Closeout Report of the DOE & NSF Dark Energy Survey (DES) Pre-Operations Review

at the Fermi National Accelerator Laboratory
April 23-24, 2013

Overall

- The team has made a lot of progress since the last review, in many areas of the project:
  - Technical maturity
  - Integration of project components
  - Management and leadership
  - Science collaboration involvement in project
- The DES project had a successful SV phase, including demonstrated data taking and processing.
- Materials prepared and provided to the review committee were comprehensive and clear.
- We commend the DES team on its performance over the past year and its preparation for this review.

2a. DECam
*Dell'Antonio, Magnier (SC1a)

Findings

- DECam has met almost all of its performance goals during commissioning, and the camera appears to be ready for the start of operations.

- Properties of the CCDs including non-linearity are close to specifications; corrections for the non-linearity have been developed (and will be integrated into the DM reductions) to satisfy the instrumental specs. More work is needed to understand why the non-linear properties of the detectors is different from those measured at FNAL.
- Pupil Ghosts and scattered light have been characterized and meet the specifications given in the SRD. Some attempts at amelioration (via baffling) are underway.

- The optical performance of the camera meets the simple requirements in terms of median delivered image quality. However, it is not clear how much of the delivered PSF size is due to residual camera configuration errors.

- The CCDs have demonstrated sensitivity to light, and a LED diode system has been installed to prevent damage to the array.

2a. DECam
*Dell'Antonio, Magnier (SC1a)

Findings (continued)

The LN2 system has proved less robust than hoped for. Although none of the failures has been critical, it is an area of risk and the DES and CTIO are investigating ways to harden the system.

Comments

- The disagreement between the optical distortion model from the donut analysis and the BCAM system is puzzling. More work is needed to be sure the optical system is understood.
- The bright star ghosts are in general not being corrected for. While they will cover a very small fraction of the area of DES, they will affect the stacked images and their effect on source catalogs, difference images, etc. needs to be flowed through and a model for masking these features should be developed by the camera team to pass on to DESDM.
- Y-band fringe corrections are important, especially for the Community Pipeline, and should not be neglected. Fringe corrections should be scaled to fit observed fringes.
- The DIMM telescope is very important for verifying that the DECam camera performs optimally. It is important that CTIO put in the effort required to make it functional again.

2b. Telescope
*Magnier, Dell'Antonio (SC1a)

Findings

- The performance of the telescope in terms of tracking and pointing has improved dramatically since the start of science verification. Delaying the start of survey operations until September, 2013 was the right choice.

- Nevertheless, the telescope slew and settle time does not support the original specification of a 20 second interval for slew and settle for sequential exposures separated by a small slew. This has consequences for the survey.

- Weekly (DOOM) meetings have been established to keep DECam and CTIO staff on the same page in terms of activities remaining to be done to improve the telescope and optical performance.

- The f/8 mechanism reintegration will begin at the end of the summer.

CTIO believes that it will not affect the timing of the beginning of DES observations.

2b. Telescope
*Magnier, Dell'Antonio (SC1a)

Comments

- Adopting a position-based LUT for active mirror support is an important part of delivering the best optical image quality.
- The current achieved time between successive exposures is ~35 seconds. Even the proposed improvements between now and the start of survey operations will still leave the time between exposures 20% longer than original specs.
- The list of tasks to be accomplished during engineering nights and during summer shutdown was claimed to be longer than the available time, but the prioritization of tasks is unclear.
- It is important for the DES to re-run the survey completion simulations using more realistic overheads and penalties for slews (the time between exposures grows quickly for large slews) so the impact on the survey is known precisely (as recommended elsewhere in the review).
- The f/8 system integration is scheduled coincident with the beginning of DES survey operations. Much more attention is required to make sure that DES is not impacted by the attention/staffing required by CTIO staff for this task.

2b. Telescope
*Magnier, Dell'Antonio (SC1a)

Recommendations

Develop a detailed work plan with a prioritized list of tests and tasks to improve telescope performance in image quality, tracking, pointing and slew/settle time. By May.

Develop a timeline for performing these tests during the engineering time and the longer summer shutdown. This plan needs to be in place by May.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Findings

The project presented a plan for conditional acceptance of the community pipeline. The project expects that the acceptance plan document will be signed in approximately one month. All members of this project consider this acceptance low risk, as does Bob Blum, speaking as Deputy Director of NOAO.

