

This is the web.

Mobile Trends

Mobile Internet access is rapidly eclipsing traditional web browsing, that is sitting at a desk in front of a large screen. Nearly 50% of Internet traffic comes by way of a mobile device and 28% of mobile Internet users rarely or never access via a desktop browser. In Africa, Asia and India the latter number jumps to 50% or more. Services like Twitter, Facebook, Yelp and Pandora are already seeing a huge shift to mobile use;

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Facebook's mobile users are twice as active as their desktop counterparts.

Responsive Design & Thinking Mobile First

Clearly, ignoring mobile is unwise, but more than that, mobile itself will continue to evolve. Web designers need to be prepared for the plethora of alternative access modes arriving in the near future. Current best practice emphasizes moving toward responsive design. In this approach, the content and site design adapts to the screen and device being used to access it. This can be as simple as reflowing the content for different screen sizes or serving up completely different content based on which device is asking for it.

While these are new ideas and implementations, they are coalescing around the idea of thinking mobile first when designing websites and Internet interactions.

By thinking "mobile first" and designing responsively, LSST can craft world class websites to serve users of any device, whether they are smart phones, tablets, gaming consoles, or any other appliance connected to the Web.

Article written by Robert McKercher, Mark Newhouse, Iain Goodenow, and Emily Acosta. Images credit Brad Frost.

This will be the web.

FROM RADIO-CONTROLLED PLANES TO THE COSMOS – HU ZHAN

Cosmologist and co-chair of two LSST science collaborations, Hu Zhan visits the Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST) at the Xinglong Observing Station. The observing station is about 90 miles northeast of the NAOC headquarters in Beijing. A 4-meter reflecting Schmidt telescope with a field of view of 5 degrees, LAMOST has 4,000 fibers for spectroscopic observations.

As tenuous as a connection between television repair, radio-controlled airplanes, and the LSST may seem, Hu Zhan, cosmologist and co-chair of two LSST science collaborations, cites those two hands-on hobbies as crucial influences on his career.

"My father assembled our family's first TV set from parts," Hu said. "My picking up that hobby and playing with those magic parts and tools was very effective for inspiring interest in science and technology."

As an aerospace engineering student at Beijing University of Aeronautics and Astronautics, Hu particularly enjoyed building and flying radio-controlled model planes with a team of enthusiastic fellow students. "Then R/C planes were built by hand and really required craftsmanship. Now, almost every toy store sells ready-to-fly R/C planes. Hu "admits with some embarrassment" that he owns a couple of such R/C helicopters in his collection. "I'm actually impressed by the fact that they are able to miniaturize and integrate the receiver, servos, and gyro into such a tiny space. This is in some way analogous to LSST. Transformative technology really makes the difference."

Enthusiasm for "being part of the enterprise that is transforming the field of astronomy" led Hu to join the LSST project in 2004 when he was a postdoctoral fellow at the University of California at Davis. Following a stint as an assistant project physicist at UC Davis, he accepted a professorship at the National Astronomical Observatory of China (NAOC), where he researches, among other things, the capability of LSST to determine the properties of dark energy. He co-chairs the Large-Scale Structure/Baryon Acoustic Oscillations Science Collaboration with Eric Gawiser and the Cosmology Interest Group with Rachel Bean. He is also leading the effort to form a Chinese consortium to join LSST.

Hu is excited about both LSST's scientific potential and its unprecedented contribution to data-intensive astronomy. "LSST will open the era of data intensive astronomy and change the way astronomical research is done," he said. "Managing and processing 200 petabytes of data is a major computational challenge! It's actually not so easy to grasp how difficult the task is because the concept is so abstract for many of us."

As an example of LSST's transformative potential, Hu described how the unprecedented sample size to be collected by LSST will affect one of his particular interests, baryon acoustic oscillations (BAO). BAO are a tiny feature in the galaxy spatial correlation function that can be used to determine cosmological distances and hence dark energy properties. "By providing a sample of four billion well-measured galaxies extending above redshift of 2.5, the LSST will be able to measure BAO far better than any existing photometry surveys. Larger sample volume means smaller errors on large scales, and higher

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sample density means smaller errors on small scales. Because the LSST sample is so huge, one can divide the galaxies into sub groups and measure both the correlation within each group and cross correlations between the groups. In this way, there will be many cross checks, and more information can be extracted."

