

LSST Annual Project Report FY 2008
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The LSST is a proposed large-aperture, wide-field, ground-based telescope designed to obtain sequential images of the entire visible sky every few nights. The optical design involves a 3-mirror system with an annular 8.4-m primary; the effective collecting area is equivalent to a 6.7-m diameter unobstructed primary. The mirror system feeds three refractive correcting elements inside a camera, providing a 10 square degree field of view sampled by a 3 Gigapixel focal plane array. The total effective system throughput, $A\Omega = 318 \text{ m}^2 \text{ deg}^2$, is nearly two orders of magnitude larger than that of any existing facility. The survey will yield contiguous overlapping imaging of more than 20,000 square degrees of sky in 6 optical bands covering the wavelength regime 300-1100 nm.

In 2003, the LSST Corporation was formed as a non-profit 501(c)3 Arizona corporation with headquarters in Tucson, AZ, to design, construct, and operate the LSST. Membership has now expanded to twenty four members including Brookhaven National Laboratory, California Institute of Technology, Carnegie Mellon University, Columbia University, Google Inc., Harvard-Smithsonian Center for Astrophysics, Johns Hopkins University, Kavli Institute for Particle Astrophysics and Cosmology - Stanford University, Las Cumbres Observatory Inc., Lawrence Livermore National Laboratory, National Optical Astronomy Observatory, Princeton University, Purdue University, Research Corporation, Rutgers University, Stanford Linear Accelerator Center, 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 Pennsylvania, University of Pittsburgh, and the University of Washington.

1. Major Research and Education Activities and Findings

This third annual report of the LSST Project summarizes major activities and findings for the period September 1, 2007 through July 15, 2008.

- An agreement has been signed between the Universidad de Chile (UHC) and AURA specifying principles and terms of operations for use of the LSST in Chile. Chile joins LSSTC as an Institutional Member of LSSTC; Chilean astronomers will have preferred access to the LSST Data Access Center in La Serena and uncompleted membership in LSST Science Collaborations.
- The LSST Conceptual Design Review (CoDR) was held Sept. 17-21, 2007 and attended by an NSF authorized Review Committee and Official Observers representing the NSF, DOE, and ESO. The Review Committee returned a highly favorable report which included these comments:

"The Review Panel unanimously finds that the Large Synoptic Survey Telescope (LSST) project has met the requirements of the Conceptual Design Review (CoDR). The Review Panel unanimously recommends that the LSST project proceed to a

Preliminary Design Re-view (PDR). The panel was very impressed by the strength and breadth of the science case for LSST. The Review Panel felt that the LSST project significantly exceeded CoDR requirements in two areas: Telescope Design and Analysis, Data Management. The project is to be highly commended for obtaining private funds to start the M1/M3 mirror acquisition, and to buy down technical risk in the CCD camera to start sensor development."