The Community Pipeline plan includes effort for punch list items required by the acceptance plan. Coadd punch list items have already been coded, waiting for release. About half are in this state, a few need significant work (e.g. pupil ghost), 2 need science working group input. By the next code freeze on June 15, they will have 7 out of 10 completed.

Comments

The panel agrees that the plan is both necessary and sufficient for acceptance of the Community Pipeline.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Findings

DES has demonstrated the ability to discover supernovae in the dedicated survey data. DESDM is not yet able to reduce SN observations in the 24 hours required to keep up with observing; the processing time is currently ~2 days. Additional processing has to be done after pipeline runs. There is not a “hard requirement” to reduce the SN data within 24 hours.

Comments

The SN search is the sole time-critical portion of the survey and is currently expected to get a large fraction of the observing time. It is critical that the software systems be ready to handle the volume of data robustly. The team is encouraged to stress-test the automation of the pipeline to ensure the timely discovery of the SNe.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Findings

The bright star ghosts are in general not being corrected for.

Comments

While they will cover a very small fraction of the area of DES, they will affect the stacked images and their effect on source catalogs, difference images, etc. needs to be flowed through and a model for masking these features should be developed by the camera team to pass on to DESDM.

Y-band fringe corrections are important, especially for the Community Pipeline, and should not be neglected. Fringe corrections should be scaled to fit observed fringes. This code should be included in the CP as well as the DESDM.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Findings

The project presented both the high-level overall schedule and various detailed schedules that clearly indicate the work planned to achieve operational readiness by September, 2013.

Comments

The DES project (including DESDM) has not provided an integrated plan, at sufficient level of detail to track and monitor progress, for “science readiness”, i.e. first year science, which requires offline data processing, archiving, and data serving.

This is in part due to the lack of stated data product and quality requirements for each annual data release (including the first one), and a description of how each release moves the project toward the final science requirements.

Neither is viewed as a reason to delay the start of operations.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Recommendations

• Define the data product and data quality requirements for each annual data release and discuss how each one moves the project toward the final science requirements. Due by December 2013.

• Create a Science Readiness Plan at the same level of detail as the Operational Readiness Plan. Due by December, 2013.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Findings

The DES DM project manager and scientist described the ongoing work in the area of astronomy codes. Testing is done using subsets of SV data and compares the data to requirements. Per prior review recommendations, DES has incorporated the science collaboration into the DESDM effort. There are 14 scientists that are contacts for astronomy codes, under Brian Yanny, overall manager of development (from Penn, FNAL, NCSA, OSU, CfA, Chicago) plus 3 people at NCSA for integration/support. Emmanuel Bertin supports Astromatic codes on a part-time basis. Robert Gruendl of DESDM is responsible for ensuring that the codes are properly integrated into the DESDM pipelines.

Comments

It was not clear that the project has completely assigned all of the activities necessary to process and validate a complete data release, and this is needed for science readiness. In particular:

- Detailed schedules for the astronomy code delivery and integration activities were not presented.

- Detailed schedules of the production, data analysis, and delivery process for the first data release were not presented.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Recommendations

By December 2013, provide a resource-loaded schedule, with activities and inter-dependencies showing, for the first annual data release after the conclusion of the first observing period, with all the work needed to:

- develop, integrate, and test all the software (developed by DESDM and SWG)
- process and validate the quality of the data products

Ensure that there are firm commitments to perform any critical path work by any scientists not formally part of the DESDM team.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Findings

Based on the recommendations of the May 2012 review, the project manager has prepared a “bare bones” but still feasible staffing plan for achieving “science readiness” and to conduct operations through August, 2016. The plan is contingent on approval of the requested $835k NSF supplement. The project is currently burning funds at a rate commensurate with that approval. Failure to approve the supplement will force a reduction in planned staff. This would have the net result of delaying maturity in the software to process and validate the annual and final full survey data releases (the latter by a project-estimated 2 years). In addition, the degree of scientific validation of the data will be significantly reduced, and this could potentially be severe enough to fail to optimize the observing schedule, increase the proportion of poor data taken, and place the scientific goals of the survey in jeopardy.

Comments

The panel agrees with the findings above and agrees that these represent unacceptable risk for the project. Protecting the already substantial past investment further argues for making this relatively small incremental investment.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Recommendations

The panel recommends in the strongest terms possible that the NSF provide the supplemental request as soon as possible.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Findings

The current plan is for the period until the current NSF grant expires mid-2016. It does not cover the period after the end of observing in 2018, when the DESDM system will do data reductions for the final full survey data release. A new grant request will be made to support this period. The project suggested that a joint DOE/NSF memorandum of agreement on funding for this period would be a good way of preparing for this eventuality.

