

Planet-forming lifeline discovered in a binary star system

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This artist's impression shows the dust and gas around the double star system GG Tauri-A. Researchers using ALMA have detected gas in the region between two discs in this binary system. This may allow planets to form in the gravitationally perturbed environment of the binary. Half of Sun-like stars are born in binary systems, meaning that these findings will have major consequences for the hunt for exoplanets. Credit: ESO/L. Calçada

Scientists using the Atacama Large Millimeter/submillimeter Array (ALMA) have detected a streamer of dust and gas flowing from a massive outer disk toward the inner reaches of a binary star system. This

never-before-seen feature may be responsible for sustaining a second, smaller disk of planet-forming material that otherwise would have disappeared long ago.

A research group led by Anne Dutrey from the Laboratory of Astrophysics of Bordeaux, France, and the National Centre for Scientific Research (CNRS) observed the distribution of dust and gas in a [binary star](#) system called GG Tau-A. It was recently discovered that one of GG Tau-A's components is itself a double star. This object is only a few million years old and lies approximately 460 light-years from Earth in the constellation Taurus.

Like a wheel in a wheel, GG Tau-A contains a large, outer disk encircling the entire system as well as an inner disk around the main central star. This second inner disk has a mass roughly equivalent to that of Jupiter. Its presence has been an intriguing mystery for astronomers since it is losing material to its central star at a rate that should have depleted it long ago.

While observing these structures with ALMA, the team made the exciting discovery of gas clumps in the region between the two disks. The new observations suggest that material is being transferred from the outer to the inner disk, creating a sustaining lifeline between the two.

"Material flowing through the cavity was predicted by computer simulations but never imaged before. Detecting these clumps indicates that material is moving between the disks, allowing one to feed off the other," explains Dutrey. "These observations demonstrate that material from the outer disk can sustain the inner disk for a long time. This has major consequences for potential planet formation."

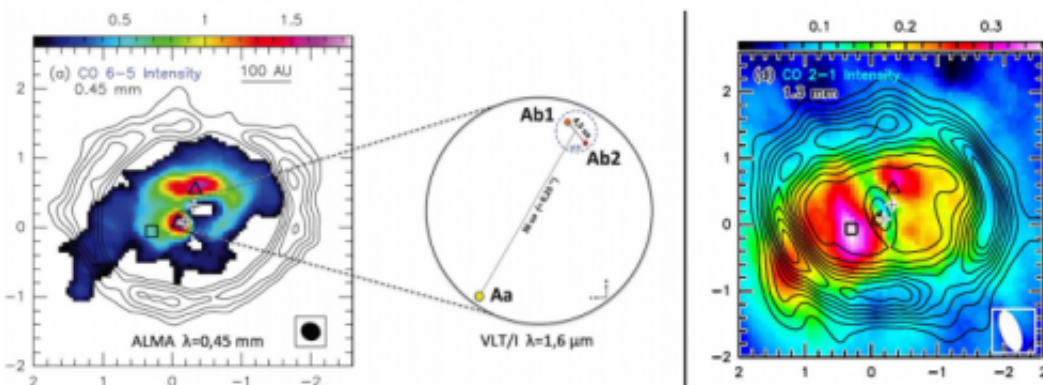
Planets are born from the material left over from star birth. This is a slow process, meaning that an enduring disk is needed for [planet](#)

[formation](#). If this same feeding process occurs in other multiple-star systems, these observations may explain the frequency with which planets have been and continue to be discovered in binary systems.

"We may be witnessing these types of exoplanetary systems in the midst of formation," said Jeffrey Bary, an astronomer at Colgate University in Hamilton, N.Y., and co-author of the paper. "In a sense, we are learning why these seemingly strange systems exist."

The first phase of exoplanet searches was directed at single host-stars like the Sun, more recently it has been shown that a large fraction of giant planets orbit binary star systems. Now, researchers have begun to take an even closer look and investigate the possibility of planets orbiting individual stars of multiple-star systems. The new discovery supports the possible existence of such planets, marking a new era in the hunt for exoplanets.

"This means that [multiple star systems](#) have a way to form planets, despite their complicated dynamics. Given that we continue to find interesting planetary systems, our observations provide a glimpse of the mechanisms that enable such systems to form," concludes Bary.



Images obtained by ALMA (left) and the IRAM interferometer (right) showing emissions of gas (CO) and dust around the triple star system GG Tau A. Dust emission is shown as black contours, gas emission in color. The central panel shows the position of the three stars observed with the VLT1 (ESO).
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This research was presented in a paper titled "Planet formation in the young, low-mass multiple stellar system GG Tau-A" by A. Dutrey et al., to appear in the journal *Nature* on 30 October 2014.

More information: Anne Dutrey, Emmanuel Di Folco, Stéphane Guilloteau, Yann Boehler, Jeff Bary, Tracy Beck, Hervé Beust, Edwige Chapillon, Frédéric Gueth, Jean-Marc Huré, Arnaud Pierens, Vincent Piétu, Michal Simon, Ya-Wen Tang. "Possible planet formation in the young, low-mass, multiple stellar system GG Tau A". *Nature*, 2014; 514 (7524): 600, [DOI: 10.1038/nature13822](https://doi.org/10.1038/nature13822)

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