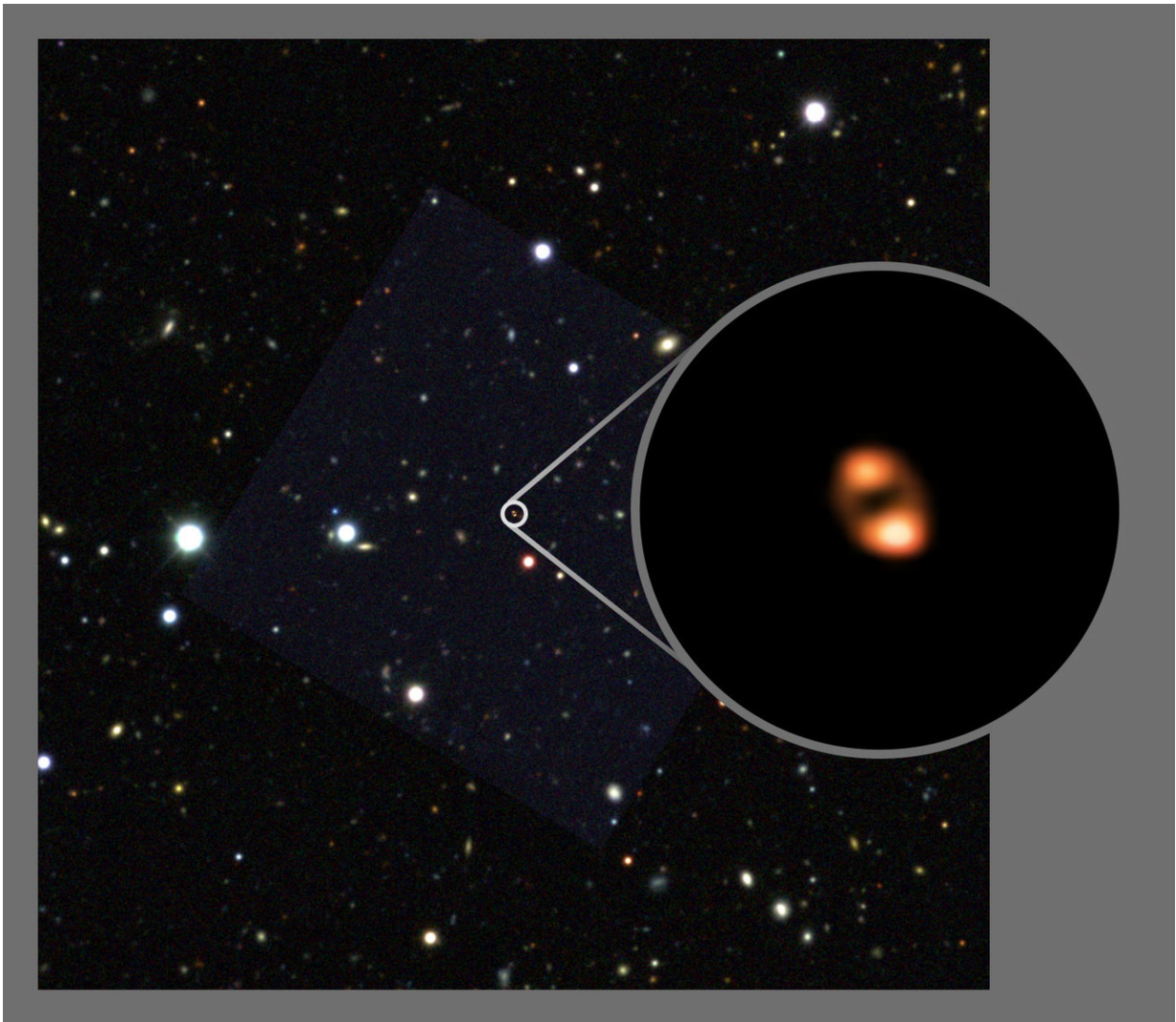


# Galactic 'wind' stifling star formation is most distant yet seen

September 6 2018

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ALMA, aided by a gravitational lens, imaged the outflow, or 'wind,' from a galaxy seen when the universe was only one billion years old. The ALMA image (circle call out) shows the location of hydroxyl (OH) molecules. These molecules