There was discussion of deferring approval of the existing grant request and incorporating that amount into this request. The project presented a spending profile for DESDM that shows annual cash flow issues as high as $1.7M. The project does not anticipate any way to address these cash flow issues if the existing request is not approved, nor if additional funding is not acquired until mid-2016 or later.

Comments

The panel agrees with the project assessment that the existing funding request should not be deferred into the later request and that a joint memorandum of agreement would be useful.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Recommendations

The panel does NOT recommend withholding the current request in anticipation of a request covering post-2016, as there will be cash flow difficulties before 2016 should that be the case.

2c. DESDM
*Kantor, Cameron, Magnier (SC1b)

Findings

As stated before, the plan to achieve science readiness and conduct operations presented is “bare bones”, i.e. the DESDM project does not have any significant funds reserved as a contingency.

Comments

While DES is entering an operations phase overall, there are substantial elements of the DESDM system that will be developed during operations. It is not clear that these items can be descoped without significant science impact.

Recommendations

The project should identify a prioritized list of possible descopes should unexpected difficulties arise, and if possible should develop and allocate contingency funds at least for the remaining DESDM development items. Due by December 2013.

Findings:

There is an existing survey strategy in place. Currently, the Science Committee is reviewing possible plans for the 2013 season, and will issue a recommendation to the Director by July 1. This recommendation will be reviewed with ObsTac and a final decision will be made by August 1. The major watershed is between 2500 sq. deg. at 4 tilings and 5000 sq. deg. at 2 tilings. Considerations include the ease of processing, overlap with external data sets, and scheduling constraints. Future adjustments to strategy based on actual performance will be made on a yearly basis (that is, not on a shorter timescale) through a similar process.

The combination of survey depth, area, and number of nights is no longer consistent, given what is known about the telescope performance, mostly because of the slew time issues. There is also no contingency for telescope and instrument faults or abnormally bad weather.

The strategy is implemented at the telescope with ObsTac. ObsTac requires a roughly daily handshake with DESDM to update the Survey Table regarding what tiles are done. This handshake requires a fair amount of handholding at this moment. The team said there was a plan to automate the handshake by Sept. 1.

Findings, cont'd.

The SN strategy guarantees a 7-day cadence, often exceeding that in bad seeing weeks because of the 1.1 arcsec cut. The SN are projected to take a large fraction of the total time (45-50%).

The dither pattern is adjusted to yield good calibration constraints using multiple observations of the same star. However, the pattern of data-taking means that observations are correlated in time in the same way as in space. Standard fields are targeted in marginal twilight. There will be flexibility in out-years to tie down large scale modes with (in addition to PreCam) multiple observations across the sky closely spaced in time, at low observational cost.

The operational aspects of the observing runs, including the use of volunteer observers under the purview of the Run Manager, have been exercised successfully in the SV period with only a small amount of observing time lost due to identified operator error.

Comments

The fact that the performance reduces the survey efficiency by ~10% needs to be addressed and accounted for on the basis of the 525 night plan, which is the very likely number of available nights. This can be handled by reducing data quality, depth, or area, and that balance needs to be evaluated from a scientific and practical perspective. We note that if the area is reduced, it will be very difficult to acquire the additional 10% in later years even if larger night allocations or extended observations are available. Any new plan needs to accommodate a fairly pessimistic weather model and some explicit assumption for telescope and instrument faults. The key point here is that the plan should be one that can be achieved, and it should be one that the science teams have access to and can forecast the realistic implications of. The results of the model should be reflected in an updated Science Requirements Document.

There should be a formal structure for re-planning the survey each year based on actual achieved performance. The Director should request yearly that the Project Scientist make a recommendation with Science Committee input.

Comments, cont'd

The calibration strategy has several pieces that need to be knitted together (DECal, PreCam, aTmCAM, the global calibration module). These appear fairly decoupled from the survey strategy and observing plan itself, but the timescales for incorporating the external constraints and instrument measurements into DESDM products need to find their way into the DESDM group's high-level schedule (discussed elsewhere).

As discussed elsewhere in this review, the SN cadence and seeing limits need to be revised in the SRD taking into account the Science Committee's analysis of the survey constraints.

