The Large Synoptic Survey Telescope (LSST)

Description: The LSST Project consists of: 1) a large-aperture, wide-field, ground-based telescope that provides a 10-square-degree field of view; 2) a camera with a 3-Gigapixel focal plane array that can be read out in 2 seconds, with 2 seconds to open and close the shutter; 3) a data management system to process, archive, and distribute the data; and 4) a 10-year survey that will obtain sequential images of the entire visible sky every few nights in six different filter bands.

Science: The LSST data will enable five probes of dark energy: 1) Weak gravitational lensing; 2) Large-scale power spectrum for the spatial distribution of matter as a function of redshift, including an angular Baryonic Acoustic Oscillations (BAO) measurement; 3) Type Ia Supernovae (SN) used as standardizable candles; 4) The spatial density, distribution, and masses of galaxy clusters as a function of redshift; and 5) Strong gravitational lensing, i.e., the angular displacement, morphological distortion, and time delay for the multiple images of a source object due to a massive foreground object. The Dark Energy Task Force has proposed a figure of merit by which to assess dark energy experiments. This figure of merit is the reciprocal of the area of the error ellipse enclosing the 95% confidence limit in the w_0--w_a plane marginalized over other cosmological parameters. While absolute projections are uncertain due to possible effects of systematics, analyses consistently show that the relative gain in the figure of merit of LSST over Stage III surveys is a factor of 5 to 10.

The LSST data are self-contained for all of these investigations and require no additional observations. However, dark energy investigations can benefit from ancillary spectroscopic data and measurements at infrared and high-energy wavelengths.

Collaboration and Funding: The LSST is a joint DOE/NSF project. The data set obtained for dark energy studies can also address a wide array of astrophysics problems, ranging from an inventory of small bodies in the solar system to the formation and evolution of galaxies. The most recent NRC decadal survey for astronomy and astrophysics gave the LSST its top ranking for a new ground-based project because of "its compelling science case and capacity to address so many of the science goals of this [decadal] survey and its readiness for submission to the MREFC process [at NSF]." An MOU between DOE and NSF has defined each agency's responsibility for the project during construction and operations.

Cost and Schedule: The total requested construction budget is $626 M in federal funds. The DOE MIE portion for the Camera is $160M and the NSF portion for the rest of the LSST Project is $466 M. These budgets are fully loaded, cast in "then-year" dollars, and include 27% contingency overall, with 40% contingency on the camera effort. According to the preliminary baseline plan, which is consistent with funding profiles supplied by DOE and NSF, science verification will begin in October, 2020, and the full survey will begin in October, 2021. The costs were vetted by the CD-1 review in November 2011 and the NSF Cost Review in May 2012. The costs to conduct the survey and carry out the data management tasks are estimated to be $37.2M/year. According to the NSF/DOE MOU, these costs will be funded by NSF at $19M/year and by the DOE at $9M/year, with the remainder contributed by international affiliates. The DOE budget includes an additional $6M/year for science operations. All operations costs are in 2011USD.

Science Classification and Readiness: The LSST project is ready for construction. The National Science Board has authorized the NSF Director to request construction funding in a future budget.