trace the location of star-forming gas as it is fleeing the galaxy, driven by either supernovas or a black-hole powered 'wind.' The background star field (Blanco Telescope Dark Energy Survey) shows the location of the galaxy. The circular, double-lobe shape of the distant galaxy is due to the distortion caused by the cosmic magnifying effect of an intervening galaxy. Credit: ALMA (ESO/NAOJ/NRAO), J. Spilker/UT-Austin; NRAO/AUI/NSF, S. Dagnello; AURA/NSF

For the first time, a powerful "wind" of molecules has been detected in a galaxy located 12 billion light-years away. Probing a time when the universe was less than 10 percent of its current age, University of Texas at Austin astronomer Justin Spilker's research sheds light on how the earliest galaxies regulated the birth of stars to keep from blowing themselves apart. The research will appear in the Sept. 7 issue of the journal *Science*.

"Galaxies are complicated, messy beasts, and we think outflows and winds are critical pieces to how they form and evolve, regulating their ability to grow," Spilker said.

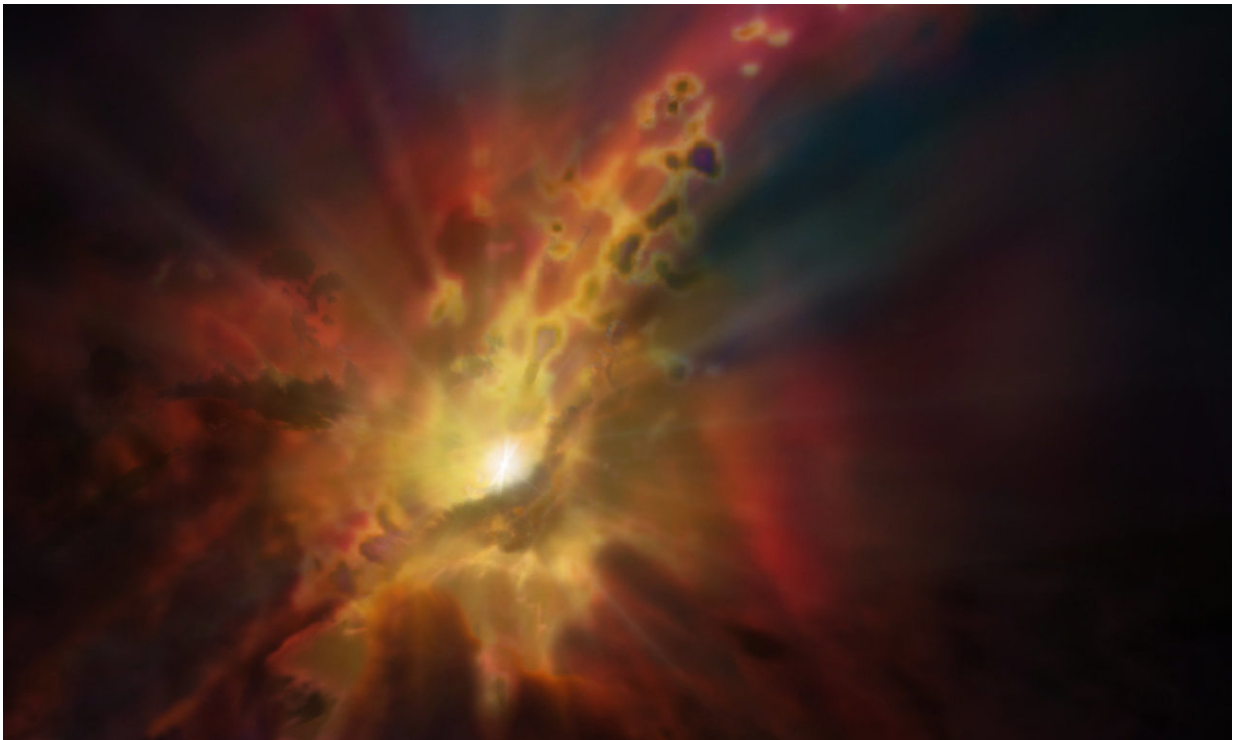
Some galaxies such as the Milky Way and Andromeda have relatively slow and measured rates of starbirth, with about one new star igniting each year. Other galaxies, known as starburst galaxies, forge hundreds or even thousands of [stars](#) each year. This furious pace, however, cannot be maintained indefinitely.

