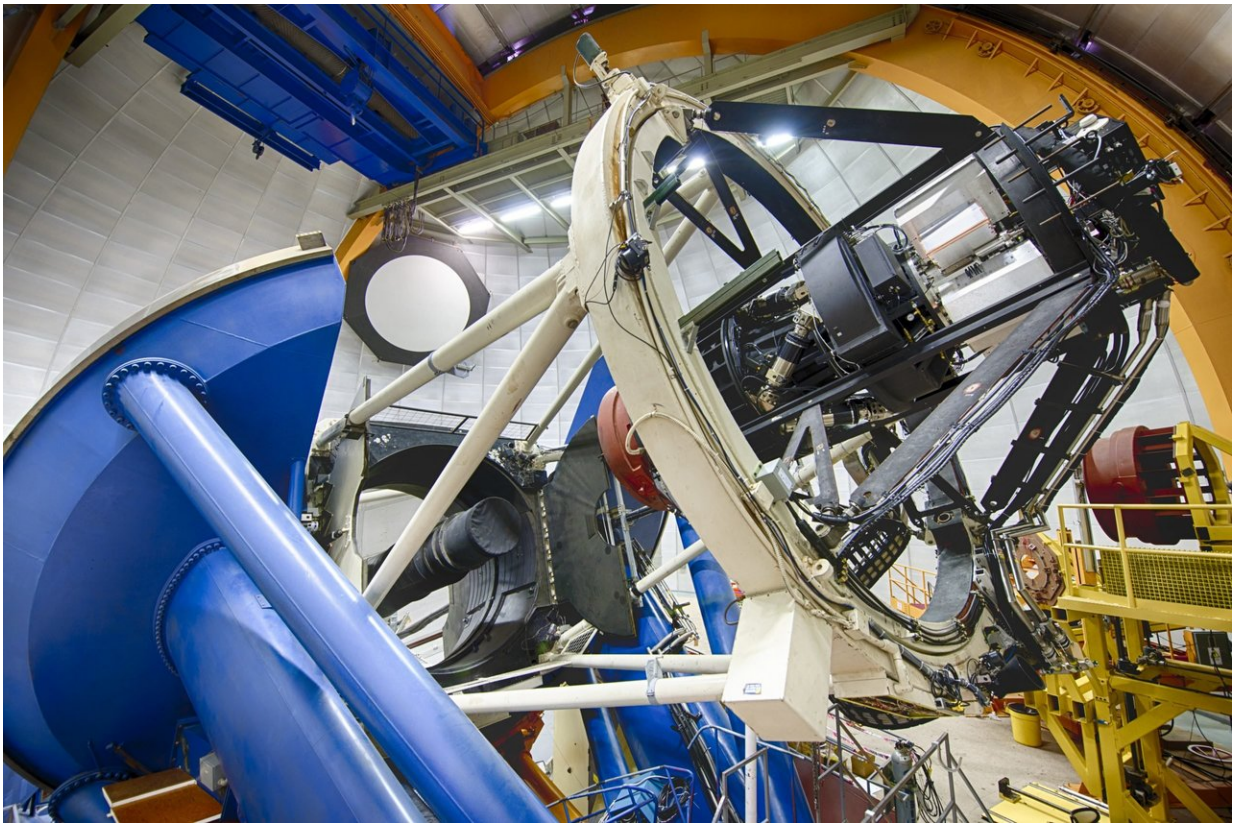
Dark Energy Survey completes six-year mission

January 9 2019



The Dark Energy Camera is mounted on the 4-meter Blanco telescope at the Cerro Tololo Inter-American Observatory in Chile. The final day of data-taking for the Dark Energy Survey is Jan. 9. Credit: Fermilab

After scanning in depth about a quarter of the southern skies for six

years and cataloguing hundreds of millions of distant galaxies, the Dark Energy Survey (DES) will finish taking data tomorrow, on Jan. 9.

The survey is an international collaboration that began mapping a 5,000-square-degree area of the sky on Aug. 31, 2013, in a quest to understand the nature of dark energy, the mysterious force that is accelerating the expansion of the universe. Using the Dark Energy Camera, a 520-megapixel digital camera funded by the U.S. Department of Energy Office of Science and mounted on the Blanco 4-meter telescope at the National Science Foundation's Cerro Tololo Inter-American Observatory in Chile, scientists on DES took data on 758 nights over six years.

Over those nights, they recorded data from more than 300 million distant galaxies. More than 400 scientists from over 25 institutions around the world have been involved in the project, which is hosted by the U.S. Department of Energy's Fermi National Accelerator Laboratory. The collaboration has already produced about 200 academic papers, with more to come.

According to DES Director Rich Kron, a Fermilab and University of Chicago scientist, those results and the scientists who made them possible are where much of the real accomplishment of DES lies.

"First generations of students and postdoctoral researchers on DES are now becoming faculty at research institutions and are involved in upcoming sky surveys," Kron said. "The number of publications and people involved are a true testament to this experiment. Helping to launch so many careers has always been part of the plan, and it's been very successful."

