High-powered telescope designed to explore origins of universe moving toward 'first light'

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An effort to peer into the origins of the universe with the most effective instrument ever used in the effort is taking a big step forward, as Johns Hopkins University scientists begin shipping a two-story-tall microwave telescope to its base in Chile.

Pieces of the Cosmology Large Angular Scale Surveyor telescope—also known as CLASS—will soon be packed in a 40-foot container and sent south, as scientists get closer to taking observations of a faint, ancient electromagnetic energy that pervades the sky, holding clues about how the universe began.

Charles L. Bennett, professor of physics and astronomy and Johns Hopkins Gilman Scholar, is the project leader.

"It's going to be great to work our way toward first light," said Bennett, referring to the first telescope observations from Chile that are expected to be made this winter. "It's very exciting after 12 years" from the earliest discussions of the CLASS concept, he said.

"We're all excited that everything is coming together," added Tobias Marriage, an assistant professor in JHU's Department of Physics and Astronomy, who is co-leading the CLASS project alongside Bennett.

In early and mid-October, professors, post-doctoral researchers, and students working at the Bloomberg Center for Physics and Astronomy will pack two containers with pieces of the telescope built at Johns

Hopkins. The telescope is designed to detect subtle patterns in the cosmic microwave background, or CMB, a relic thermal energy of the hot infant universe more than 13 billion years old. By sea, highway, and dirt road, the telescope parts will take a six-week trek to an elevation of about 17,000 feet in the Atacama Desert in northern Chile.

Members of the Johns Hopkins team will then reassemble the telescope, which stands about 24 feet tall, fitting the base with one of four cylinders that contain detectors designed to receive the signal. In the next two years, three more cylinders will be mounted on two towers, enabling the instrument to detect four electromagnetic frequencies and improve the quality of the observations.

The number of frequencies is part of what makes the CLASS telescope the most powerful instrument yet trained on the cosmic microwave background. Discovered in 1964 by two Americans, who later shared a Nobel Prize for their work, the CMB has provided scientists with a wealth of information about the universe, Bennett said.

Because the radiation has taken billions of years to reach us, the CMB in effect captures a moment when the 13.77-billion-year-old universe was about 380,000 years old.

The CLASS project is meant to examine 70 percent of the sky—the most yet for a land-based instrument—for evidence of a polarization pattern in the cosmic microwave background. That evidence would test the prevailing hypothesis about how the universe expanded.

This notion, known as "inflation," holds that the universe began with quantum fluctuations—random changes in energy—in a space smaller than an atom within the first microsecond of the life of the universe.

If "inflation" advocates are correct, those quantum fluctuations created gravitational waves that left a fingerprint on the cosmic microwave background. The mark would appear as a pattern, or polarization, in this encompassing field of electromagnetic radiation.

Bennett has devoted much of his career to studying the cosmic microwave background, first as a NASA scientist, then at Johns Hopkins. He was on the science team for the Cosmic Background Explorer, a NASA satellite that measured the CMB in the early 1990s. Later he served as the principal investigator for the Wilkinson Microwave Anisotropy Probe, or WMAP, a NASA space mission that mapped the CMB.

CLASS goes another step further in instrumental capability to probe the history of the universe.

In speaking engagements, Bennett said, he is often asked how it is that scientists can know so much about the universe—its age; its expansion rate; and its makeup of dark energy, cold dark matter, and ordinary matter. In response he points to the object of his life's work, the cosmic microwave background.

"The answer is this radiation is how we can know all this," Bennett said. "The magic is that this radiation comes to us directly from the early universe and we can look at it, effectively providing us a time machine."

Provided by Johns Hopkins University