- Interested members of the US astronomy and physics communities were invited to participate in shaping the science for the LSST survey, through membership in the LSST Science Collaborations. The announcement was made by LSST, NOAO, and SLAC in July of 2008; further details are available at: www.noao.edu/lsst/collab_prop/Scicollab.htm
- The LSST primary/tertiary mirror experienced a successful High Fire over the weekend of March 28 & 29th, 2008, reaching a peak temperature of approximately 1165°C (2125°F) in the rotating oven of The University of Arizona's Steward Observatory Mirror Lab. After a flawless casting, the LSST mirror is now annealing and cooling gradually to room temperature; it will be removed for grinding and polishing in mid-August, 2008. Selected images from the High Fire event can be found at: http://www.lsst.org/News/highfire_event.shtml
- The LSST Corp Project Office has begun electronic distribution of a quarterly newsletter, to raise awareness of LSST with the public and to increase communication among project members. The first two issues have been emailed to nearly 6000 subscribers; issues are available for download or browsing at <http://www.lsst.org/News/enews/archive.html>
- LSSTC established a Charitable Gift Agreement with the Charles Simonyi Funds for Arts and Science and Microsoft Founder Bill Gates for a total of \$30M. Press Release LSSTC-06 announced the funding and resulted in hundreds of published reports around the world and a peak 55,000 hits per day on www.lsst.org.
- The Institute National de Physique Nucleaire de Physique des Particules (IN2P3) has signed a MOU with SLAC to formalize involvement with the camera construction. IN2P3 Researchers and engineers bring technical and partnership experience to the LSST team; this agreement serves as a model for future anticipated international participation.
- LSST was well represented at the 211th meeting of the American Astronomical Society in Austin, TX, in January of 2008. Twenty eight posters documenting the LSST system and science were presented in addition to an LSST booth on the exhibit floor. Posters are available at <http://www.lsst.org/Meetings/AAS/2008/AAS211.shtml>
- National Center for Supercomputing Applications (NCSA) hosted the fourth LSST All Hands Meeting in Urbana-Champaign, Illinois the week of May 19, 2008. 160 people attended the five-day meeting. The five-day meeting format included a two-day plenary session with presentations by project managers and chairs of the science collaborations teams. All ten LSST Science Collaborations were represented, and each collaboration chairperson presented an elaboration of the scientific reach of the LSST for his/her team's specialization.
- In April of 2008, the LSST Corporate headquarters relocated from our Camp Lowell Drive offices to the 5th floor of Steward Observatory on the University of Arizona campus.
- The membership of LSST Corporation increased to 24 members when Carnegie Mellon University and Rutgers University became Institutional Members of LSSTC in January 2008 and June 2008 respectively.

1.1 Science and Simulations

- Zeljko Ivezic, together with the Science Council and Science Collaborations members, posted an LSST overview paper to arXiv site (astro-ph/0805.2366) titled *LSST: From Science Drivers to Reference Design and Anticipated Data Products*. This paper will be a living document and updated annually with new project information. The paper includes a high-level technical summary of the system and examples of science projects that LSST data will enable.
- A project-wide collaboration on LSST simulations including both the operations simulation and overall image simulation has begun involving Andy Connolly (science lead), Phil Pinto (science lead), and Victor Krabbendam (project manager).
- A new version of the Operations Simulator website has been published for internal team use. The site will be opened and established for communication with the Project Scientist and science collaborations following a review and comment period and additional links to data.
- Zeljko Ivezic and Lynne Jones produced a simulated LSST stellar catalog using a Milky Way model trained on Sloan Digital Sky Survey (SDSS) data. The catalog maps the Galaxy in position-velocity-metallicity space and will be initially utilized in the modeling of photometric and astrometric calibration procedures.
- The team upgraded the operation simulator tools to provide robust interaction of the science community with the simulation team. Upgrades furnish automatic post processing of simulation runs providing a consistent set of analysis results for completed simulations, a standard reporting tool, and web interface pages. Access and usage instructions were prepared for dissemination at the LSST All Hands Meeting.

1.2 Telescope and Site

- LSST received and reviewed two bids for the fabrication of the secondary mirror blank. Corning Glass has been awarded a contract for fabrication of the LSST secondary mirror blank after a competitive review process. This contract is privately funded.
- Site Preparation has been a priority for the Telescope & Site group during this reporting period with a focus on civil engineering and characterization of conditions. LSST has placed a Civil Engineering contract with ARCADIS Geotecnica to design the rough excavation process. Engineers were on site in May of 2008 to initiate the effort.
- After a successful pre-fire of the casting furnace, UA installed the glass for the primary/tertiary (M1M3) casting and began the casting process. The primary mirror reached high fire on March 29th amidst a very successful celebration event. Purchase of the M1M3 mirror is privately funded.
- UA provided a proposal for additional work requested by LSST on the M1M3 mirror. The effort is to provide additional surface conditioning around the 6 hardpoints for increased glass strength in these areas. A detailed analysis of the forces in the M1M3 mirror at the 6 position defining struts, aka "hard points" is complete.
- LSST completed a preliminary run of the mirror temperature and stress test in a DC magnetron mirror coating plant with good results.

