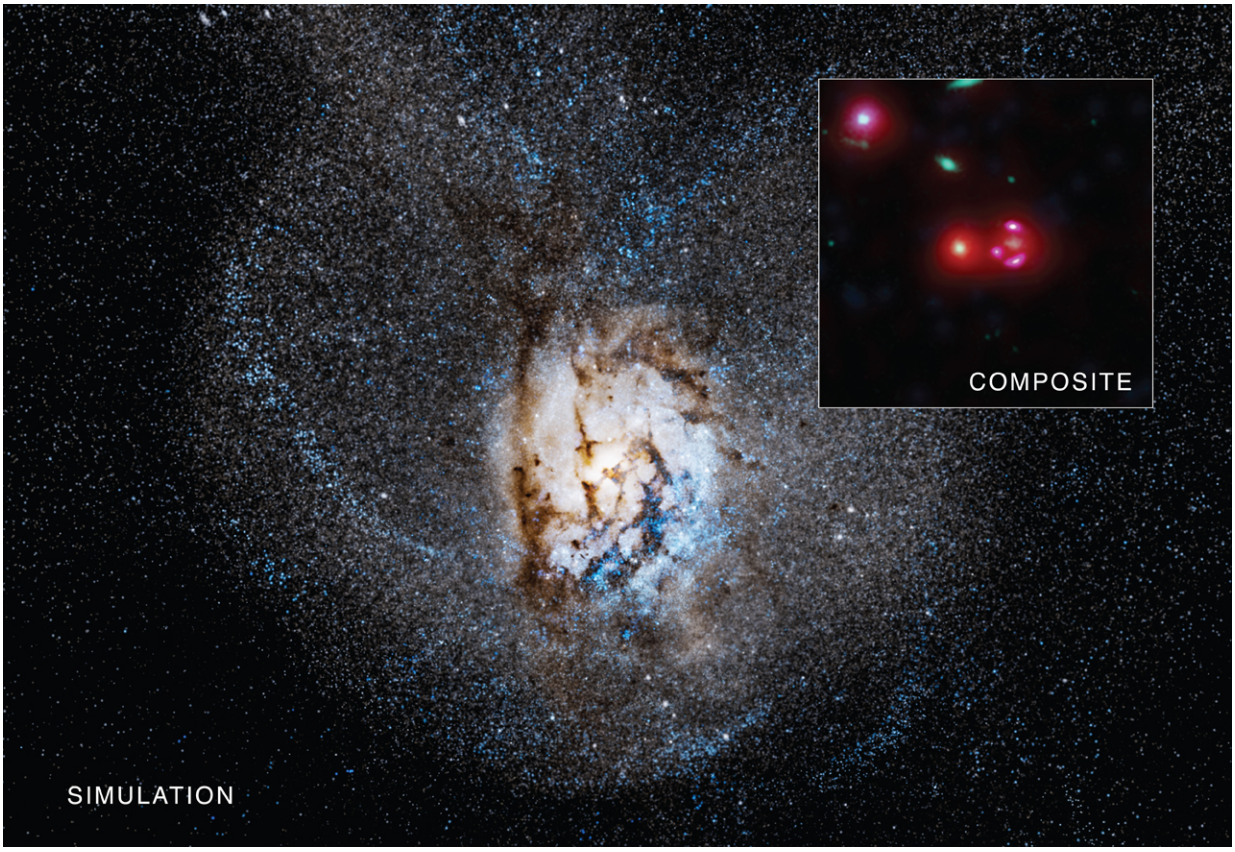
Under construction: Distant galaxy churning out stars at remarkable rate

December 8 2016, by Megan Watzke



This graphic shows a frame from a computer simulation (main image) and astronomical data (inset) of a distant galaxy undergoing an extraordinary construction boom of star formation, as described in our press release. The galaxy, known as SPT0346-52, is 12.7 billion light years from Earth. This means that astronomers are observing it at a critical stage in the evolution of galaxies, about a billion years after the Big Bang. Credit: X-ray: NASA/CXC/Univ of Florida/J.Ma et al; Optical: NASA/STScI; Infrared: NASA/JPL-Caltech; Radio: ESO/NAOJ/NRAO/ALMA; Simulation: Simons Fdn./Moore Fdn./Flatiron