Ending on an optimistic note: the survey should have a contingency plan if the weather is EXTREMELY good: what do you do on a night where there is nothing new to observe in the current pass? There should be an idea of how to take advantage of good fortune.

Recommendations

Evaluate survey performance using projected realistic parameters and adjust SRD

- Due date: Aug. 1

Finish and test automated handshake between DESDM and Survey Table

- Due date: Aug. 1

3b. Science Planning
*Cameron, Blanton (SC2b)

Findings:

• Current ObsTac control parameters (seeing cut, deadman timeout) result in a high fraction of DES observing being used for SN fields.

• Seeing data from DIMM are used in current modeling of survey strategy and modeling of fraction of observing time given to SN fields.

• SWGs are now participating in the DES reviews, which is good to see

- This had been a recommendation at earlier DES reviews

• Many key science performance requirements have been verified or partially verified using SV and extended SV data

- Several aspects of telescope performance have been improved

•DESDM is anticipating increase in efficient feedback of SV test results and processes into DESDM with the start of the DESDM Build Manager

3b. Science Planning
*Cameron, Blanton (SC2b)

Findings (continued):

• In response to previous review recommendation, SWG computing have investigated and increased use of large-scale national computing resources such as NERSC (DOE)

• Computing resources for the 4 SWGs (WL, LSS, SN, GC) plus simulations group are spread across several facilities: XSEDE, NERSC, SLAC (DOE/KIPAC), plus Barcelona, and also DESDM systems

• Additional costs have been identified for more data disk storage at NERSC (although) still investigating tape storage concepts, and at SLAC.

3b. Science Planning
*Cameron, Blanton (SC2b)

Comments:

• SWGs will be responsible for some data to be incorporated into DESDM processing systems: e.g. LSS group will be responsible for Mangle mask generation to be incorporated into DESDM processing. SWGs will have to coordinate their processing timescales with DESDM change control board timeline expectations for DESDM updates.

• Analyses by the SWGs are likely to be important to examining and trading options for accommodating a lower observing efficiency than planned. Are they asked specific questions to address to make such a decision?

3b. Science Planning
*Cameron, Blanton (SC2b)

Comments (continued):

• It is not clear if additional funding for data storage at NERSC and SLAC, plus 0.5 FTE for software support at FNAL for data processing for SWGs is in the current DES budget.

•There is a plan to release an updated Y1C1 dataset on April 30 to Science Working Groups for generating first science papers from SV data, followed by another full official release of revised Y1C1 data to SWGs in late August

- 26 papers being planned, with 19 based on analysis of SV data
- Not clear how the SWGs will effectively use the 2 Y1C1 datasets released 4 months apart

3b. Science Planning
*Cameron, Blanton (SC2b)

Recommendations:

- Revise estimates for expected DES observing time spent on SN fields by replacing DIMM-based seeing data with more realistic SV-based plus expected improved seeing data in science planning. Reassess expected fraction of photometric survey time that will be used for SN observations. Reassess set points on ObsTac parameters controlling SN observing fraction. Re-evaluate DES science requirement of <10% for SN observing time. Assess impact to other DE science goals from reassessed survey time fractions.
    - Due date: Aug. 1 2013

- Revise and update prior 5-year science processing plan, to reflect recent accommodation of more national computing resources (e.g. NERSC), including data support costs.
    - Due date: Aug. 1 2013

4. Cost & Schedule
*Gillespie, Wisniewski (SC3)

Findings

- The aggregate cost of DES operations is ~$5-6M/yr. There are forecasted cost risks in labor costs for DESDM implementation and NERSC data storage hardware systems that are currently unfunded.
- The remaining development, testing and operations schedules are currently in an overview form, and need to be resource loaded and interconnected between the various teams.

Comments

- The projected operations costs are not unreasonable in comparison to other similar projects.
- The requested supplement funding for DESDM is compelling to the committee, and will forestall larger future cost overruns, schedule delays, and significant impact to the science products of the survey.
- There is no apparent contingency, other than schedule/performance, available to mitigate unplanned liens to the survey performance.