- LSST awarded a follow-on contract to Angstrom Sciences for a last round of coating sample production to support the design of the mirror reflective coating development effort.
- The team of Victor Krabbendam, Kirk Gilmore, and safety engineers from NOAO and SLAC established the goals and working relationships to develop the LSST Safety and Hazard Management Policy. The team will develop the draft policy to govern how the design, construction, and operation of LSST at its many sites will be governed to ensure the safety of personnel and equipment.
- In Chile, bulldozers extended the provisional road another 200 feet to provide crane access at the future LSST site. This is necessary to support the micro thermal measurement campaign later this year.
- In February, LSST contacted biologists to move the cactus from the LSST summit site to special gardens for safe-keeping and proceeded with summit design.
- LSST kicked off a dome design study with European Industrial Engineering (EIE) at a meeting on January 15, 2008.
- LSST awarded a follow-on contract to Angstrom Sciences for a last round of coating sample production to support the design of the mirror reflective coating development effort.
- The IR all-sky camera (ASIVA) was successfully operated on Kitt Peak, successfully transported to Chile, and installed on Cerro Pachón. The camera will be moved to Cerro Tololo for the November calibration run and subsequently re-deployed on the LSST site for long term sky testing. Three photo diode sky brightness monitors were also completed and are ready for testing next period.
- AURA has submitted on behalf of LSST, the Environmental Impact Declaration (Declaración de Impacto Ambiental [DIA]) to CONAMA (Comisión Nacional de Medio Ambiente), the Chilean Environmental Protection Agency. The DIA is a description of the construction and operation phases of the project and describes any direct foreseeable environmental impacts. The report, submitted in July 2008, is to be reviewed by CONAMA and its regional counterpart, COREMA, by September 2008. The review process includes a site visit and presentation of the report by AURA in late July 2008. The DIA review is expected to be the final environmental process for building permits in Chile for projects like LSST that are designated low impact and are not located in a national park or protected region.
- Victor Krabbendam and Jeff Barr visited with seven architectural & engineering (A&E) firms in Chile to promote the project and establish the level of interest in the area to address our A&E needs for the LSST. This was a good first interaction with many very interested and capable firms.
- During a trip to La Serena, Chile, Victor Krabbendam and Jeff Kantor held a kick-off meeting with the CTIO Recinto Building Committee regarding coordination of LSST base facility with other planned and proposed improvements. Representatives of LSST, Gemini, Southern Astrophysical Research (SOAR) Telescope, and CTIO discussed building needs and expectations in the coming years, potential areas of common infrastructure, and suitable options.

1.3 Data Management

- The Data Management team completed Data Challenge 2 (DC2) final report. All DC2 goals and performance requirements were met (15% of LSST final scale for Nightly Pipeline processing). We collected all DC2 statistics that are being used to calibrate the UML-based software estimate for the Major Research Equipment and Facilities Construction (MREFC) phase.
- The second Data Challenge 3 scoping meeting was held at IPAC/Caltech. Initial use cases for Nightly and Data Release pipelines for DC3 have been written. The DM team revised the version control structure and conducted a test case for using virtualization to simplify our cross-platform deployment process. They have started evaluating tools for coverage testing in preparation for a more formal integration and test process in DC3. Data Challenge 3 will include:
 - A new revision to the Nightly Pipelines that can process LSST simulated images (to be provided by the Simulation Department);
 - The first prototype of the Data Release Pipelines;
 - New versions of the Pipeline Middleware to support inter-slice communications;
 - Additional scalability and reliability tests of the Middleware and Infrastructure;
 - Open source download and build support for all software and
 - Pilot incorporating a community-developed component (cross-platform porting/testing or database scalability).
- Discussions have begun with Mike Stonebreaker (the creator of the PostGRES database system) and his startup Scientifica for extremely large databases (XLDB). There is considerable interest within the “Big Science” community (astronomy, high energy physics, fusion, remote sensing, etc.) to coordinate a new approach as current commercial RDBM systems limit the scale of science that can be done. Under SLAC leadership, we created a plan for partnering with Scientifica to create an open source science-oriented database management system. LSST is to be a “lighthouse” project and drive primary requirements for the system.
- Data Management team members established a strategy for incorporating community-developed components into the DM baseline. DM team members plan to develop a roadmap for implementing this process in DC3 and DC4.
- The Data Management team developed draft use cases for Data Release Pipelines, Instrument Signature Removal, and Science Data Quality Assessment for Data Challenge 3 (DC3). We initiated prototyping of a java-based SDQA visualization tool. They developed the DC3 project plan in March and adjusted the DC3 scope to permit a CY08 deliverable. Data Challenge 3 accomplishments included:
 - Individual project plans for DC3 Applications (IPAC), DC3 Middleware/ Infrastructure (NCSA), and PDR preparation (LSSTC) were merged.
 - Unified Modeling Language (UML) training was conducted at IPAC.
 - Approximately 100 DC3 Use Cases were reviewed and updates are in work.
 - Tools for DC3 coverage testing and automated builds were evaluated.
- LSST established a new DM Security Working Group with Bill Baker of NCSA as Chair to develop the DM Cyber-Security Plan for PDR.

