

NEWS ASTRONOMY

The oldest disk galaxy yet found formed more than 12 billion years ago

This newly described galaxy was in place just 1.5 billion years after the Big Bang



A galaxy called the Wolfe Disk (shown in this artist's illustration) shines its light from just 1.5 billion years after the Big Bang.

S. DAGNELLO/NRAO, AUI, NSF

By **Lisa Grossman**

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The oldest disk-shaped galaxy ever spotted formed just 1.5 billion years after the Big Bang, a new study finds.

That's much earlier than astronomers thought that this type of galaxy could form. Previous observations show that disk-shaped galaxies — including sprawling, spiral systems like the Milky [Way](#) — didn't show up in large numbers until between 3 billion and 4 billion years after the Big Bang, which occurred about 13.8 billion years ago.

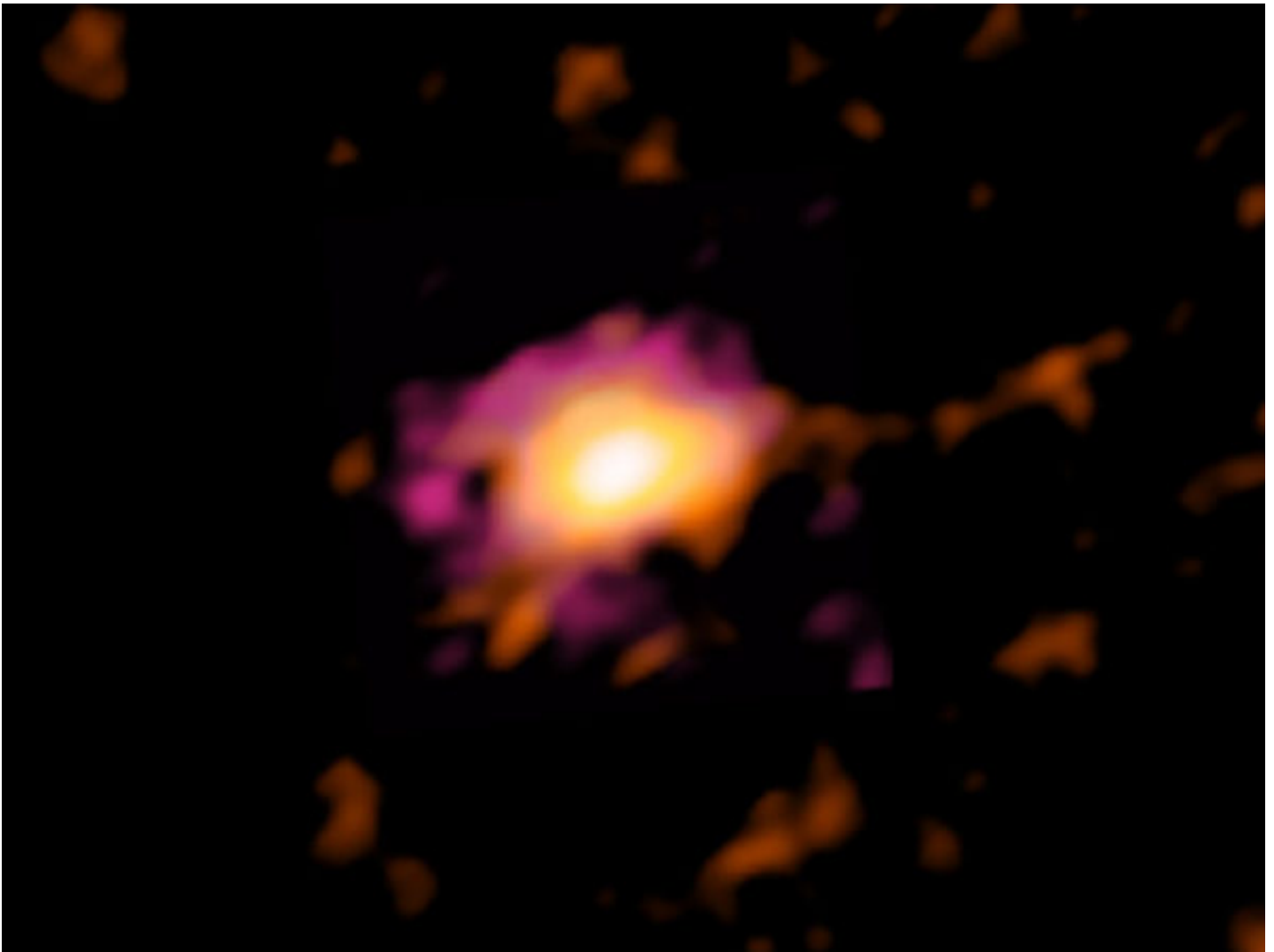
This precocious galaxy's existence suggests that massive spiral galaxies like the Milky Way [can grow up relatively quickly](#), astronomers report in the May 21 *Nature*.