Recommendations

- Identify agency, or other, supplemental funding for the DESDM project. Due Aug. 1
- Develop bottom-up, resource-loaded schedules for 6-mo. duration, w/ dependencies between teams and deliverables, and coarse milestones beyond. Aug. 1

5. Management
*Wisniewski, Gillespie (SC4)

Findings

- The team has developed an extensive set of organization charts backed up by documentation.
- A set of acceptance tests has been developed.
- CTIO is responsible for the operation of the full instrument. DESDM provides the framework for data processing as well as processing the data. DES produces the output science.
- DESDM has reevaluated its scope and costs. There is a shortfall of funds at the end of the grant period of $835K. A supplemental request for funds to NSF has been pending at the agency for several months without final action. In addition, there will be shortfalls of up to $1.7M at the end of the worst case for a fiscal year.
- The integrated schedule developed by the DES team is in an early stage of development.
- Plans for Observers and Run Managers, and their training, with extensive documentation, have been developed. These functions are filled by collaboration members.
- Management structures and processes were changed, improved.
- Inter-institutional relations seem more amicable, productive.
- Science teams taking more active role in survey development and planning.
- Management and organizational structures are in place to start operations.

5. Management
*Wisniewski, Gillespie (SC4)

Comments

- Committee feels that the DES team has a viable plan for beginning the survey in September.
- The organization charts are for the most part appropriate. The highest level organization chart should be revised to explicitly detail the analysis team.
- The roles of the three institutions are clearly defined. The DESDM and DES efforts are more closely interwoven. The organizations' common goal is the success of the project.
- The funds shortfall for DESDM threatens the science goals of DES, the quality of the data taken, as well as delaying results for both DES and CP.
- The integrated schedule deals with near term goals. What is lacking is the middle and long term vision that connects these to the final goals of the survey. The guideposts provided by these longer term milestones will provide added focus to the short term goals. The detailed schedule should roll up to indicate at the highest level the interdependencies of the efforts of the three teams. This high level schedule should be held by the senior management team.
- The model chosen for manning observation shifts at the observatory is likely to be successful. The management team should be ready to adjust the plan in the out-years to ensure continued high quality coverage.
- Project budget constrained, schedule and performance are tweakable.
- Gap in planning for mid-term activities.
- Replanning "triggers" and response mechanisms could be more formal, robust.
- Collaboration and science teams feedback and involvement needs to continue to be folded into survey planning and decision-making loops.

5. Management
*Wisniewski, Gillespie (SC4)

Recommendations

• Execute the plan to prepare for the first year of the survey in September.

• Approve funding of the DESDM supplemental request to enable successful accomplishment of the DES science goals. The agency will also need to forward-fund the grant to avoid near term shortfalls.

• Hold ownership of the high level integrated schedule, which should include key dependencies and the intermediate and long term goals of the experiment, in the DES senior management team.

• Strengthen roles of Director and Deputy to better define explicit deciding authority regarding all survey resources, e.g., financial, observing plan, telescope allocation, trades, etc.

6. Environmental Safety & Health

***McHugh, Gillespie (SC5)**

Findings

CTIO is “hardening” its critical systems such as the electrical utilities, water/glycol system, dry air, LN2 and vacuum systems. CTIO has relatively new chillers. CTIO has added redundancy to its dry air system and improved telemetry, alarms and control displays. There is on-the-job systems training. There is a DECam expert list with backup personnel for responding to issues. A risk register was created (a recommendation from the March Director’s review). CTIO has a new safety professional that is supporting the safety culture and work planning process. CTIO has a trained medical staff on the mountain.

Comments

The project has evaluated and identified ES&H issues and equipment risks using the risk register. The project and CTIO should emphasize work planning in all aspects of the project and operations. The project and CTIO should continue to foster the integrated safety management culture. Continue plans to install second photodiode system for CCD protection.

Recommendations

No high-level recommendations

Overall

If DES keeps to their aggressive schedule, they will be ready to start the survey in September 2013.

The $835K supplemental request for DESDM needs to be provided for the survey to be successful.