- Moving Object Processing (MOPS) software was installed on a UW cluster (including porting to the MOAB scheduler) to support work being done for the Science Council and DM.
- The Mountain - Base Network baseline bandwidth was increased (from 2 x 10 to 10 x 10 gigabits/second bandwidth (60-fiber bundle). The original baseline cost had increased by 33% because of the recent devaluation of U.S. dollar relative to the Chilean peso. By moving to a higher density bundle installed by CTIO and using larger switches, we were able to accommodate the change within the same cost envelope.

1.4 Camera

Funding for the LSST camera comes from non-NSF sources. SLAC is the lead institution. For completeness, we include these from the camera team:

- The LSST camera team has issued the camera filter Request for Proposals (RFP).
- LSST distributed the camera sensor RFP and four vendors submitted proposals. Sensor prototype contracts have been awarded with \$3M in private funding.
- LSST performed and reviewed a Finite Element Analysis (FEA) of the camera during FY08Q3.
- The camera group tested the Application Specific Processing Integrated Circuit (ASPIC) at the Laboratoire de l'Accellérateur (LAL).
- The LSST contamination evaluation system that will be used to determine which materials qualify for use in the camera cryostat met major milestones this period:
 - Installed and tested the heating/processing components;
 - Completed installation and testing of the quartz microbalance and
 - Installed optical transmission test equipment and sample mover.
- A prototype raft/tower was fabricated at BNL under the guidance of Paul O'Connor. This is a full-scale prototype that will be used for thermal and mechanical evaluation and will be the first full-scale operational raft when the packaged sensors arrive from the prototype RFP.
- Testing of a 4kx4k study sensor device continues at Brookhaven National Laboratory as part of the study phase of sensor development.
- A CMOS sensor being evaluated for telescope guiding has been evaluated in the lab and has had one iteration at the telescope for on-sky observations.
- A discrete, two channel electronics front-end / back-end system running at LSST rates (~500kHz) and meeting LSST noise requirements has been completed and is now operational.
- A custom high dynamic range charge injector is now working to allow bench test of electronics. This system is used to evaluate the cross-talk and component layout of the electronics boards.
- The camera control systems group is exercising the major hardware pieces of the data acquisition (DAQ) subsystem. They now have in hand and are evaluating at least 1 functional instance of:

- the DAQ crate
- the RNA board prototype
- the network hub card
- the fiber transition card

1.5 Calibration

- Victor Krabbendam, Chuck Claver and four others visited the 1.1-m Calypso Telescope on Kitt Peak to determine if the LSST project can use this facility to evaluate and simulate the proposed LSST calibration telescope.
- LSST has completed plans for two campaigns to provide additional atmospheric measurements of seeing conditions on site.