By showing that a disk galaxy could form so early in the universe's history, the new study "challenges the accepted paradigm for how disk galaxies form and evolve in the universe," says astrophysicist Rachel Somerville of the Flatiron Institute in New York [City](#), who was not involved in the study.

The earliest galaxies probably were made when [clumps of invisible dark matter](#) pulled in surrounding gas and dust, forming stars and eventually creating galaxies that were round and blobby, observations and computer simulations suggest (*SN: 1/26/18*). Theorists reason that assembling those early galaxies was a violent process that scrambled and heated gas. Since hot gas expands, the idea goes, the first galaxies were spherical blobs because they were too hot for the gas to settle into a disk. Only when gas has had lots and lots of time to cool off could it [collapse into bright starry disk galaxies](#) (*SN: 9/3/18*), researchers thought.

In the last 15 years, however, computer simulations have showed that cold streams of gas could sneak into ancient, blobby galaxies, potentially making it easier for disk galaxies to arise more quickly.

To see if that process, called the cold accretion method, actually occurs in the universe, astronomer Marcel Neeleman and colleagues sought the earliest disk galaxies they could find. Most early galaxies are too far away and thus too faint for Earth-based telescopes to catch light from their stars. But sensitive radio telescopes can detect light from even more distant quasars — blazing, white-hot disks surrounding supermassive black holes — [filtering through the galaxies' gas](#) (*SN: 7/12/18*). A bright quasar behind the early disk galaxy, called DLA0817g, let it show up in silhouette, revealing the galaxy's contents and structure.



The oldest disk galaxy ever spotted (shown in radio waves) was seen with the ALMA radio telescope in Chile.

M. NEELEMAN, ESO, NAOJ, ALMA, S. DAGNELLO/NRAO, AUI, NSF

Neeleman, of the Max Planck Institute for Astronomy in Heidelberg, Germany, and his colleagues [first saw hints of DLA0817g](#) using the Atacama Large Millimeter/submillimeter Array in Chile, the team reported in 2017. Follow-up observations in 2019 showed that the galaxy is rotating like a record: Half of the galaxy's gas is moving away from Earth, and half is moving toward us. That motion is a sure sign that the galaxy is a cold, flat rotating disk, and likely has a spiral shape, the scientists say.

The galaxy is also massive, at least 72 billion times the mass of the sun. [Behemoth galaxies have been spotted](#) in the early universe before (SN: 8/7/19). Growing a massive galaxy of any shape so quickly "is challenging enough," says astronomer and study coauthor J. Xavier Prochaska of the University of California, Santa Cruz. "But the shocker is to see one in a nice spiral disk."

The team unofficially named the galaxy the Wolfe Disk after astrophysicist Arthur Wolfe of the University of California, San Diego, [who died in 2014](#). Wolfe was one of the first to suggest that disk galaxies existed in the universe's infancy, to widespread skepticism, says Prochaska, who was one of Wolfe's Ph.D. students.

"He was right, at least partially," Prochaska says. "He deserves credit for having planted that flag against all conventional wisdom."

CITATIONS

M. Neeleman et al. [A cold, massive, rotating disk galaxy 1.5 billion years after the Big Bang](#). *Nature*. Vol. 581, May 21, 2020, p. 269. doi: 10.1038/s41586-020-2276-y.

M. Neeleman et al. [\[C II\] 158- \$\mu\text{m}\$ emission from the host galaxies of damped Lyman-alpha systems](#). *Science*. Vol. 355, March 24, 2017, p. 1285. doi: 10.1126/science.aal1737.