deconstruction: dark energy camera goes to chile

Doing big science takes big effort and big cooperation. Building and installing one of the world's largest digital cameras to conduct the most extensive galaxy survey to date requires scientists and manufacturers from across the globe. Researchers from 26 institutions enlisted the help of 129 companies in the United States and about half a dozen foreign ones to fabricate the often one-of-a-kind components for the Dark Energy Camera. **By Tona Kunz**

KEY COMPONENTS FOR THE DARK ENERGY SURVEY:

1 Camera imager to measure galaxy distributions, supernovae, and distortions caused by dark matter. Designed and assembled at Fermilab.

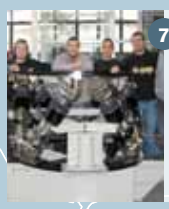
2 Most sensitive photo chips, or CCDs, for red and infrared light. Developed and partially processed by Berkeley Lab; assembled and tested by Fermilab.

3 Filters for five colors, or wavelengths, of light allow the camera to determine galaxy distances by their redshifts. Worked on by a Japanese company.

4 World's largest filter changer to identify light that left galaxies 9 billion years ago. Made by University of Michigan.

5 World's largest shutter to take pictures every two minutes. Made by Bonn University and the Arlanger Institute.

6 Instrument-control software that controls camera components as they survey the sky. Made by Ohio State University and University of Illinois at Urbana-Champaign.



7 Precision hexapod to help align a 3-ton camera to within a few microns. The camera will perform the world's most extensive optical sky survey. Made by an Italian firm.

8 Five lenses, the biggest almost 1 meter in diameter. Made by a company in New York, polished by a French company, and assembled by University College London.

9 Image readout boards record 300-plus images a night, each containing about 200,000 galaxies. Made by Spanish institutions IFAE and CIEMAT with Fermilab design help.

10 One-of-a-kind cryogenics system to keep photo chips at minus 100 degrees Celsius. Designed and assembled at Fermilab.

11 One of clearest sky views in the world provided by Chile's 4-meter Blanco telescope, which will hold the camera.

SMALLER COMPONENTS

Numerous smaller components were made by companies in Hungary and in 25 US states: Arkansas, Arizona, California, Colorado, Connecticut, Florida, Ohio, Illinois, Indiana, Maine, Michigan, Minnesota, New Hampshire, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Washington, Wisconsin, Virginia, Vermont.

Most components for the camera, part of the Dark Energy Survey, migrate to the Department of Energy's Fermilab for testing before heading to the 4-meter Blanco telescope in the remote Chilean mountains. The journey requires help from planes, trains, trucks and boats to traverse continents and oceans, and ends with an 11-hour drive to a mountaintop.

The DES's combination of survey area and depth will far surpass what has come before and provide researchers for the first time with four search techniques in one powerful instrument. To find clues to the characteristics of dark energy and why the expansion of the universe is accelerating, DES will trace the history of the expanding universe roughly three-quarters of the way back to the time of the big bang.

During five years of operation, starting in 2012, the 570-megapixel camera will create in-depth color images of one-eighth of the sky, or 5000 square degrees, to measure 100,000 galaxy clusters, 4000 supernovae, and an estimated 300 million distant galaxies, about 10 million times fainter than the dimmest star you can see from Earth with the naked eye. It will yield the largest 3-D map of the cosmic web of large-scale structures in the universe.

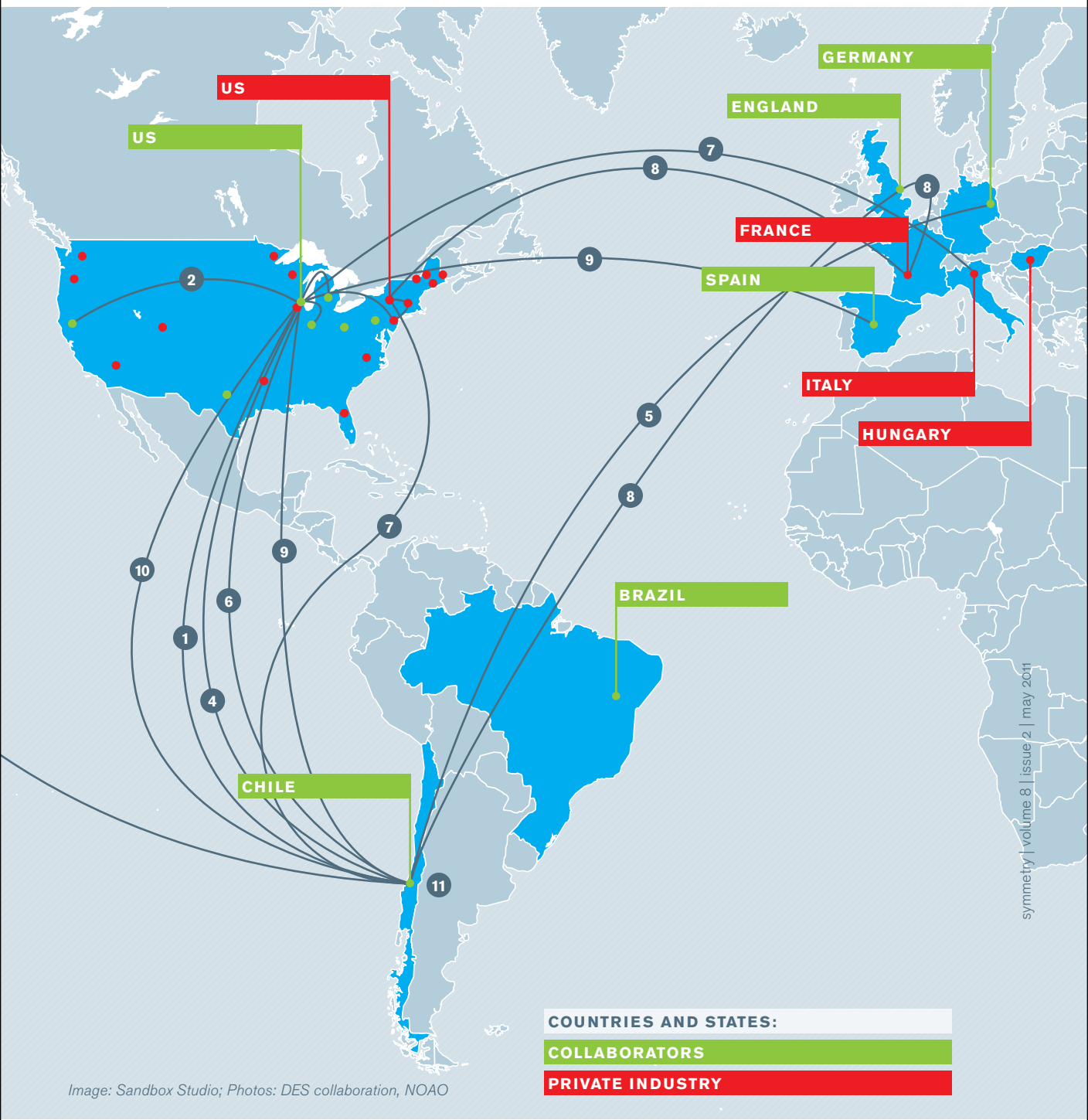


Image: Sandbox Studio; Photos: DES collaboration, NOAO