1.6 Education and Public Outreach

- The LSST Education and Public Outreach (EPO) group continued the formal process of Understanding by Design to facilitate the cohesive planning and implementation of LSST education activities at distributed locations.
- Press Release LSSC-06 announcing the Simonyi & Gates private donation was issued January 3, 2008.
- The first issue of the quarterly LSST E-News was distributed to nearly 6000 recipients electronically in early March of 2008. The newsletter is also available online.
- Press Release LSSTC-07 announcing the glass loading and upcoming High Fire for the LSST primary/tertiary mirror was issued jointly with the UA on March 17, 2008.
- S. Jacoby (LSST), J. Olsen (LSST), M. Nichols (Adler Planetarium) and S. Schultz (SLAC) presented a poster “LSST EPO: Understanding by Design” , at the Astronomical Society of the Pacific annual meeting held in Chicago Sept 5-7, and wrote an accompanying paper for the proceedings. <http://www.astrosociety.org/pubs.html>
- S. Jacoby (LSST), J. Olsen (LSST), K. Borne (GMU), S. Bronson (BNL), and D Isbell (NOAO) represented EPO at the CoDR in Tucson. S. Jacoby gave a plenary talk and led a breakout session. Discussions took place regarding the possibility of supplemental funding for EPO within the MREFC budget, a topic of current discussion within the NSF and National Science Board.
- S. Jacoby attended a meeting of the IAU on Communicating Astronomy to the Public in Athens, Greece, in October, 2007, presenting a paper on the Understanding by Design process being used to build a framework for the LSST EPO Program.

2. Major Findings

Conclusions that have emerged from FY08 activities are included in the previous text describing Activities.

3. Opportunities for Training and Development

- Jeff Kantor held two sessions of SysML training at Stanford Linear Accelerator Center (SLAC) for the Data Management group during FY08Q3. SysML is the tool used to document and track system requirements and their flow from Science requirements to subsystems.
- The Data Management group conducted a Moving Object Processing System (MOPS) training session jointly with the Pan-STARRS MOPS team in Tucson in March of 2008. Fifteen attendees from the Pan-STARRS and LSST Science Collaborations learned to use the MOPS in simulation mode and did hands-on simulation runs.
- Several LSST project management staff members met with US Cost Corporation to evaluate their Success Enterprise and Schedule Exchange products as possible replacements for current tools in the LSST Project Management Control System (PMCS).
- Several members of the Telescope Team participated in an Earthquake Preparedness Workshop in La Serena Chile held in early December.
- Staff participated in a Controls Workshop with the Camera Controls Team on January 21-22 in Tucson, AZ. A significant results for Data Management was there will be some portion of the Image Processing Pipeline that will run on the mountain and base for image visualizations for control and commissioning purposes.
- Meetings were held with Ephemian and InterfaceGuru, two Tucson-based firms specializing in operations control and usability. The LSST project will be doing a pilot study with them to define operational use cases and visualization requirements.
- Face to Face meetings at Google Mountain View were conducted on October 23 - 24. This was a DM All-Hands meeting with additional presentations by Google about relevant technologies. Approximately 50 people attended, with representatives from all DM partners and LSST project management, the Royal Edinburgh Observatory, and Google. We established the basic scope for DC3 and identified areas for exploring open source versions of Google technologies to DC3.
- The LSST Data Management group sponsored and attended the Extremely Large Database (XLDB) conference at SLAC on October 25. Of particular relevance to LSST DM, we left with a strong sense of how the industry users (eBay, Google, Yahoo, AT&T, others) are already dealing with scaling and operational reliability issues of the kind DM will need to address, and how the suppliers are responding.
- Several DM staff and management members visited the University of Pittsburgh, Carnegie Mellon University, and Google Pittsburgh. We anticipate collaborating with UP/CMU on U.S. long-haul networks and streaming query technology for alert classification. We anticipate participating with Google in assessing the applicability of open source technology (hadoop, hbase, hdfs) to LSST DM via Google 20% projects.

4. Outreach

- LSST Director Tony Tyson testified before Congress on November 8, 2007, on the role LSST will play in mitigating risk from Potentially Hazardous Asteroids. Responses to follow-up questions from the House Committee on Science regarding LSST and detecting Near Earth Objects (NEOs), which along with his original testimony will appear in the Congressional Record.
- Tony Tyson presented an invited paper on LSST at a dark energy conference at STScI. Tony interacted and consulted with several proposed projects that will rely on LSST

data including the US-based dark energy missions ADEPT and DESTINY and the proposed European space mission EUCLID.

