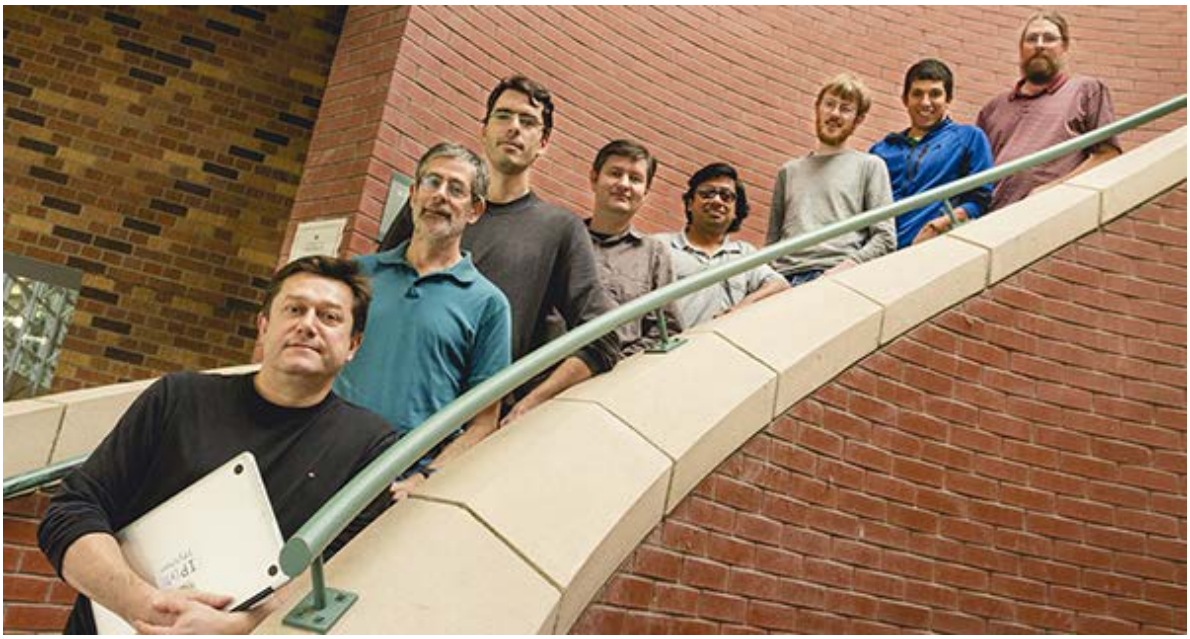
COLLEGE OF ARTS & SCIENCES
UNIVERSITY of WASHINGTON

Perspectives
NEWSLETTER

Big Universe, Big Data: LSST Project Moves Forward

The stars over Chile better not be camera shy. Once the Large Synoptic Survey Telescope (LSST) begins operations, Chile's night sky will get the paparazzi treatment for a full decade, with a new picture taken every 20 seconds. Each digital image will be so detailed that viewing one in full resolution would require 1,500 high definition TV screens. Scientists expect the resulting data to provide valuable clues to the origins of the universe.

The University of Washington, a founding member of the LSST project, is involved in all aspects of the survey. In July the National Science Foundation (NSF) approved funding for construction of the project, with an anticipated completion date of 2019.



An expanding team of UW scientists is working on the LSST project. The team currently includes (from left) Zeljko Ivezic, Russell Owen, Mario Juric, Peter Yoachim, Rahul Biswas, Scott Daniel, Bryce Kalmbach, and Simon Krughoff, and—not pictured—Bob Abel, Yusra AlSayyad, Andrew Becker, Andrew Connolly, and Lynne Jones. Photo by Isaiah Brookshire.

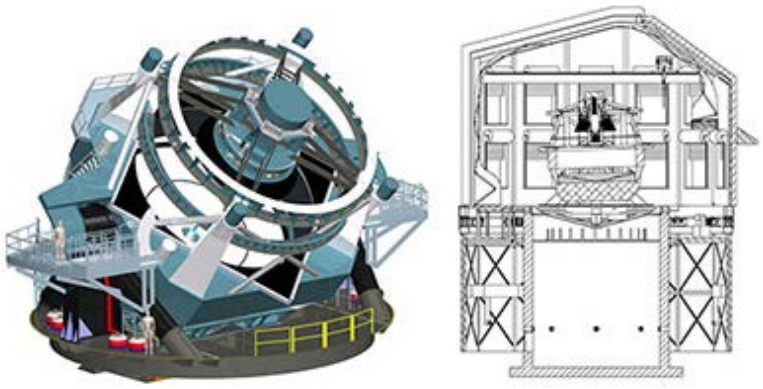
"The LSST is one of the most exciting experiments in astrophysics today," says Andrew Connolly, UW professor of astronomy. "When it comes online at the end of this decade, it could completely transform our knowledge of our universe, from understanding how dark energy drives the expansion of the universe to identifying asteroids that may one day impact the Earth."

