Project Status

Victor Krabbendam
LSST Project Manager
Executive Summary
• Busy times for the entire team: Reviews with a sprinkle of Development
  – Completing construction funding details with NSF and the DOE
  – Development is impressive

• Project is Ready for Construction Start
The LSST team gathered in August 2013 to focus on FDR
FDR was a great Success for the entire team

• In the last 3 years, LSST has conducted ~50 reviews, most with outside reviewers
• Camera Team completed CD-3a for Sensors in May
• DOE CD-2 in November (Cost Review in August)

18 reviewers and Government representatives join the staff at the FDR in December 2013
After FDR the Project Office was busy making final preparations for MREFC Start

- Completed an NSF “Budget Sufficiency Review” conducted by Booz Allen Hamilton.

  “Assess and form an opinion on the sufficiency of the estimate for construction of the National Science Foundation (NSF) sponsored scope for the Large Synoptic Survey Telescope Project; including whether the estimate is:
  - Adequate with regard to the validity of cost and schedule assumptions and cost estimating methodology,
  - Complete, and
  - Prepared in accordance with the recipient’s cost accounting practices and relevant Office of Management and Budget administrative requirements and cost principles.

- Verbal description of Report: We meet 10 requirements, partially meet 3 more for a total rating of “Adequate”....Apparently high praise from auditors.
$473 TPC Established....Realized Bid Savings and Commissioning shortened 5 ½ months

- 6 month (+4m optional) early System I&T with ComCam
  - Interface testing
  - Initial Telescope and Active Optics Control Testing
  - Calibration Operations and Cal. Data Products Pipeline Processing
  - Scheduler Driven Operations Testing
- 7 ½ month Camera-Telescope-DM integration
  - Final System Interface Verification
  - Telescope-Camera Integration and Test
  - DM Pipeline Testing with Full FPA Data
  - OSS Requirements Verification
- 5 month Science Verification
  - Mini Surveys to Characterize SRD performance
  - LSR Requirements Verification and Characterization
  - Operations Readiness and Verification using Initial Survey Cadence

Increased Risk to Year 1 Science – No Permanent Science Impact - Detailed re-plan underway with external review planned in 2016.
3.5 months of Pre-award Audit and Cost Review with the NSF

- Extensive deep dive into costs, BOEs and process
- Level of Effort and TPC conditions were a surprise
- LSST and NSF worked closely to Navigate new Territory
- Effort has been good trial for next Audit
- The Cooperative Service Agreement is now in place and NSF has initiated Construction
  - Final Contingency value is not established but,
  - Current TPC is: $467,799,933
  - Current Contingency is: $79,042,248 (20.3%)
COOPERATIVE SUPPORT AGREEMENT (CSA)

AWARD: AST-1202910

EFFECTIVE DATE: July 1, 2014

EXPIRATION DATE: September 30, 2022

GOVERNING COOPERATIVE AGREEMENT: 1258333

PROJECTED TOTAL AWARD FUNDING:

(Subject to availability of funds)
$467,798,923

CUMULATIVE AMOUNT:

$27,500,000

SOLICITATION:

(Incoporated by reference, as amended)

NSF 11-1

Grant Proposal Guide - GPG

CFDA NUMBER:

47.049

OTHER AWARDS UNDER THIS PROGRAM:

Show List of Awards

AWARDEE:

Association of Universities for Research in Astronomy, Inc.

PROJECT TITLE:

Construction of the Large Synoptic Survey Telescope (LSST) under the Major Research Equipment and Facilties Construction (MREFC) Account

<table>
<thead>
<tr>
<th>Year</th>
<th>Fiscal Year</th>
<th>MREFC Funds</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>FY2014</td>
<td>$27,500,000 (3 months)</td>
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<tr>
<td>2</td>
<td>FY2015</td>
<td>$79,640,045</td>
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<tr>
<td>3</td>
<td>FY2016</td>
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<td>4</td>
<td>FY2017</td>
<td>$67,120,018</td>
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<td>5</td>
<td>FY2018</td>
<td>$55,799,993</td>
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<td>6</td>
<td>FY2019</td>
<td>$47,889,942</td>
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<td>7</td>
<td>FY2020</td>
<td>$45,749,977</td>
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<td>8</td>
<td>FY2021</td>
<td>$39,899,993</td>
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<td>9</td>
<td>FY2022</td>
<td>$4,529,893</td>
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</table>
Now We Finalize the Transition Plan and Move Forward!