- DM team members presented papers on LSST data management at four technical meetings in Chile, Brazil, and California.
- DM team members gave two Data Management presentations (Requirements Flowdown with SysML and UML, Infrastructure) to Brown Bag luncheon sessions at NOAO. Both were well-attended and well-received.
- Zeljko Ivezic gave an invited talk at the recent AAS DPS meeting in Orlando about the LSST prospects for fulfilling the Congressional NEO mandate; this talk was well attended by NASA/NEO personnel. Zeljko also gave an invited talk about predictions for the accuracy of LSST proper motion and geometric parallax measurements at the IAU 248 meeting in Shanghai. Briefly, LSST will extend the Gaia measurements to a four magnitude deeper limit, and the two surveys will be highly complementary.
- Tony Tyson, Don Sweeney, and Zeljko Ivezic spoke before the Association of Universities for Research in Astronomy (AURA) Steering Committee on the Astronomy Decadal Survey, in Pasadena, CA.
- LSST team members attended the Austin, Texas American Astronomical Society (AAS) Meeting in January 2008 and presented twenty-eight posters.
- A number of LSST staff attended the DOE P5 High Energy Physics review held at SLAC on February 21-22.
- Jeff Kantor participated as a Data Management reviewer in the Dark Energy Survey (DES) Director's Review at Fermilab, December 11 - 13.
- Members of the DM team visited the Indiana University in anticipation of collaboration on U.S. long-haul networks.
- Two members of the Telescope team, D. Neill and B. Gressler, attended the SPIE annual meeting in San Diego. Doug presented a paper on work performed on lateral supports for thin meniscus mirrors which are currently part of the LSST M2 reference design.
- Two papers were presented at the ADASS 2007 (XVII) Conference: "Building a Framework for Data Preservation of Large-Scale Astronomical Data" (J. Kantor) and "Organizing the Extremely Large LSST Database for Real-Time Astronomical Processing" (J. Becla).
- J.Kantor attended the International Virtual Observatory Alliance Interop 2007 Conference in Cambridge, UK, and presented a paper on LSST Data Curation and Preservation.

5. Journals

Publications:

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1. The LSST System Sidney Wolff, D. Sweeney, J. A. Tyson, S. Kahn, Z. Ivezic, C. Claver, V. Krabbendam, K. Gilmore, J. Kantor, T. Axelrod, LSST Collaboration.
2. LSST Survey Strategy Zeljko Ivezic, J. A. Tyson, A. Axelrod, D. Burke, C. F. Claver, S. M. Kahn, R. H. Lupton, D. G. Monet, P. A. Pinto, M. A. Strauss, C. W. Stubbs, K. H. Cook, L. Jones, A. Saha, C. Smith, LSST Collaboration.
3. LSST: Cadence Design and Simulation Philip A. Pinto, K. H. Cook, F. Delgado, M. Miller, C. Petry, L. Denneau, A. Saha, P. A. Gee, J. A. Tyson, Z. Ivezic, L. Jones, LSST Collaboration.
4. Science Opportunities with the LSST Michael A. Strauss, LSST Science Collaboration.
5. Four LSST Probes of Dark Energy J. Anthony Tyson, H. Zhan, L. Knox, LSST Collaboration.
6. Cosmology with Photometric Baryon Acoustic Oscillation Measurements Hu Zhan, L. Knox, J. A. Tyson, LSST Baryon Oscillation Science Collaboration.