Hu considers that discovery space to be the true value of a high quality survey like the LSST. "The most exciting discoveries will be those yet to be identified."

A native of Shanghai, Hu envisions the rapid growth of the Chinese science and technology sector having a significant positive impact on projects like LSST. "There is so much room for growth in astronomy. For example, currently there are only four astronomy departments and a handful of astronomy-related centers and institutes in Chinese universities. I wouldn't be surprised to see the size of the Chinese astronomy community double by the time LSST goes prime. I welcome the challenge of convincing more people and institutions to commit their time and other resources to the project."

Article written by Robert McKercher and Hu Zhan

SEEKING THE FUNDAMENTALS OF THE UNIVERSE: COSMOLOGICAL PHYSICS WITH LSST

This E-News article is based on Chapter 15 of the LSST Science Book: Cosmological Physics.

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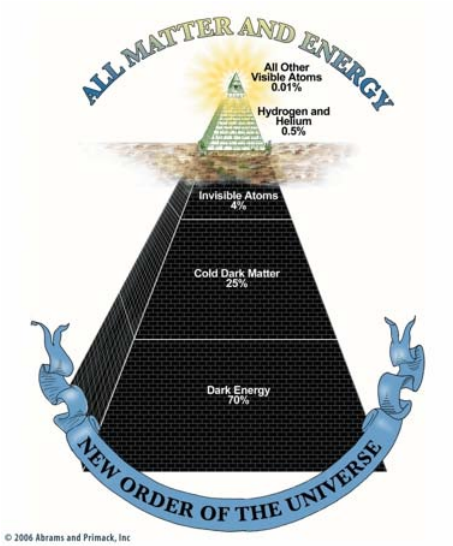
The goal of LSST observations is to deepen our understanding of the Universe: its components, its origins, its fundamental nature and evolution, and the framework on which all these rest. Observations with a survey as comprehensive as LSST, one that samples an enormous volume of the Universe with billions of galaxies, can produce unsurpassed measurements and evidence to test our underlying theories and hone our cosmological framework, a framework that has undergone significant changes in the last two decades.

By the 1960s, when the cosmic microwave background (CMB) was discovered, the Big Bang universe model had gradually emerged as the winner among the many cosmological models proposed by scientists. Later on, inflation was proposed to address several problems of the Big Bang theory. However they realized that even if they counted the invisible dark matter, the total mass density of the Universe was insufficient to explain its observed flatness and isotropy. In the early 1990s, statistics of galaxy spatial distribution also showed preference for a low-density Universe, posing a challenge to inflation theory. The accelerated cosmic expansion revealed by Type Ia supernovae data in the late 1990s presented yet another challenge to the then accepted cosmological model, which could only produce deceleration of the expansion. Today, cosmologists continue to find the acceleration of cosmic expansion perhaps the most perplexing puzzle ever encountered.

The puzzle of accelerating expansion has prompted scientists to pursue innovative associations of data to understand what is going on. Combining data from Type Ia supernovae observations with the examination of large-scale structure and CMB confirms that the Universe is expanding at a greater rate over time. These observations have led scientists to propose dark energy as the phenomenon that reconciles the measured geometry of space with the total amount of matter in the Universe. Today, scientists recognize that fully 96% of mass and energy is dark, and dark energy is propelling the expansion at an ever-increasing rate.

What is dark energy, how does it create acceleration of the expansion of the Universe, and how does it affect the final fate of the Universe? In 2005, NSF-NASA-DOE created the Dark Energy Task Force (DETF) to advise on future research of this "new" phenomenon. DETF stated "nothing short of a revolution in our understanding of fundamental physics will be required to achieve a full understanding of the cosmic acceleration." LSST's survey data will produce significantly larger and more uniform data on the powerful probes of the Universe to investigate the cosmic acceleration and the ultimate fate of the Universe.



