Bend it like Einstein: Astronomers turn galaxies into magnifiers

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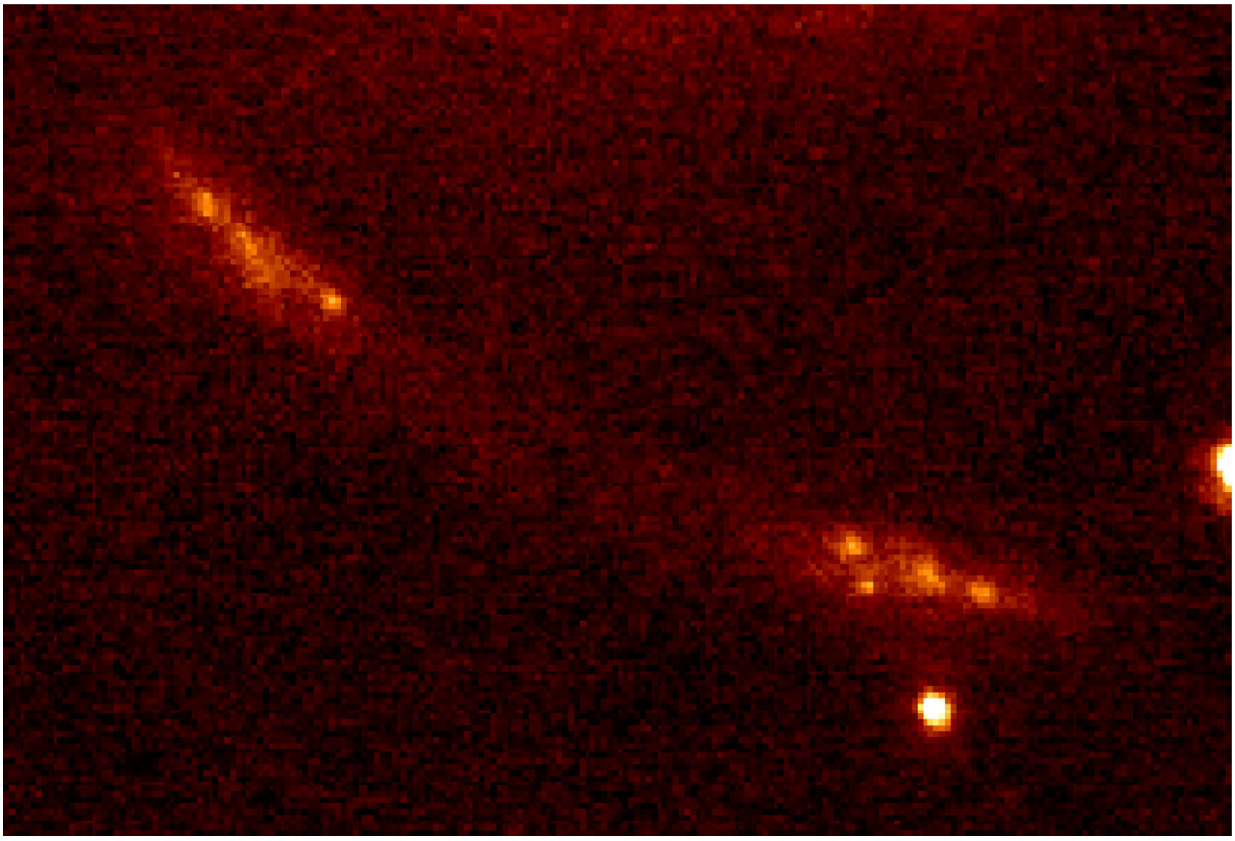

Credit: Science in Public

Astronomers have turned a cluster of galaxies into a gargantuan magnifying lens, using it to study another galaxy, 10.7 billion light years away, in unprecedented detail.

Taking advantage of a phenomenon known as "gravitational lensing," the team of scientists, led by NASA Goddard Space Flight Centre scientist Dr. Soniya Sharma, identified star forming regions in the distant and ancient galaxy.

The research was funded by Australia's ARC Centre of Excellence in All Sky Astrophysics in 3 Dimensions (ASTRO 3D), and will be of direct benefit to NASA's next orbiting observer.

Without the use of the massive magnifying effect, the galaxy, dubbed cswa128, would be a tiny blur to even the most powerful telescopes on Earth. With it, the astronomers can see stars being formed just three billion years after the Big Bang.

"Our 'lens' is a cluster of galaxies roughly 3.3 billion light years away," explained Dr. Sharma.

"The cluster is so huge that its gravity actually bends light, turning it into a sort of magnifying glass. The effect makes cswa128, which lies behind it and seven billion light years further away, appear much larger than it otherwise would from Earth.

"In fact, the galaxy appears about 10 times bigger. We can clearly see bright lights in clumps, which are tell-tale signs of stellar nurseries—parts of the galaxy that are making new stars."

The first formal prediction that light would bend around a massive object and magnify distant things was made by Albert Einstein in his General Theory of Relativity. Its confirmation during a solar eclipse in 1919 rocketed him to fame.

The idea lensing can operate on a galactic scale was demonstrated in 1979. Today, it is Dr. Sharma's stock in trade.

Her team's current research—published in the journal *Monthly Notices of the Royal Astronomical Society*—marks a significant leap forward in the field. The scientists developed a sophisticated algorithm to accurately interpret the spectroscopic information for the target galaxy captured by the WM Keck Observatory in Hawaii.

"This magnifying phenomenon of nature comes at a cost," said co-author and former ASTRO 3D researcher Dr. Tiantian Yuan.

"The enlarged images are stretched and distorted. Using the algorithm meant we were able to recover the true shape of the distant galaxy. We also found that it contains twice as many star-forming areas than previously reported."

Professor Lisa Kewley, director of ASTRO 3D, added: "This new algorithm allows lensed galaxies to be reconstructed at much finer detail than ever before. It is like taking a dusty magnifying glass, cleaning it, and seeing a much clearer picture."

The success of the current research project is of particular importance to NASA.

"The algorithm we've developed will be used in interpreting the lensed galaxy observations to be conducted using the new James Webb Space Telescope, set for launch later this year," said Dr. Sharma.

"It will help in the mission to interpret the mechanism that governs how stars are made, and thus how galaxies evolve and form in the universe."

More information: Soniya Sharma et al, Resolving star-forming clumps in a z ~ 2 lensed galaxy: a pixelated Bayesian approach, *Monthly Notices of the Royal Astronomical Society: Letters* (2021). DOI: 10.1093/mnrasl/slab040