To avoid burning out in a short-lived blaze of glory, some galaxies throttle back their runaway starbirth by ejecting—at least temporarily—vast stores of gas into their expansive halos, where the gas either escapes entirely or slowly rains back in on the galaxy, triggering future bursts of star formation.

Until now, however, astronomers have been unable to directly observe these powerful outflows in the very early universe, where such mechanisms are essential to prevent galaxies from growing too big, too fast.

Spilker's observations with the Atacama Large Millimeter/submillimeter Array (ALMA), show—for the first time—a powerful galactic wind of molecules in a galaxy seen when the universe was only 1 billion years old. This result provides insights into how certain galaxies in the early universe were able to self-regulate their growth so they could continue forming stars across cosmic time.

Astronomers have observed winds with the same size, speed and mass in nearby starbursting galaxies, but the new ALMA observation is the most distant unambiguous outflow ever seen in the [early universe](#).



An artist impression of an outflow of molecular gas from an active star-forming galaxy. Credit: NRAO/AUI/NSF, D. Berry

The galaxy, known as SPT2319-55, is more than 12 billion light-years away. It was discovered by the National Science Foundation's South Pole Telescope.

ALMA was able to observe this object at such tremendous distance with the aid of a gravitational lens provided by a different galaxy that sits almost exactly along the line of sight between Earth and SPT2319-55. Gravitational lensing—the bending of light due to gravity—magnifies the background galaxy to make it appear brighter, which allows the astronomers to observe it in more detail than they would otherwise be able to. Astronomers use specialized computer programs to unscramble the effects of gravitational lensing to reconstruct an accurate image of the more-distant object.

This lens-aided view revealed a powerful wind of star-forming gas exiting the galaxy at nearly 800 kilometers per second. Rather than a constant, gentle breeze, the [wind](#) is hurtling away in discrete clumps, removing the star-forming gas just as quickly as the galaxy can turn that gas into new stars.

The outflow was detected by the millimeter-wavelength signature of a molecule called hydroxyl (OH), which appeared as an absorption line: essentially, the shadow of an OH fingerprint in the galaxy's bright infrared light.

Molecular winds are an efficient way for galaxies to self-regulate their growth, the researchers note. These winds are probably triggered by either the combined effects of all the supernova explosions that go along

with rapid, massive star formation, or by a powerful release of energy as some of the gas in the galaxy falls down onto the supermassive black hole at its center.

"So far, we have only observed one galaxy at such a remarkable cosmic distance, but we'd like to know if winds like these are also present in other galaxies to see just how common they are," Spilker concluded. "If they occur in basically every galaxy, we know that molecular winds are both ubiquitous and also a really common way for [galaxies](#) to self-regulate their growth."

This research is presented in a paper titled "Fast Molecular Outflow from a Dusty Star-Forming Galaxy in the Early Universe," by J.S. Spilker et al. in the journal *Science*.

**More information:** J.S. Spilker et al., "Fast molecular outflow from a dusty star-forming galaxy in the early Universe," *Science* (2018). [science.sciencemag.org/cgi/doi ... 1126/science.aap8900](https://science.sciencemag.org/cgi/doi/10.1126/science.aap8900)

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