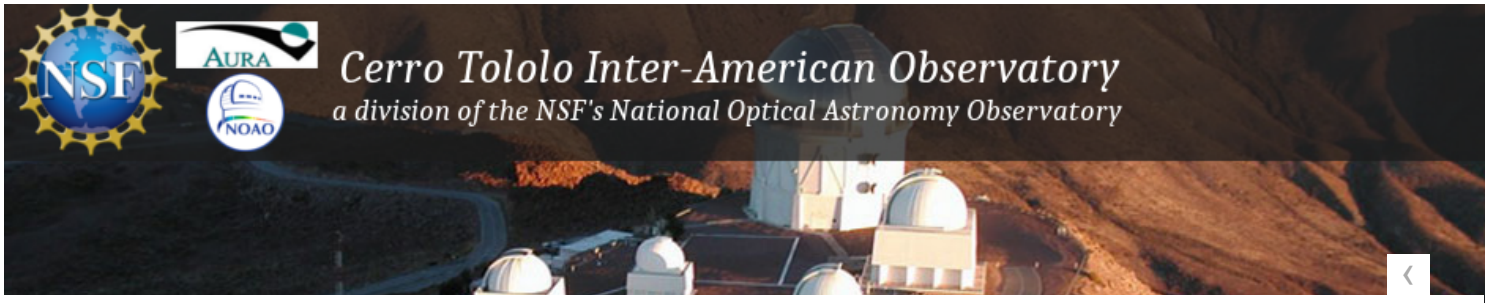

NOAO: A Survey Machine and a Data Trove – Dark Energy Survey's Rich Legacy

NOAO: A Survey Machine and a Data Trove – Dark Energy Survey's Rich Legacy

On the night of 9 January 2019, the V. M. Blanco 4-meter telescope at the National Science Foundation's (NSF) Cerro Tololo Inter-American Observatory (CTIO), high in the mountains of Chile, will close the camera's shutter on the final image from the Dark Energy Survey (DES) – a survey that has mapped 5,000 square degrees of the heavens, almost one-quarter of the southern sky. Although the survey is ending, both the camera used in the survey and the survey data itself are expected to continue to yield abundant new discoveries.

Mapping the Sky to Understand Dark Energy

The Blanco telescope, which began operation in 1976, and the purpose-built Dark Energy Camera (DECam), which was mounted on the telescope in 2012, are exploring one of the most enigmatic phenomena in the Universe: dark energy. Dark energy is the mysterious force that is accelerating the expansion of the Universe.

Over the past six years, more than 400 DES scientists from over 25 institutions have collected a rich trove of data – 50 terabytes worth, mapping nearly a billion galaxies. That's 5 followed by 13 zeros worth of bytes! Now this international collaboration is departing the telescope to study the resulting map, with the aim of probing the nature of dark energy by measuring, with high precision, the 14 billion year history of cosmic expansion.

As DES departs, CTIO continues to make full use of the instrument built to carry out the survey. DECam remains installed on the Blanco telescope, and according to Dr. Tim Abbott, a DES team member and the Blanco Telescope Scientist, "The DECam-Blanco combination is as yet unchallenged as the southern hemisphere's most powerful tool for surveys across the optical and near-infrared spectrum. DECam is an NOAO (National Optical Astronomy Observatory) facility instrument, available to all users. "

A State-of-the-Art Survey Machine

With its large field-of-view, DECam can image almost 3 square degrees of sky at once – an area equivalent to 16 full moons. In the fall and winter, when the sky is dominated by our own Milky Way galaxy and DES's view of the distant universe is restricted, DECam has been used by CTIO's community of scientists in the US and across the globe to explore objects from our own planetary back yard to the far reaches of the Universe.

Dr. Alistair Walker of CTIO, a DES team member and the DECam Instrument Scientist, described how equipping the Blanco 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. Twelve 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."

Discoveries Galore!

In addition to these discoveries, DECam has completed studies of the plane of the Milky Way, which arches high overhead from Chile, as well as RR Lyrae variable stars in the Milky Way's halo. Streams of stars stripped from clusters, which probe our Galaxy's gravitational field and formation history, have been found. Surveys of our neighboring galaxies, the Magellanic Clouds, have discovered hitherto unknown dwarf galaxies.

DECam is also being used in parallel with radio telescopes to try and catch the enigmatic Fast Radio Bursters in the act, and it spotted the first optical counterpart to a gravitational wave source, the neutron star merger GW170817. New DECam filters are now facilitating narrow band studies of galaxies and the search for black holes.

Data Available to All

Throughout the observations made by DES and the broader astronomical community, CTIO has refined the performance of the telescope and instrument, making them as reliable and efficient as possible. Software tools have been built and data handling processes honed so that DECam data are quickly transmitted to the headquarters of the NOAO in Tucson, AZ, where they are processed and made accessible to the world.

While the original DECam images are available via the NOAO Science Archive (NSA), retrieving hundreds of terabytes of image data and analyzing all of the pixels is beyond most of us. To facilitate

the recycling and re-use of the DECam data, catalogs of measurements made from the images are also available. Astronomers often work with catalogs rather than images to make their discoveries.

