Galaxies detected by their “shadows”

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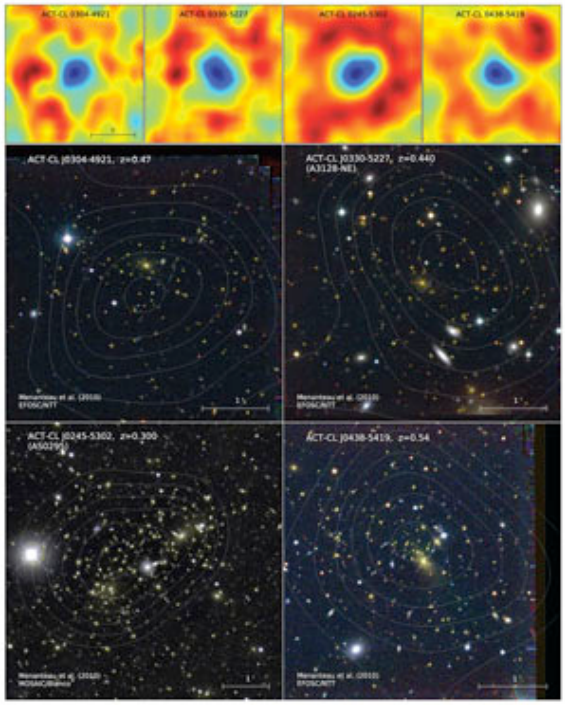
Courtesy of Rutgers
and World Science staff

Astronomers have reported finding 10 huge new clusters of galaxies using a new method that detects their “shadows” on the background light that permeates the universe.

This so-called microwave background radiation, too low-energy to be visible to the unaided eye, is thought to be a leftover glow from the “Big Bang,” a sort of explosion that gave birth to the cosmos.



Top row: four Atacama Cosmology Telescope images of cosmic background radiation, with dark blue indicating "shadows" cast by galaxy clusters. Below, four visible-light pictures of the galaxy clusters. Faint white contour lines (clearer in the full-page image here) correspond to the cosmic background radiation intensity levels in the top-row images. (Credits: top row: Tobias Marriage, Johns Hopkins / Princeton; bottom grid: Felipe Menanteau, Rutgers)

The investigation of the galaxies began in 2008 with a new radio telescope in northern Chile’s Atacama Desert – one of the driest places on Earth. The instrument, known as the Atacama Cosmology Telescope, collects millimeter-length radio waves that reveal images of the background radiation. These radio waves are easily blocked by water vapor, hence the telescope’s home high in the Andes Mountains.

“The groundbreaking observations at Atacama, led by Lyman Page of Princeton University, surveyed large areas of the [Southern] sky to reveal shadows that pointed astronomers to these previously unseen massive galaxy clusters,” said Felipe Menanteau, a research scientist at Rutgers University in New Jersey.

Yale University cosmologist Priyamvada Natarajan, who wasn’t involved with the study, said “it will build our inventory of the most massive and distant clusters in the universe,” which will help scientists better understand how the universe was born and changes.

In a paper published in the Nov. 10 issue of *Astrophysical Journal*, the investigators described visual telescope observations of these galaxy clusters, considered essential to verify the “shadow” sightings.
Physicists Rashid Sunyaev and Yakov Zel’dovich predicted the shadow phenomenon 40 years ago,

now known as the Sunyaev-Zel'dovich effect. Astronomers later verified it by finding shadows cast by previously known galaxy clusters. The new radio telescope now makes it practical for astronomers to essentially reverse the procedure – to search the cosmic background radiation for shadows that indicate the presence of unseen clusters.

The "shadows" that the instrument revealed "are not shadows in the traditional sense, as they are not caused by the galaxy clusters blocking light from another source," said Rutgers astronomer Jack Hughes, who participated in the new work. "Rather, the hot gases within the galaxy clusters cause a tiny fraction of the cosmic background radiation to shift to higher energies."

Cosmic background radiation was first observed by two Bell Labs astronomers in New Jersey back in the 1960s, a discovery that earned them the Nobel Prize in Physics in 1978.