Credit: Nancy Ellen Abrams and Joel R. Primack, The New Universe and the Human Future, Figure 30. (Yale University Press, 2011).

Probes of geometry and growth of structure, such as weak lensing (LSST E-News, Volume 4, Number 4, April 2012), baryon acoustic oscillations (LSST E-News, Volume 4, Number 3, October 2011), Type Ia supernovae (LSST E-News, Volume 4 Number 1, April 2011), and cluster counts, will provide multiple precision observations to provide cross-checks of results and methods. Because

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different cosmic probes are subject to different systematic effects, researchers can compare the measurements and reduce systematic errors. Scientists will be able to achieve more robust and tighter constraints on cosmological parameters.

Several investigations combining LSST data sets and non-LSST data sets will bring new insight into cosmological questions: constraining dark energy properties, determining neutrino mass, testing gravity, large-scale measurements, and the like.

A joint analysis of weak lensing and baryon acoustic oscillations (BAO) dramatically improves the constraints on the dark energy equation of state, which relates dark energy's pressure to its density. Weak lensing extracts cosmological knowledge from shear, the distribution of minute distortions of the background galaxies caused by foreground mass. Weak lensing measures all matter, both luminous and dark. The shear statistics reflect the clustering of dark matter, although teasing the results from data requires tight control of various systematic effects. BAO studies use a characteristic scale in galaxies' special distribution, a "cosmic ruler," to translate angles into distances and so determine the expansion history versus cosmic epoch.

Constraining neutrino mass helps better define the model of the Universe. Joining the LSST survey with CMB observations can offer constraints on neutrino properties complementary to parameters determined from particle physics experiments. Constraints on the masses could improve by a factor of two using complementary data sets such as the measurement of expansion from Type Ia supernovae and BAO to determine other cosmological parameters.

Scientists ask, "Is dark energy a new dilute type of mass-energy with negative pressure or a new, beyond-Einstein form of gravity?" To answer such questions, one also needs to utilize multiple probes to examine the consistency between the expansion history, the growth rate of fluctuations in mass density, and the mass density-light bending relationship within the framework of each gravity theory. All four major LSST dark energy probes – weak lensing, BAO, Type Ia supernovae, and cluster counts – probe the expansion history. Weak lensing and cluster counts probe all three areas.

LSST's 18,000 square degree (deg2) wide and deep coverage of billions of galaxies has the power to test differences in characteristics across various directions in the Universe. Weak lensing, BAO, and other observables can be measured in patches of sky across the whole survey area. Scientists will be able to address specific questions about fluctuations of cosmological quantities (e.g., distances) over different directions from these observations. Although scientists don't yet have any plausible models of what dark energy is or how it works, LSST's wide survey area is particularly suited to measure dark energy properties in many patches and to detect variations in the dark energy equation-of-state parameters to several percent level (depending on the patch size, equation-of-state parameterization, and other factors) across the sky to improve our understanding of the phenomenon.

Article By Anna H. Spitz, Hu Zhan and J. Anthony Tyson.

For more information about LSST and Dark Energy:

- LSST web page, Dark Energy at http://www.lsst.org/lsst/public/dark_energy
- LSST poster at the 219th meeting of American Astronomical Society (2012), LSST Probes of Dark Energy: New Energy v. New Gravity at http://lsst.org/files/docs/aas_219/med/219-RC-1524-AAS_Bradshaw.pdf