- Start date and preparations have changed in the last three months
  - Award was a 1 August – lost 1/3 of first yr plan
  - Project office focused on Audit – many preparations were not completed
- Busy with work packages, charge numbers, and vendor agreements
  - Transition must be “deliberate”
  - Must be consistent with Award scope (D&D and MREFC)
  - Details unfolding this week for each subsystem
Integrated Project Schedule (IPS) : Construction to Operations

Adjust Start for 1 August and Transition to MREFC

Start Early Commissioning with ComCam

Install Camera

Science Verification

Operations Review

April 1, 2019 Early Ops Start

7 Mo Float

Remove 6 months here: Maintains 2 years of commissioning and schedule contingency

We status 70 interface milestones between IPS and Cam schedule at SLAC
LSST is Ready to Move to the Next Phases of Fabrication and Construction
Systems Engineering team is engaged with all subsystems

Robust set of systems engineering tools in place and functioning well
Classical Systems Engineering

• Monthly Change Control Board meetings
  – Requirement and process document clarifications and minor updates
  – Further interface details

• Developed and negotiated ICD refinements and updates

Change Control Items
- Implemented, 46
- Proposed, 2
- Studied, 8
- Pending, 8
- Approved, 1

Jira Issue Tracker
- Open, 39
- In Progress, 21
- Closed, 76
- Deferred, 2
- Reopened, 1
**Systems Engineering team is working to remove all TBDs / TBRs in requirements and interfaces**

<table>
<thead>
<tr>
<th>ICD. No.</th>
<th>ICD Title</th>
<th>4/16/2014</th>
<th>TBDs</th>
<th>TBRs</th>
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<tbody>
<tr>
<td>LSE-64</td>
<td>Utilities &amp; Services Interface between the Camera and the Telescope</td>
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<td>LSE-65</td>
<td>Summit Facility Interface between the Camera and Telescope</td>
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<td>2</td>
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<tr>
<td>LSE-66</td>
<td>Guider Interface between the Camera and Telescope</td>
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<td>LSE-67</td>
<td>Wavefront Sensor Interface between the Camera and Telescope</td>
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<td>LSE-69</td>
<td>Interface between the Camera and Data Management</td>
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<td>LSE-71</td>
<td>OCS-Camera Software Communication Interface</td>
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<td>LSE-72</td>
<td>OCS Command Dictionary for Data Management</td>
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<td>LSE-73</td>
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<td>LSE-75</td>
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<td>LSE-76</td>
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<td>LSE-77</td>
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<td>LSE-78</td>
<td>LSST Observatory Network Design</td>
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<td>LSE-80</td>
<td>Mechanical, Thermal, and Access Interfaces between the Camera and Telescope</td>
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<td>LSE-131</td>
<td>Data Management Interface Requirements to Support Education and Public Outreach</td>
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<td>LSE-132</td>
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<td>LSE-140</td>
<td>Auxiliary Instrumentation Interface between Data Management and Telescope</td>
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**Total:** 32 TBDs, 13 TBRs
System modeling is key SE Tool

A simulated sky

Observing an LSST simulation

Producing a simulated image

Galaxies (de Lucia et al 2006)
Stars (Juric et al 2008)
Asteroids (Grav et al 2007)

Pointing, Filter, Airmass, Time and Atmosphere from Op Sim
Custom instance of field of view

$10^{10}$ photons per CCD
Separate amplifiers
Early non-federal funds supported key technical and programmatic risk reduction efforts

Secondary Mirror Substrate ready for optical polishing

The Site today – ready for construction
SOML polishing effort on M1M3 nearing completion

• Mirror polishing continues
  – M1 surface at final specification (23nm) - within structure function
  – M3 surface final polishing (~40nm vs. 20nm)

• Transport box delivered and Tucson storage ready
Industry partnerships growing with design/build procurements

- Early selection supports vendor specific design development, eliminate bid jeopardy risks and promote swift start to construction.
  - Secondary Mirror Optical Fabrication: Exelis Corporation, Rochester NY
  - Hexapod Systems Fabrication: Moog - CSA, Mountain View CA
  - Telescope Mount Assembly: GHESA / Astrofeito, Madrid Spain
  - First Article Science Sensors: E2V, England and ITL Tucson AZ
  - L1-L2 Assembly: Ball Aerospace, Boulder CO
  - Summit Facility General Construction: Design Optimization – Besalco Ltd.
  - Dome Fabrication: Procurement in Progress – Bids due in October
Hardware, software, and electronics teams are focused on detailed interfaces.......

