Researchers discover association of gas-rich galaxies near the infancy of cosmic time

February 18 2014, by Blaine Friedlander

Image credit: Hubble/NASA

(Phys.org) —Squinting close to the beginning of time, Dominik Riechers, Cornell assistant professor of astronomy, has discovered an association of gas-rich galaxies near the infancy of cosmic time. It's an early epoch – some 12.7 billion years ago – telling a tale that revolves around an exceptionally dusty galaxy called AzTEC-3.

This massive galaxy is the second-most-distant one of its kind known to humanity, Riechers announced at a Feb. 16 lecture at the American Association for the Advancement of Science (AAAS) annual meeting in Chicago.

"AzTEC-3 is a massive galaxy that already contains billions of stars at

this early epoch, but has the potential to form many more by present day. It produces a thousand times more stars each year than what our own Milky Way galaxy produces," said Riechers. "Think about a star factory that puts out 50 billion objects the mass of our sun."

The Milky Way galaxy – our own cosmic neighborhood – forms one star the mass of Earth's own sun each year, said Riechers. AzTEC-3 produces about five of our suns each Earth day, churning out a total of 1,800 solar masses annually. Such ancient massive star-bursting galaxies can be found by astronomers using modern, mountaintop telescopes like the National Science Foundation-funded Atacama Large Millimeter/submillimeter Array (ALMA) telescope in Chile.

"These things are just humongous," said Riechers. "That's why we call them 'monsters.' Essentially, thanks to telescopes like the ALMA, we're looking back in time to the childhood, the toddler years of the universe, and are trying to discern how these galaxies form."

This exceptional AzTEC-3 galaxy, which at present day is only slightly younger than the 13.8 billion-year-old universe, is named after the AzTEC-millimeter-wave camera on the James Clerk Maxwell Telescope – through which it was initially found. Subsequent observations with the W.M. Keck Observatory, Mauna Kea, Hawaii; the IRAM Plateau de Bure interferometer, in the French Alps; and the Karl G. Jansky Very Large Array, Socorro, N.M., were necessary to identify it as an extremely distant object.

For Riechers' study ALMA was used to obtain a sharp image of the gas and dust inside the galaxy.

Sifting through the gas and dust, Riechers and other astronomers are learning to grasp how molecular gas plays a central role in "these often heavily obscured systems," he said. "[The gas] represents the material

from which these stars or solar masses form. We are examining how the mass, distribution, excitation and dynamics of the gas provide crucial insight into the physical processes that support the ongoing star formation and stellar mass buildup."

While astronomers once needed days and days of telescope time to layer images and detect galaxies, "with the more sensitive ALMA, we can slice through cosmic gas and dust – and find these massive star bursts instantly," Riechers said. "We are finally seeing the cosmos in high definition at these submillimeter wavelengths. It's just amazing."

Given the enormous sensitivity of ALMA, these observations also provide sharp images of the star-forming gas in a number of galaxies at the same distance as AzTEC-3, but these galaxies form stars at about 100 times lower rates. The high density of such objects close to such a massive star factory suggest that we are witnessing a massive cluster of galaxies in an early stage of formation.

Provided by Cornell University