Signs of the formation of a planetary system around the star HD169142

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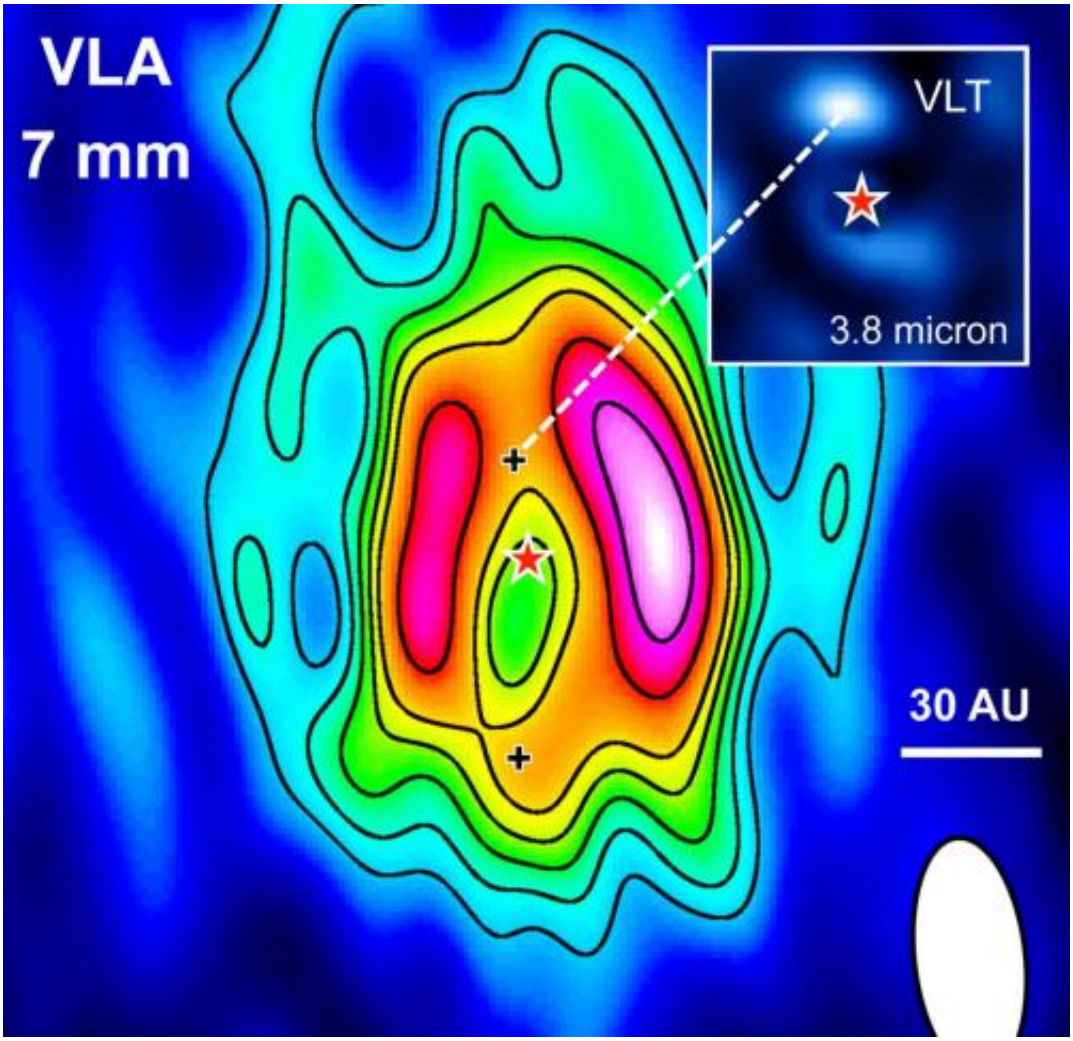

Image at 7 mm wavelength of the dusty disk around the star HD 169142 obtained with the Very Large Array (VLA) at 7 mm wavelength. The positions of the protoplanet candidates are marked with plus signs (+) (Osorio et al. 2014, ApJ, 791, L36). The insert in the upper right corner shows, at the same scale, the bright infrared source in the inner disk cavity, as observed with the Very Large

Telescope (VLT) at 3.8 micron wavelength (Reggiani et al. 2014, ApJ, 792, L23).

Planets are formed from disks of gas and dust that orbit around young stars. Once the "seed" of the planet —composed of a small aggregate of dust— is formed, it will continue to gather material and it will carve out a cavity or gap in the disk along its orbital path.

This transitional stage between the original disk and the planetary system, difficult to study and as yet little known, is precisely what has been observed in the star HD169142 and is discussed in two articles published in The *Astrophysical Journal Letters*.

"Although in recent years more than seventeen hundred extrasolar planets have been discovered, few of them have been directly imaged, and so far we have never been able to capture an unequivocal image of an still-forming planet", says Mayra Osorio, researcher at the Institute of Astrophysics of Andalusia (IAA-CSIC) heading one of the articles. "In HD 169142 we may be seeing indeed those seeds of gas and dust which will later become planets."

HD169142 is a young star with twice the mass of the Sun and whose disk extends up to two hundred and fifty astronomical units (an astronomical unit, or AU, is a unit equivalent to the distance between the Sun and the Earth: one hundred and fifty million kilometers). The system is in an optimal orientation for the study of planet formation because the disk is seen face-on.

The first article explores the disk of HD169142 with the Very Large Array radio telescope, which can detect centimeter-sized dust grains. The results, combined with infrared data which trace the presence of

microscopic dust, reveal two gaps in the disk, one in the inner region (between 0.7 and 20 AU) and another, farther out and less developed, between 30 and 70 AU.

"This structure already suggested that the disk was being modified by two planets or sub-stellar objects, but, additionally, the radio data reveal the existence of a clump of material within the external gap, located approximately at the distance of Neptune's orbit, which points to the existence of a forming planet", says Mayra Osorio (IAA-CSIC).

One (or two) companions around HD169142

The second study focused on searching for infrared sources in the gaps of the disk, using the Very Large Telescope. They found a bright signal in the inner gap, which could correspond to a still-forming planet or to a young brown dwarf (a sort of failed star that never reached the threshold mass to trigger the nuclear reactions characteristic of stars).

Infrared data did not, however, corroborate the presence of an object in the outer gap as radio observations suggested. This non detection could be due to technical limitations: the researchers have calculated that an object with a mass between one tenth and 18 times the Jupiter's mass surrounded by a cold envelope may well remain undetected at the observed wavelength.

"In future observations we will be able to verify whether the disk harbors one or two objects. In any case, HD 169142 remains as a promising object since it is one of the few known transitional disks and it is revealing to us the environment where planets are formed", says Mayra Osorio (IAA-CSIC).

More information: M. Osorio et al. "Imaging the Inner and Outer Gaps of the Pre-Transitional Disk of HD 169142 at 7 mm". The

Astrophysical Journal Letters, 791, L36. DOI: 10.1088/2041-8205/791/2/L36

M. Reggiani et al. "Discovery of a companion candidate in the HD169142 transition disk and the possibility of multiple planet formation". The *Astrophysical Journal Letters*, 792, L23, DOI: 10.1088/2041-8205/792/1/L23