Inst./Caltech/C. Hayward & P. Hopkins

Astronomers have used NASA's Chandra X-ray Observatory and other telescopes to show that a recently-discovered galaxy is undergoing an extraordinary boom of stellar construction. The galaxy is 12.7 billion light years from Earth, seen at a critical stage in the evolution of galaxies about a billion years after the Big Bang.

After astronomers discovered the galaxy, known as SPT 0346-52, with the National Science Foundation's South Pole Telescope (SPT), they observed it with several space and other ground-based telescopes. Data from the international Atacama Large Millimeter/submillimeter Array (ALMA) previously revealed extremely bright infrared emission, suggesting that the galaxy is undergoing a tremendous burst of star birth.

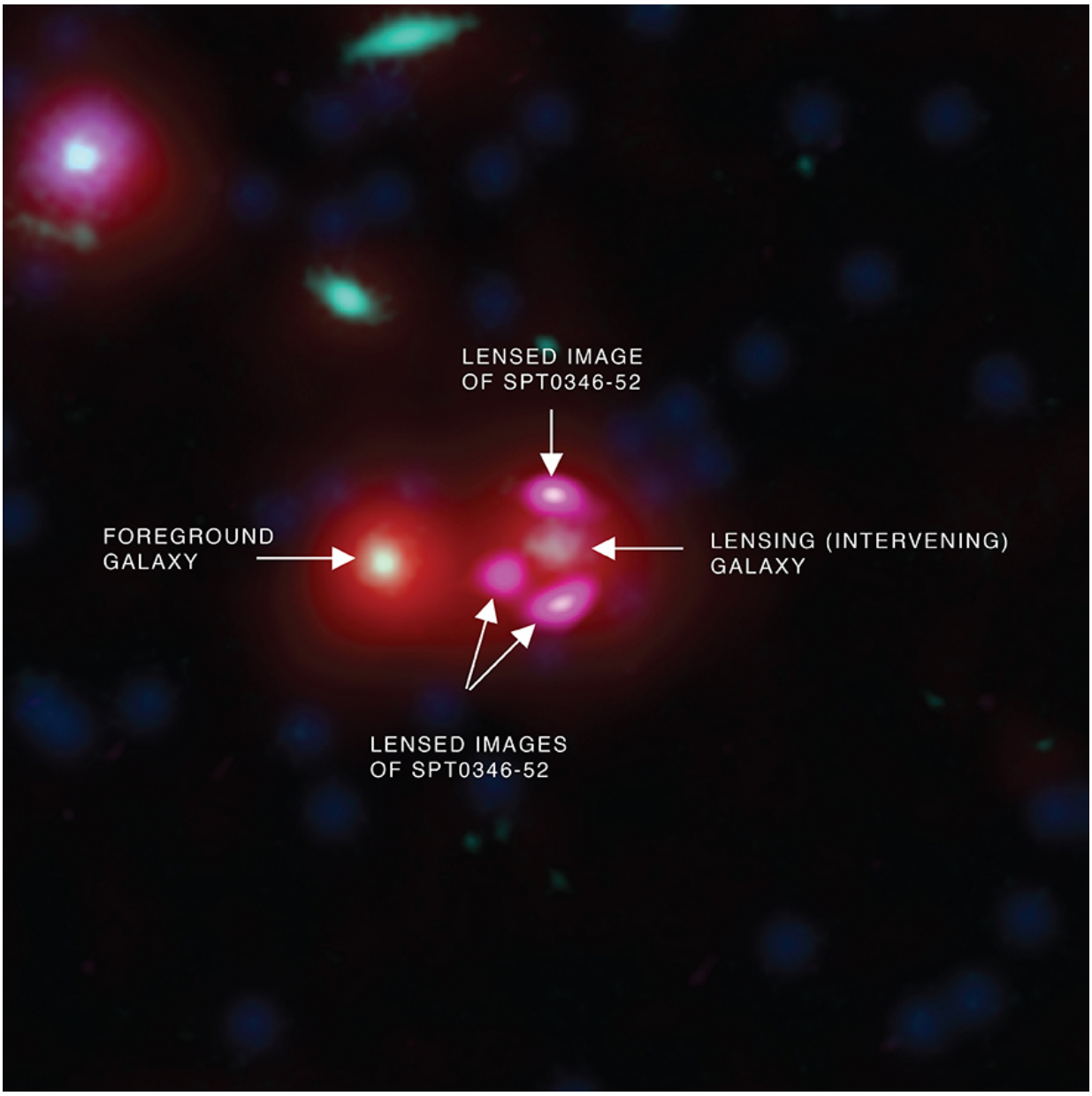
However, an alternative explanation remained: Was much of the infrared emission instead caused by a rapidly growing supermassive black hole at the galaxy's center? Gas falling towards the black hole would become much hotter and brighter, causing surrounding dust and gas to glow in infrared light. To explore this possibility, researchers used NASA's Chandra X-ray Observatory and CSIRO's Australia Telescope Compact Array, a radio telescope.