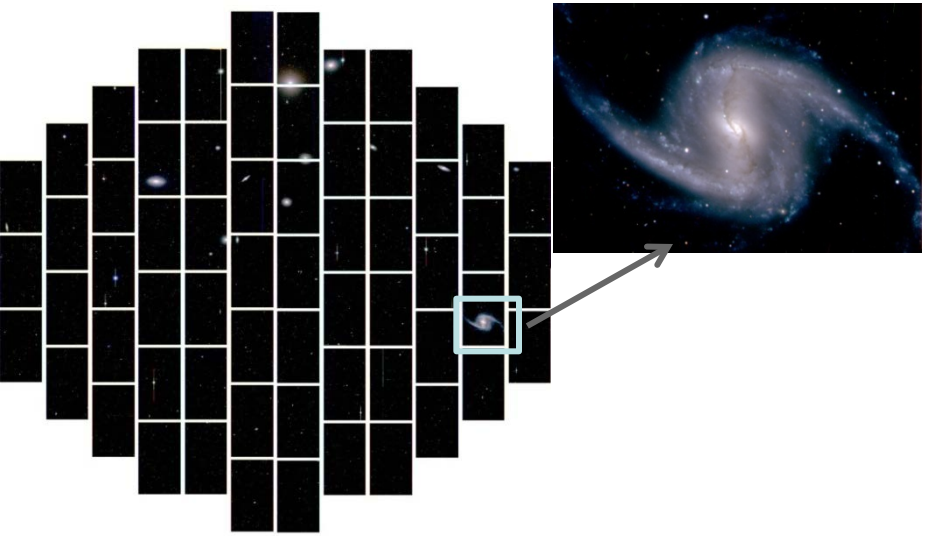
A detailed work plan & schedule needs further development, including near-term, mid-term, and long term efforts & milestone.

- mid- and long-term plans can be developed at coarser level
- include interfaces between all aspects of DES, including science working group & DESDM, as well as CTIO activities on telescope & DECam
- DESDM development plan should be tied to data release dates & requirements

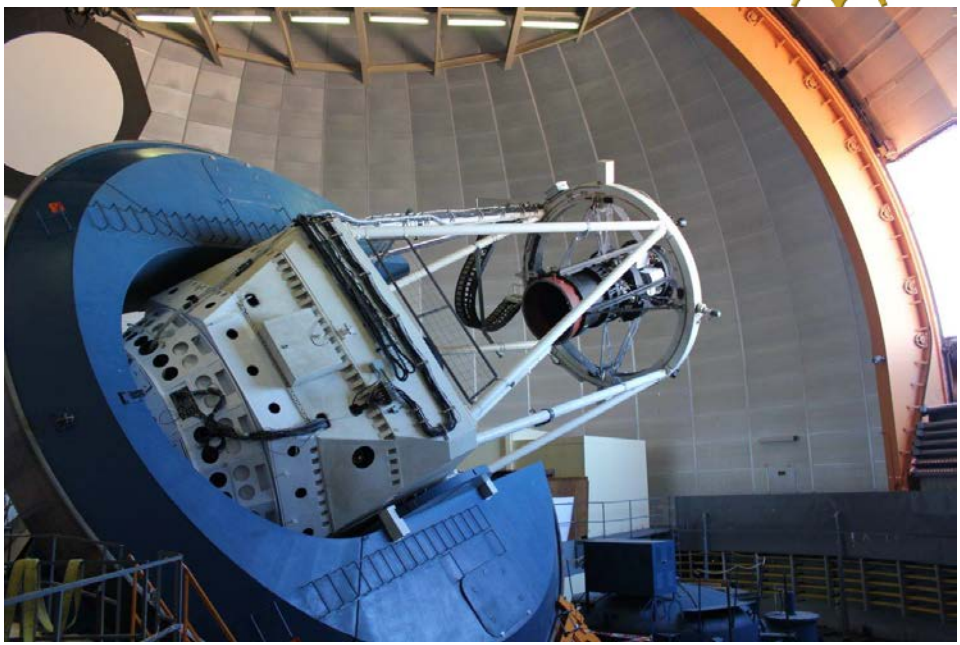
Update survey strategy with realistic telescope efficiency and operational parameters, and examine impacts on science requirements

Dark Energy Survey (DES)

Fornax cluster with close-up of the galaxy NGC 1365



DES – first light on 9/2/12



- DOE/NSF partnership with private and foreign contributions
- DOE/NSF Joint Oversight Group (JOG) meets monthly
- HEP supported fabrication of the Dark Energy camera (DECam), managed by Fermilab, which was installed on Blanco telescope in Chile
- NSF supporting telescope and camera operations and the data management system
- Status: commissioning & science verification completed; camera working well, telescope performance improved; plan to start the 5 year science survey in Sept. 2013
- April 2013: Panel review of DES pre-operations status and planning (last review May 2012)

Charge Memorandum Introduction

The DES experiment is a joint DOE and National Science Foundation (NSF) partnership to study the nature of dark energy. It uses a new Dark Energy Camera (DECam) and data management system (DESDM) on the Blanco Telescope at the National Optical Astronomy Observatory's (NOAO) Cerro Tololo Inter-American Observatory (CTIO) in Chile. NSF is responsible for the DESDM and CTIO facilities improvement project (CFIP). The DECam fabrication was the responsibility of the DOE. After the delivery of the DECam to CTIO, NOAO took over responsibility for the installation, commissioning and operations of the DECam on the telescope, with DOE contributing to DECam support during these phases. The DECam saw first light in September 2012. Commissioning of the DECam and upgraded telescope was carried out in early fall 2012, followed by science verification studies through February 2013.