Camera on Telescope top end

Utility lines on telescope
...and bringing designs to prototypes and fabrication

- LSST Custom Mirror actuator
- Inner Loop Control Board
- Filter Change Mechanism
- Refrigeration /cryostat Tests
Single-CCD imaging setup

Small cryostat with engineering-grade 4Kx4K pre-production sensor

REB with 1 stripe populated

Full DAQ system
DM team has reduced risks with prototype development and production at scale

- **Algorithm Design**
  - ~60% of the software functional capability has been prototyped
  - Over 350,000 lines of C++, Python coded, unit tested, integrated, run in production mode
  - Released 3 terabyte-scale datasets, including single frame measurements, point source and galaxy photometry

- **Petascale Computing Design**
  - Executed in parallel on up to 10k cores (TeraGrid/XSEDE and NCSA Blue Waters hardware) with scalable results

- **Petascale Database Design**
  - Conducted parallel database tests up to 300 nodes, 100 TB of data, 100% of scale for first year of operations.

- **Gigascale Network Design**
  - Currently testing at up to 1 Gbps
LSST data processing software is currently capable of scientific analysis

HyperSuprime Cam photometry processed with LSST software

Photometry from reprocessing of SDSS Stripe-82 with LSST software

(Robert Lupton, private communication)
Education and Public Outreach system development continues to optimize design for broad participation

- EPO and DM working closely
  - Frossie Economou hired for shared “Technical Manager” position
  - Exploring common architectures for infrastructure and Interfaces

- EPO Manager hire planned in mid-2015
  - Communications and EPO Scope clearly separate
  - 5-year construction plan within 8 year effort
Communications

• Outreach to Community will continue at appropriate conferences

• Website renovation in-Progress
  – Need to separate Project from Corporation
  – Public remains lsst.org with sub-domains;
    • project.lsst.org
    • science.lsst.org
  – Working on system to “push” more data

• July E-News; 23 issues since March of 2008
  http://www.lsst.org/lsst/news/enews
Unusual new telescope gets green light
news.sciencemag.org/funding/2014/0...

Funds awarded to begin construction of Large Synoptic Survey Telescope :: UC Davis News & Information news.ucdavis.edu/search/news_de...

AURA's Large Synoptic Survey Telescope to Begin Construction, Thanks to National Science Foundation Funding Support science.tamu.edu/news/story.php...

UA Optics at Heart of Telescope Poised to Catch the Action in the Universe | UANews uanews.org/story/ua-optic... via @uofa

Retweeted by LSST
Victor Krabbendam @Vlk321 - Aug 1
Its a good day @LSST. NSF approved AURA CSA for LSST Construction!
Welcome

LSST Receives Construction Authorization

August 4, 2014 - The long awaited news has arrived - LSST has received its federal construction start as described in these press releases from AURA and the NSF. On Friday afternoon, August 1, the NSF authorized the LSST project for construction with $27.5M in FY14 and a budget plan that stays within a $473M overall budget cap. The effort to make LSST a reality that began in the mid-1990s will be realized in the start of science operations in 2022. LSST has broken through the technology, science, and political challenges and is on its way to revolutionizing both our cosmic knowledge and the open and collaborative methods of acquiring that knowledge. With thanks to the hard work by so many who contributed to this milestone and every confidence in the project team to complete the construction task, we are excited to begin this next phase for LSST.

Simple DocuShare Operations

Collection

What's New
Project Office Theme for the Week: Transition and Compliance

• Cost Account Manager Training
  – Various times with PMCS guru – Kevin Long

• Communications Feedback
  – Several Sessions (Suzanne Jacoby)
  – Collaborations
Project Office Theme for the Week:
Transition and Compliance

- Meet the new Chile Office at Base Facility Breakout
  - Site Manager Eduardo Serrano and,
  - LSST Administrator Carol Chirino - Tues. 3:30PM

- LSST Safety Meeting – Wed. 11:00AM
  - Chuck Gessner to overview program and tools

- Collaboration Tools
  - Remote interaction equipment to be at major centers (talk to Iain Stefan, Suzanne or me)
  - Enterprise tools (Iain, Brian, Kevin)

- Archiving Data and Documentation
  - We must renew our efforts for central storage
  - We use Docushare, GIT, PDM and more
  - Come see Docushare upgrades and discuss issues
The Large Synoptic Survey Telescope is seeking scientific, engineering, education, and administrative talent to build "one of the most important scientific experiments in human history". LSST sees the diversity of its team as a critical component in constructing and operating a large scientific facility of value to all. We reflect that deep commitment by strongly encouraging women, minorities, veterans and disabled individuals to apply for the opportunities offered here.

In anticipation of our federal construction start, key positions are available now and in the near future for the construction and eventual operation of this new generation observing facility. Operating as an AURA Center since 2011, the LSST headquarters are in Tucson, AZ with additional work sites at NOAO (also an AURA Center), the DOE-funded SLAC National Accelerator Laboratory, University of Washington, Princeton University, IPAC, and NCSA among others. All LSST work sites offer exceptional benefits packages and room for professional growth.
CONSTRUCTION START