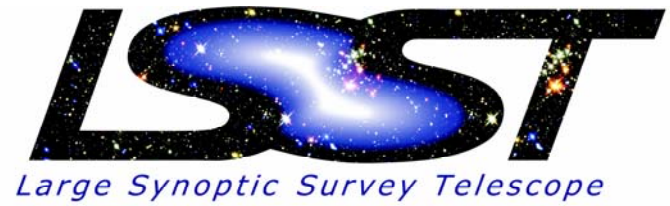


LSST Education & Public Outreach: Bringing the Changing Universe to the Public



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The potential for education and outreach with the LSST is as far reaching as the telescope itself. The LSST data will be open to the public and scientists around the world; anyone with a web browser will be able to access and analyze images, data products, tools, and educational materials. Standing on the shoulders of precursor projects, the LSST EPO group will be developing NVO-compliant data management strategies for the public. We describe ideas being explored in four areas: Visualizing LSST observations in science centers and planetaria across the nation; Exploring real scientific data and demystifying its meaning in formal and informal education venues; Creating partnerships of public, amateur, and professional astronomers to broaden participation in the cutting-edge research enabled by LSST; Using internet-based technology to empower the public's participation in scientific investigations of the nature of our universe.

We intend to not only generate excitement and awareness with the LSST outreach program, but to support an understanding of science through existing and innovative educational channels. We begin by evaluating our audience, which includes the public with a range of levels of interest, educators and students in both formal and informal settings, and amateur astronomers, who will contribute in many ways. The LSST outreach program will be aligned with the LSST Science Goals.

Education and Outreach has been part of the LSST since its inception, and the EPO group has the luxury of exploring ideas while there is still time to build support into the project design and budget. We will build upon precursor projects, leveraging off their experience and supporting their continued success. As demonstrated by the positive public impact of the Hubble Space Telescope, it may well turn out that the social benefits the LSST project will rival its scientific value.

Constraining Dark Energy and Dark Matter • Taking an Inventory of the Solar System • Exploring the Transient Optical Transients • Mapping the Milky Way

VISUALIZATION

By remapping the visible sky every few nights, the LSST will open a movie-like window to the changing universe. In partnership with the American Museum of Natural History (AMNH), we are exploring ways to use the power of LSST images to convey excitement and information in science centers, planetaria, and web-based products. Several venues are being considered to enable a digital representation of the universe, allowing three-dimensional flybys and time lapse explorations which the user could control through touch panels and interactive kiosk programming. A first step in this effort is to import precursor data into the Digital Universe, a AMNH Project producing a catalogue database which is then visualized into a 3-dimensional atlas that can be interactively explored. The Kitt Peak National Observatory Visitor Center will serve as a partner in our visualization efforts, replicating venues for smaller centers.



LSST@HOME

The *lsst@home* program would provide a way for the public to adopt a piece of the celestial highway and call it their own. Like the public service along our nation's highways, individuals and organizations would register at no cost to be identified with a patch of the universe. They could nurture and promote their selection, taking pride in discoveries and wonders contained within. This concept lends itself to dramatic, interactive digital displays at science centers and on the web.



CREATIVE PARTNERSHIPS FOR FOLLOW-UP

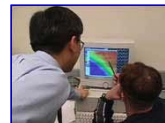
It is estimated that the LSST will generate tens of thousands of alerts a night of moving or changing objects. This will expand the volume of discoveries requiring confirmation and follow-up to gigantic proportions. Creative partnerships involving the interested public, the amateur community, and professional astronomers could participate in the follow-up of these discoveries.

The *Las Cumbres Observatory Global Telescope Network* will be instrumental in providing the necessary telescopes for follow up observations. This network will consist of six or seven 2+-meter science grade telescopes, longitudinally distributed and placed in both the northern and southern hemisphere. Their primary mission will be time-variant astrophysics, providing follow-up for large survey telescope projects including Pan-STARRS and LSST. The LSST EPO group is working to develop ways of effectively providing this powerful network of telescopes to support our outreach efforts.



The RoboNet-1.0 project is a prototype for the Las Cumbres Observatory Global Telescope Network. RoboNet-1.0 is funded by PPARC and includes two Las Cumbres Observatory (LCO) telescopes and the Liverpool Telescope on La Palma. The two LCO telescopes are the Faulkes North telescope at Haleakela, HI, and the Faulkes South telescope, at Siding Springs Observatory, Australia.

DATA-DRIVEN EDUCATION AND OUTREACH



A second thread of the LSST EPO program is the exploration of real data in formal and informal education settings. By placing LSST data into the AMNH Digital Universe, we will have laid the cornerstone for its inclusion in sky shows, Science Bulletins, and interactive displays that can be replicated at smaller installations. We are exploring the NSF-funded Real Astronomy Experience (RAE) Exhibit Kiosk Activities, which allows visitors to explore data at the Lawrence Hall of Science. In formal settings, Hands-On-Universe (HOU), the NOAO Teacher Leaders in Research Based Science Education (TLRBSE) program, and the SDSS outreach efforts have all brought authentic exploration into the classroom. We intend to offer professional development through online courses and integration of appropriate LSST science themes into textbooks. Students will benefit from LSST data packaged for science fair projects and independent research.

High school exploration topics could include:

- Variable Quasars
- Novae in Local Group Galaxies
- Novae between Galaxies
- Type Ia Supernovae

Asteroids would be featured for middle school, including their identification, distribution, classification, and composition.

The asteroid project will build on the experience of HOU, TLRBSE, and SDSS, make use of the Las Cumbres Observatory Global Network for follow up, and could be made into an online course for earth science teachers. This program is strongly aligned with middle school science standards, and addresses an identified need in formal education. This prototype is a major effort of our Design & Development phase, underway now through the NOAO Educational Outreach group.



EMERGING TECHNOLOGIES

When LSST data begins to flow late in 2012, technology unfamiliar to most of us now will be commonplace. Custom web portals and portable devices for two-way interaction with text, graphics, data and video will be routine, but there will still be a bandwidth challenge. The data rates required by LSST to bring the universe into home and school environments are achievable. Color JPEGs at 0.4 arcsecond resolution of the static deep sky will require only 180GB, downloadable in 30 minutes on a 1GB link. Dynamic graphics overlays from metadata (time varying or moving objects) require little bandwidth, and tools for public query of the LSST dynamic sky database will be provided. The LSST Outreach efforts will make use of the powerful technology of the future, facilitating the investigation and appreciation of the dynamic universe by everyone.

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