The catalog from the first DES data release last year contains measurements of 400 million galaxies and stars. The more comprehensive NOAO Source Catalog, which reports measurements for all of the public DECam data, catalogs 3 billion stars and galaxies measured multiple times for a total of 30 billion entries to date.

An 'Engine of Discovery' for the Coming Decade

Although the data collection for DES is concluding, and the all-sky-mapping Large Synoptic Survey Telescope (LSST), currently under construction on Cerro Pachón in Chile with major funding from NSF, will catalog many more sources than DES – a whopping 18 billion LSST sources is expected in the first year of operations – CTIO Director Steve Heathcote foresees a bright future for DECam.

"With its ability to map large areas of sky efficiently and to flexibly employ diverse filters and cadences, DECam will remain a front-line 'engine of discovery' for many years to come – a cutting edge tool for specialized programs, deep surveys, and the observational follow up of LSST's own discoveries."

DECam was built to carry out the Dark Energy Survey (DES) Project by the DES Collaboration, which is a Fermilab-led international collaboration of more than 400 scientists from over 25 institutions around the world. The collaboration has already produced about 200 academic papers with more to come.

DES scientists will discuss recent results at a special session at the American Astronomical Society winter meeting in Seattle today, Jan. 8. DES will also host an interactive event from 2:30 to 3:30 p.m. Pacific time on Wednesday, Jan. 9, at the NOAO booth in the main exhibit hall of the AAS meeting, featuring a live connection to the observatory in Chile as scientists prepare for the final night of data-taking.

The DES Project is funded by the DOE and NSF, the funding agencies of the UK, Spain, and Brazil, and contributions from the Collaboration institutions.

The CTIO complex is part of the US National Optical Astronomy Observatory (NOAO), along with the Kitt Peak National Observatory (KPNO) in Tucson, Arizona. NOAO is operated by the Association of Universities for Research in Astronomy (AURA), under cooperative agreement with the National Science Foundation (NSF). NSF is an independent federal agency created by Congress in 1950 to promote the progress of science. NSF supports basic research and people to create knowledge that transforms the future. CTIO, as part of the AURA Observatory in Chile, operates in

Chile under Chilean law, through an Agreement with the University of Chile and with the auspices of the Ministry of Foreign Affairs of Chile.

Science Contacts

Dr. Alistair Walker
CTIO/NOAO
Tel: (011)-56-512-205-305
E-Mail: awalker@ctio.noao.edu

Dr. Timothy Abbott
CTIO/NOAO
Tel: (011)-56-512-205-216
E-Mail: tabbott@ctio.noao.edu

Dr. Steve Heathcote
CTIO/NOAO
Tel: (011)-56-512-205-293
E-Mail: sheathcote@ctio.noao.edu

More information on: NOAO News Release 19-01

Read Dr. Tom Diehl's Speech and see some pictures

See the Spanish Version of NOAO News (Vea la Versión en Español)

Lea discurso del Dr. Tom Diehl y vea alguna fotos

SUMMARY:
Milky Way over CTIO: This stunning image of the Milky Way arching over CTIO was taken from the eastern edge of the observatory, looking West (and South and North). The panorama shows the central and brightest part of the Milky Way. The bright objects on the left are the two Magellanic Clouds; the Andromeda Galaxy is visible on the right, just above the horizon. The green and red stripes in the sky are from airglow; the orange domes are from light pollution. The panorama is a composite of 9 images, taken on the night of July 31, 2014, with a Canon 6d and a Samyang 24mm lens. Credit: Anja von der Linden.On the night of 9 January 2019, the V. M. Blanco 4-meter telescope at the National Science Foundation’s (NSF) Cerro Tololo Inter-American Observatory

(CTIO), high in the mountains of Chile, will close the camera’s shutter on the final image from the Dark Energy Survey (DES) – a survey that has mapped 5,000 square degrees of the heavens, almost one-quarter of the southern sky. Although the survey is ending, both the camera used in the survey and the survey data itself are expected to continue to yield abundant new discoveries.Mapping the Sky to Understand Dark EnergyThe Blanco telescope, which began operation in 1976, and the purpose-built Dark Energy Camera (DECam), which was mounted on the telescope in 2012, are exploring one of the most enigmatic phenomena in the Universe: dark energy. Dark energy is the mysterious force that is accelerating the expansion of the Universe.Over the past six years, more than 400 DES scientists from over 25 institutions have collected a rich trove of data – 50 terabytes worth, mapping nearly a billion galaxies. That’s 5 followed by 13 zeros worth of bytes! Now this international collaboration is departing the telescope to study the resulting map, with the aim of probing the nature of dark energy by measuring, with high precision, the 14 billion year history of cosmic expansion.Science ContactsDr. Alistair Walker CTIO/NOAOTel: (011)-56-512-205-305E-Mail: awalker@ctio.noao.eduDr. Timothy Abbott CTIO/NOAOTel: (011)-56-512-205-216E-Mail: tabbott@ctio.noao.eduDr. Steve Heathcote CTIO/NOAOTel: (011)-56-512-205-293E-Mail: sheathcote@ctio.noao.eduMore information on: NOAO News Release 19-01Read Dr. Tom Diehl's Speech and see some picturesSee the Spanish Version of NOAO News (Vea la Versión en Español) Lea discurso del Dr. Tom Diehl y vea alguna fotos