What makes the LSST so promising? While some telescopes use massive mirrors to capture very faint light from

the earliest galaxies, and others orbit above the Earth's atmosphere to take exquisitely detailed images, the LSST's strength is its ability to sample huge swaths of sky. Its enormous 3,200 Megapixel digital camera—the largest in history, about the size of a Volkswagen Beetle—will take three pictures every minute, with each picture as wide as seven full Moons, completing a survey of the visible sky every three nights. The sky will be imaged about one thousand times over the course of the LSST's decade of operation, providing an almost unimaginable trove of more than 100 petabytes of data. All that data will alert scientists to changes in the sky, which will in turn provide clues to the universe's evolution.

"Our sky is in constant motion," Connolly explained in a March 2014 TED Talk. During the talk, a video showed asteroids circling the Sun. "This swarm of objects you see streaming across the sky are asteroids as they orbit our Sun," Connolly said, "and it's these changes and the motion and it's the dynamics of the system that allow us to build our models for our universe, to predict its future and to explain its past."

The mountains of data collected by the LSST will be open source, accessible to anyone in the U.S. or Chile. But devising the software and algorithms to analyze all that data is a major aspect of the project. "It's as critical to the science as the telescopes and the cameras that we've built," says Connolly.



At left, a rendering of the Large Synoptic Survey Telescope. At right, a drawing of the telescope's enclosure design. Courtesy of LSST.

The UW team is heavily involved in data management as well as most other aspects of the LSST. At the UW, Mario Juric, professor of astronomy, heads LSST data management. Connolly is leading the LSST simulation effort, tasked with ensuring that the three main components of the LSST—the telescope, camera, and data management—all work together seamlessly. Zeljko Ivezic, professor of astronomy, is the Project Scientist for the entire project. Also on the team are research faculty and scientists Andrew Becker, Lynne Jones, Simon Krughoff, Scott Daniel, Russell Owen, and Peter Yoachim, all funded through an NSF grant, as well as graduate students Yusra AlSayyad and Bryce Kalmbach. Seven additional members will be joining the UW team this year through NSF funding.

Once the LSST is closer to first light, or its first use, UW graduate students may begin doing LSST-related dissertation research. About half of the Astronomy Department's recent graduate applicants mentioned the LSST as a factor in their decision to apply to UW. Even before the telescope is constructed, faculty are encouraging graduate students to work on smaller LSST projects lasting one or two quarters "just to give them the experience and flavor of what it means to work on a huge project," says Ivezic. "It's high on our list of priorities to engage as many students, both undergraduate and graduate, as we can."

Working with simulated data is a major focus right now. By building a virtual LSST that brings together existing information about the telescope, the camera, the data transfer technology, and astronomical objects, the team can simulate scenarios that the actual LSST might encounter. Simulations will continue to play a role once the LSST is operational, particularly when results are not as expected. By testing hypotheses in simulations, problems ranging from a misaligned mirror to a faulty sensor may be identified.

While UW scientists will be involved with the LSST throughout its lifespan, they will have little reason to visit the actual telescope in Chile. All collected data will be accessible remotely on office computers. Some astronomers lament this development, but Ivezic is not one of them. He's as drawn to the romance of the sky as anyone—he thought astronomy was "the coolest thing in the world" when he joined the astronomy group in elementary school, and still thinks so today—but he also embraces the powerful possibilities of new technology.

"Some prominent astronomers have commented that they don't like this idea of LSST because they like to go to the mountain, to the telescope, and do their observations from there," Ivezic says. "They say we are killing that in

astronomy. I think you can be romantic or you can be on the cutting edge of science. For the questions we're asking, LSST is the best way to look for answers. We cannot answer them any other way."

Return to Table of Contents, October 2014 issue