No X-rays or radio waves were detected, so astronomers were able to rule out a black hole being responsible for most of the bright infrared light.

"We now know that this galaxy doesn't have a gorging black hole, but instead is shining brightly with the light from newborn stars," said Jingzhe Ma of the University of Florida in Gainesville, Florida, who led the new study. "This gives us information about how galaxies and the

stars within them evolve during some of the earliest times in the Universe."

Stars are forming at a rate of about 4,500 times the mass of the Sun every year in SPT0346-52, one of the highest rates seen in a galaxy. This is in contrast to a galaxy like the Milky Way that only forms about one solar mass of new stars per year.



Credit: X-ray: NASA/CXC/Univ of Florida/J.Ma et al; Optical: NASA/STScI; Infrared: NASA/JPL-Caltech; Radio: ESO/NAOJ/NRAO/ALMA; Simulation: Simons Fdn./Moore Fdn./Flatiron Inst./Caltech/C. Hayward & P. Hopkins

"Astronomers call galaxies with lots of star formation 'starburst' galaxies," said co-author Anthony Gonzalez, also of the University of Florida. "That term doesn't seem to do this galaxy justice, so we are calling it a 'hyper-starburst' galaxy."

The high rate of star formation implies that a large reservoir of cool gas in the galaxy is being converted into stars with unusually high efficiency.

Astronomers hope that by studying more galaxies like SPT0346-52 they will learn more about the formation and growth of massive galaxies and the supermassive black holes at their centers.

"For decades, astronomers have known that supermassive black holes and the stars in their host galaxies grow together," said co-author Joaquin Vieira of the University of Illinois at Urbana-Champaign. "Exactly why they do this is still a mystery. SPT0346-52 is interesting because we have observed an incredible burst of stars forming, and yet found no evidence for a growing supermassive black hole. We would really like to study this galaxy in greater detail and understand what triggered the star formation and how that affects the growth of the black hole."

SPT0346-52 is part of a population of strong gravitationally-lensed galaxies discovered with the SPT. SPT0346-52 appears about six times brighter than it would without gravitational lensing, which enables astronomers to see more details than would otherwise be possible.

A paper describing these results appears in a recent issue of The *Astrophysical Journal*.

More information: Jingzhe Ma et al. SPT0346-52: NEGLIGIBLE AGN ACTIVITY IN A COMPACT, HYPER-STARBURST GALAXY AT= 5.7, *The Astrophysical Journal* (2016). DOI: 10.3847/0004-637X/832/2/114 , arxiv.org/abs/1609.08553

Provided by Chandra X-ray Center