Spectrograph Team Awaits October Hubble Servicing Mission

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A $70 million instrument designed by the University of Colorado at Boulder that will be inserted on the Hubble Space Telescope during an October 2008 servicing mission should help astronomers better understand how galaxies, stars and planets evolved.

Known as the Cosmic Origins Spectrograph, the telephone booth-sized instrument is expected to help scientists untangle the mysteries of the "cosmic web" of material permeating the universe, said CU-Boulder Professor James Green, COS science team leader. Built primarily by Ball Aerospace & Technologies Corp. of Boulder, COS will gather information from ultraviolet light emanating from distant objects, allowing scientists to look back in time and space and reconstruct the physical condition and evolution of the early universe, said Green.

The COS team will use distant quasars as "flashlights" to track light as it passes through the cosmic web, believed to be made up of long, narrow filaments of galaxies and intergalactic gas separated by enormous voids, said Green. Light absorbed by material in the web should reveal "fingerprints" of matter like hydrogen, helium and heavier elements, allowing scientists to build up a picture of how the gases are distributed and how matter has changed over time as the universe has aged, he said.

"Our main science goal is to understand the large-scale structure of the universe," said Green. "This instrument can help us understand the composition of this cosmic web, including how galaxies like our own Milky Way formed and evolved over time."

The spectrograph will break light into its individual components -- similar to the way raindrops break sunlight into the colors of the rainbow -- revealing information about the temperature, density, velocity, distance and chemical composition of galaxies, stars and gas clouds. The COS instrument will peer back in time to 10 billion years ago when the first galaxies and chemical elements were forming, Green said.

COS will improve Hubble's ability to detect UV light in the universe by a factor of 10 over the previous Hubble instruments, said CU-Boulder Professor Michael Shull of CASA, a COS science team member. "There are hundreds or thousands of new targets in our sights that are just too faint to image with Hubble's other instruments," Shull said.

COS also will be used to detect young hot stars shrouded in the thick dust clouds they formed in, providing new information on star birth, said Shull. Scientists also will point COS at gas surrounding the outer planets of the solar system to glean new clues about planetary evolution, Shull said.

Although COS was completed in 2004, the servicing mission was put on hold and later canceled as a result of the 2003 Columbia space shuttle disaster before being resurrected in October 2006 by NASA. "I never completely lost faith that it would fly," said Green. "The opportunity to do great science was very clear to everyone in the astronomical community."

CU-Boulder researchers have a long heritage with the Hubble Space Telescope, said Green. CU-Boulder Professor Jack Brandt, now retired, was the science team leader for the high-resolution spectrograph on the orbiting telescope when it launched with worldwide fanfare in 1990. Dozens of other CU-Boulder astronomers also have participated in hundreds of observations using Hubble over the years.

Green and his COS science team, which is made up of 14 CU-Boulder scientists and engineers and 10 scientists from other institutions, have been allotted 552 orbits of observing time on Hubble. CU-Boulder's CASA is in the process of hiring several dozen postdoctoral researchers, graduate students and undergraduates to work on the project in the coming years, Green said.

The team will use "sight lines" between Hubble and quasars -- highly energetic objects thought to surround "supermassive" black holes -- to sample the light from the galaxies lying in between in order to better understand their evolution. By measuring abundances of the heavy elements in galaxies -- which likely formed during supernova explosions -- scientists can deduce the ages of such galaxies, Green said.

The instrument also will be used to study cold interstellar gas clouds, which contain a number of rare elements thought to have been produced by supernovae.

Other participating co-investigators on COS are from Ball Aerospace, the Southwest Research Institute in Boulder, the University of Wisconsin-Madison, the University of California, Berkeley, NASA's Goddard Space Flight Center in Greenbelt, Md., and the Space Telescope Science Institute in Baltimore, Green said.

Source: the University of Colorado