7. Gravitationally Lensed Point Sources in the LSST Survey R. D. Blandford, LSST Strong Lensing Science Collaboration.
8. The LSST Galaxies Science Collaboration Henry Closson Ferguson, K. Borne, M. Dickinson, E. Gawiser, K. Gilmore, G. Fabio, R. Jimenez, V. Margoniner, D. Norman, M. Obic, A. Rasmussen, R. Roskar, M. Seigar, A. Stanford, M. Strauss, R. Wechsler.
9. Active Galaxy Science with the Large Synoptic Survey Telescope Niel Brandt, LSST Active Galaxies Science Collaboration; *Penn State Univ.*
10. Supernova Science and Cosmology with The LSST Scot S. Olivier, W. M. Wood-Vasey, S. Asztalos, D. Cinabro, K. Cook, W. de Vries, S. Nikolaev, P. Pinto, L. Wang, Y. Wang, H. Zhan, LSST Supernova Science Collaboration.
11. Mapping the Milky Way with LSST James Bullock, LSST Milky Way Structure Science Collaboration.
12. Transients and Variables with LSST Shrinivas Kulkarni, A. Becker, J. Bloom, K. Cook, S. Kahn, P. Szkody, T. Tyson, W. Vestrand, LSST Transients Science Working Group.
13. Stellar Populations and Nearby Galaxies with the LSST Abhijit Saha, K. Olsen, D. G. Monet, LSST Stellar Populations Science Collaboration.
14. Solar System Science with LSST R. Lynne Jones, S. R. Chesley, A. J. Connolly, A. W. Harris, Z. Ivezić, Z. Knežević, J. Kubica, A. Milani, D. E. Trilling, LSST Solar System Science Collaboration.
15. LSST Telescope and Site Overview Victor Krabbendam, C. F. Claver, J. Andrew, J. Barr, W. Gressler, J. Kingsley, D. R. Neill, S. Olivier, J. Sebag, LSST Collaboration.
16. LSST Summit Testing and Facility Design Jacques Sebag, V. L. Krabbendam, C. F. Claver, J. Andrew, J. Barr, D. Neill, LSST Collaboration.
17. A Prototype Automated Wavefront Sensing Pipeline for the LSST Timothy Rodigas, C. F. Claver, K. Mighell, B. Kuhn, M. Lang.
18. Performance and Analysis of the LSST Optical System Chuck F. Claver, L. Seppala, M. Liang, K. Gilmore, W. Gressler, V. Krabbendam, D. Neill, S. Olivier, J. Sebag, LSST Collaboration.
19. The LSST CCD Development Program Ivan Kotov, J. S. Frank, J. Geary, K. Gilmore, P. O'Connor, V. Radeka, P. Takacs, J. A. Tyson *Brookhaven National Lab, SAO, SLAC, UC Davis.*
20. LSST Camera Electronics Richard Van Berg, P. O'Connor, J. Oliver, J. Geary, V. Radeka.
21. Photometric Redshift Calibrations for LSST Samuel Schmidt, J. A. Newman, J. A. Tyson, A. J. Connolly, V. E. Margoniner, D. M. Wittman, A. Choi, LSST Collaboration.

22. Calibration of LSST Instrument and Data David Burke, T. Axelrod, J. Bartlett, D. Cinabro, C. Claver, M. Creze, J. Frank, K. Gilmore, J. Haggerty, Z. Ivezić, L. Jones, V. Krabbenham, B. Meadows, D. Monet, P. O'Connor, J. Oliver, B. Popescu, A. Saha, A. Smith, C. Smith, C. Stubbs, J. A. Tyson.
23. The Science Data Quality Assessment System for LSST Deborah A. Levine, V. Mannings, R. Cutri, S. Dodd, C. Claver, J. Kantor, T. Axelrod, T. Tyson, S. Kahn, Z. Ivezić, D. Sweeny, D. Monet, K. Gilmore, T. Schalk, LSST Team.
24. Data Mining Research with the LSST Kirk D. Borne, M. A. Strauss, J. A. Tyson.
25. The LSST Data Challenges Tim S. Axelrod, J. Becla, A. Connolly, D. Dossa, A. Jagatheesan, J. Kantor, D. Levine, R. Lupton, R. Plante, C. Smith, A. Thakar, J. A. Tyson, LSST Data Management Team.
26. Ellipticity Correlation of the LSST PSF and Optimal Interpolation Scheme Myungkook J. Jee, J. G. Jernigan, J. R. Peterson, J. A. Tyson, D. Burke, S. M. Kahn, C. F. Claver, D. Wittman, P. Gee.
27. LSST Exposure Time Calculator Perry Gee, J. A. Tyson, P. Pinto, Z. Ivezić, D. K. Gilmore, K. H. Cook.