The purpose of this review is to assess the experiment's progress since the last review, its current status, and plans and preparations for readiness for the start of science survey operations in September 2013. To achieve the science goals, the DES collaboration is expected to use 525 nights of observing on the telescope, which they expect to use during a season from September to February each year over a total period of five years.

Charge Memorandum
Charge Questions

Technical

1. Are there well-defined, mature and achievable plans in place to ensure that critical systems will be able by the time the survey starts to acquire survey-quality data efficiently enough to meet the science goals?
2. Have the remaining risks been identified and mitigation strategies sufficiently developed?

Survey and Data

3. Are the survey strategy and observing plans in place and consistent with successful delivery of the required data?
4. Are there well-defined, mature and achievable plans in place to ensure that the data management system will be able by the time the survey starts to carry out the survey and perform the time-critical data processing and analysis tasks?
5. Are plans in place, appropriate to this stage of the experiment, to ensure that the data management system will be able to perform necessary offline data processing, and to archive and serve science-quality data products to support science analyses by the collaboration?
6. Are the tools, tasks and computing systems needed for the data analyses developed to the appropriate level for this stage of the experiment?

Charge Memorandum
Charge Questions

Cost and Schedule

7. Are the estimated costs to carry out the pre-operations tasks as well as to support science survey operations understood, justified, and balanced with projected funding?
8. In the event that realized costs exceed projected funding, are there adequate plans for adjusting project scope to minimize the impact on project outcomes?
9. Have schedules with milestones been developed to ensure successful completion of pre-operations tasks, leading to the start of science data-taking in September 2013?

Management

10. Is the management structure in place and appropriate to ensure success at completing the pre-operations tasks and carrying out science data-taking? Are appropriate acceptance tests in place?
11. Are the roles and responsibilities of the three hosts and the collaborating institutions well defined and adequate for achieving the goals?

ES&H

12. Are ES&H aspects properly identified and addressed and are Integrated Safety Management Principles being followed?

Review Committee Participants & Assignments

Kathleen Turner, DOE/HEP, Review Chairperson

SC1a – Technical (Overall, DECam, Telescope); Q1, Q2

*****Ian Dell'Antonio	ian@het.brown.edu
Gene Magnier	eugene@ifa.hawaii.edu

SC1b – Technical (DESDM); Q1, Q2, Q4, Q5

*Jeff Kantor	jkantor@lsst.org
Rob Cameron	rac@slac.stanford.edu
Gene Magnier	eugene@ifa.hawaii.edu

SC 2a - Survey & Data (Survey Strategy & Observing Plan); Q3

*Michael Blanton	blanton@nyu.edu
Ian Dell'Antonio	ian@het.brown.edu

SC 2b - Survey & Data (Science Planning); Q6

*Rob Cameron	rac@slac.stanford.edu
Michael Blanton	blanton@nyu.edu

SC3 – Cost & Schedule; Q7, Q8, Q9

*****Bruce Gillespie	bgillespi@apo.nmsu.edu
Bill Wisniewski	wjw@slac.stanford.edu

SC4 – Management; Q10, Q11

*****Bill Wisniewski	wjw@slac.stanford.edu
Bruce Gillespie	bgillespi@apo.nmsu.edu

SC5 – ES&H; Q12

*Eric McHugh	emchugh@fnal.gov
Bruce Gillespie	bgillespi@apo.nmsu.edu

Observers

Nigel Sharp, NSF	nsharp@nsf.gov

Agency POCs:

Vernon Pankonin NSF/AST
vpankoni@nsf.gov

Nigel Sharp NSF/AST
nsharp@nsf.gov

Kathy Turner DOE/HEP
kathyg451@gmail.com
240-461-3837

***Lead Subcommittee member**
Q# -- Question # from Charge

Review Panel & Agency members