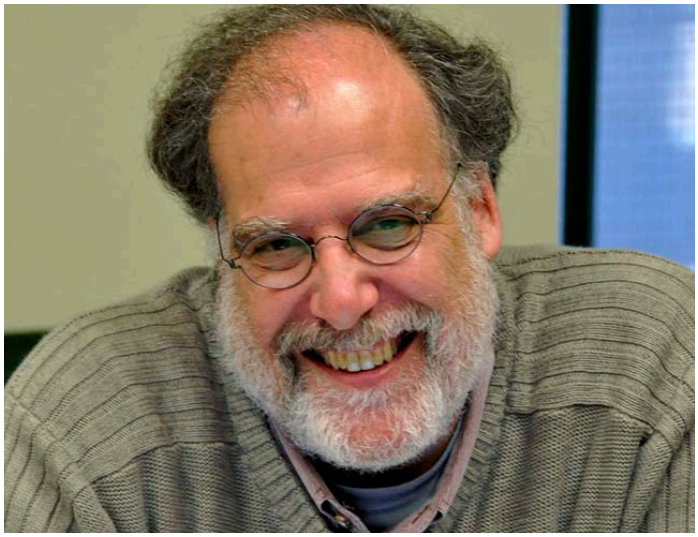
LSST DEPUTY DIRECTOR ELECTED TO AMERICAN ACADEMY OF ARTS AND SCIENCES

Steven Kahn, LSST deputy director and Camera Lead Scientist at SLAC National Accelerator Laboratory, has been elected to membership in the American Academy of Arts and Sciences.

He joins 220 individuals elected to the academy for 2012. The class includes some of the world's most accomplished scholars, scientists, writers, and artists. This year's impressive cohort – announced on April 17 – includes Melinda Gates, Neil Simon, and Hillary Rodham Clinton.

"I am, of course, delighted to have been elected to the academy," said Kahn, a professor of particle physics and astrophysics at SLAC. "This is an extremely distinguished organization, and I feel very honored to have been recognized in this way."

Kahn joined LSST and SLAC in 2003. SLAC is responsible for building the LSST camera, the largest ever constructed. The 3.2-gigapixel digital camera will be positioned in the middle of the telescope and will capture extremely high quality images



LSST Deputy Director Steve Kahn.

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of the widest, fastest, and deepest view of the night sky ever observed. Specializing in cosmology and X-ray spectroscopy of cosmic sources, Kahn also chairs the Physics Department at Stanford and holds the Cassius Lamb Kirk Professorship in the Natural Sciences.

Founded in 1780 by John Adams, James Bowdoin, John Hancock, and other leaders, the Academy is an international learned society, which elects to membership "men and women of exceptional achievement, drawn from science, scholarship, business, public affairs, and the arts … to conduct a varied program of projects and studies responsive to the needs and problems of society." Members contribute to Academy publications and studies of science and technology policy, energy and global security, social policy and American institutions, the humanities and culture, and education.

Membership encompasses more than 4,000 Fellows and 600 Foreign Honorary Members, reflecting the full range of disciplines: mathematics, the physical and biological sciences, medicine, the social sciences and humanities, business, government, public affairs, and the arts. Among its Fellows are more than 200 Nobel Prize laureates and 100 Pulitzer Prize winners. Former members include such luminaries as George Washington, Benjamin Franklin, Daniel Webster, Ralph Waldo Emerson, Albert Einstein, and Winston Churchill.

The 2012 class will be inducted at a ceremony on October 6, at the Academy's headquarters in Cambridge, Massachusetts.

Article adapted by Robert McKercher from SLAC and AAAS press releases.

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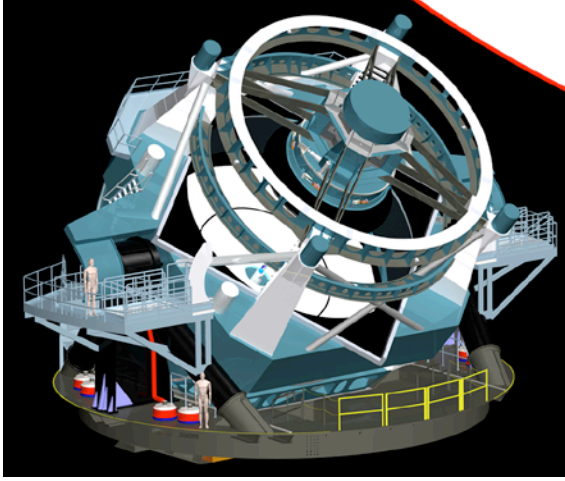

Large Synoptic Survey Telescope