DES remains one of the most sensitive and comprehensive surveys of distant galaxies ever performed. The Dark Energy Camera is capable of

seeing light from galaxies billions of light-years away and capturing it in unprecedented quality.

According to Alistair Walker of the National Optical Astronomy Observatory, a DES team member and the DECam instrument scientist, equipping the telescope with the Dark Energy Camera transformed it into a state-of-the-art survey machine.

"DECam was needed to carry out DES, but it also created a new tool for discovery, from the solar system to the distant universe," Walker said. "For example, 12 new moons of Jupiter were recently discovered with DECam, and the detection of distant star-forming galaxies in the early universe, when the universe was only a few percent of its present age, has yielded new insights into the end of the cosmic dark ages."

The survey generated 50 terabytes (that's 50 million megabytes) of data over its six observation seasons. That data is stored and analyzed at the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign.

"Even after observations are ended, NCSA will continue to support the scientific productivity of the collaboration by making refined data releases and serving the data well into the 2020s," said Don Petravick, senior project manager for the Dark Energy Survey at NCSA.

Now the job of analyzing that data takes center stage. DES has already released a full range of papers based on its first year of data, and scientists are now diving into the rich seam of catalogued images from the first several years of data, looking for clues to the nature of dark energy.

The first step in that process, according to Fermilab and University of Chicago scientist Josh Frieman, former director of DES, is to find the

signal in all the noise.

The National Science Foundation's Cerro Tololo Inter-American Observatory in Chile houses the Dark Energy Camera. Credit: Fermilab

"We're trying to tease out the signal of dark energy against a background of all sorts of noncosmological stuff that gets imprinted on the data," Frieman said. "It's a massive ongoing effort from many different people around the world."

The DES collaboration continues to release scientific results from their storehouse of data, and scientists will discuss recent results at a special session at the American Astronomical Society winter meeting in Seattle

today, Jan. 8. Highlights from the previous years include:

- the most precise measurement of dark matter structure in the universe, which, when compared with cosmic microwave background results, allows scientists to trace the evolution of the cosmos.
- the discovery of many more dwarf satellite galaxies orbiting our Milky Way, which provide tests of theories of dark matter.
- the creation of the most accurate dark matter map of the universe.
- the spotting of the most distant supernova ever detected.
- the public release of the survey's first three years of data, enabling astronomers around the world to make additional discoveries.

DES scientists also spotted the first visible counterpart of gravitational waves ever detected, a collision of two neutron stars that occurred 130 million years ago. DES was one of several sky surveys that detected this gravitational wave source, opening the door to a new kind of astronomy.

Recently DES issued its first cosmology results based on supernovae (207 of them taken from the first three years of DES data) using a method that provided the first evidence for cosmic acceleration 20 years ago. More comprehensive results on dark energy are expected within the next few years.

The task of amassing such a comprehensive survey was no small feat. Over the course of the survey, hundreds of scientists were called on to work the camera in nightly shifts supported by the staff of the observatory. To organize that effort, DES adopted some of the principles of high-energy physics experiments, in which everyone working on the experiment is involved in its operation in some way.

"This mode of operation also afforded DES an educational opportunity," said Fermilab scientist Tom Diehl, who managed the DES operations. "Senior DES scientists were paired with inexperienced ones for training and, in time, would pass that knowledge on to more junior observers."

The organizational structure of DES was also designed to give early-career scientists valuable opportunities for advancement, from workshops on writing research proposals to mentors who helped review and edit grant and job applications.

Antonella Palmese, a postdoctoral researcher associate at Fermilab, arrived at Cerro Tololo as a graduate student from University College London in 2015. She quickly came up to speed and returned in 2017 and 2018 as an experienced observer. She also served as a representative for early-career scientists, helping to assist those first making their mark with DES.

"Working with DES has put me in contact with many remarkable scientists from all over the world," Palmese said. "It's a special collaboration because you always feel like you are a necessary part of the experiment. There is always something useful you can do for the collaboration and for your own research."

The Dark Energy Camera will remain mounted on the Blanco telescope at Cerro Tololo for another five to 10 years and will continue to be a useful instrument for scientific collaborations around the world. Cerro Tololo Inter-American Observatory Director Steve Heathcote foresees a bright future for DECam.

"Although the data-taking for DES is coming to an end, DECam will continue its exploration of the universe from the Blanco telescope and is expected remain a front-line 'engine of discovery' for many years," Heathcote said.

The DES collaboration will now focus on generating new results from its six years of data, including new insights into dark energy. With one era at an end, the next era of the Dark Energy Survey is just beginning.

More information: Follow the Dark Energy Survey online at www.darkenergysurvey.org

Provided by Fermi National Accelerator Laboratory

Citation: Dark Energy Survey completes six-year mission (2019, January 9) retrieved 25 April 2024 from https://phys.org/news/2019-01-dark-energy-survey-six-year-mission.html