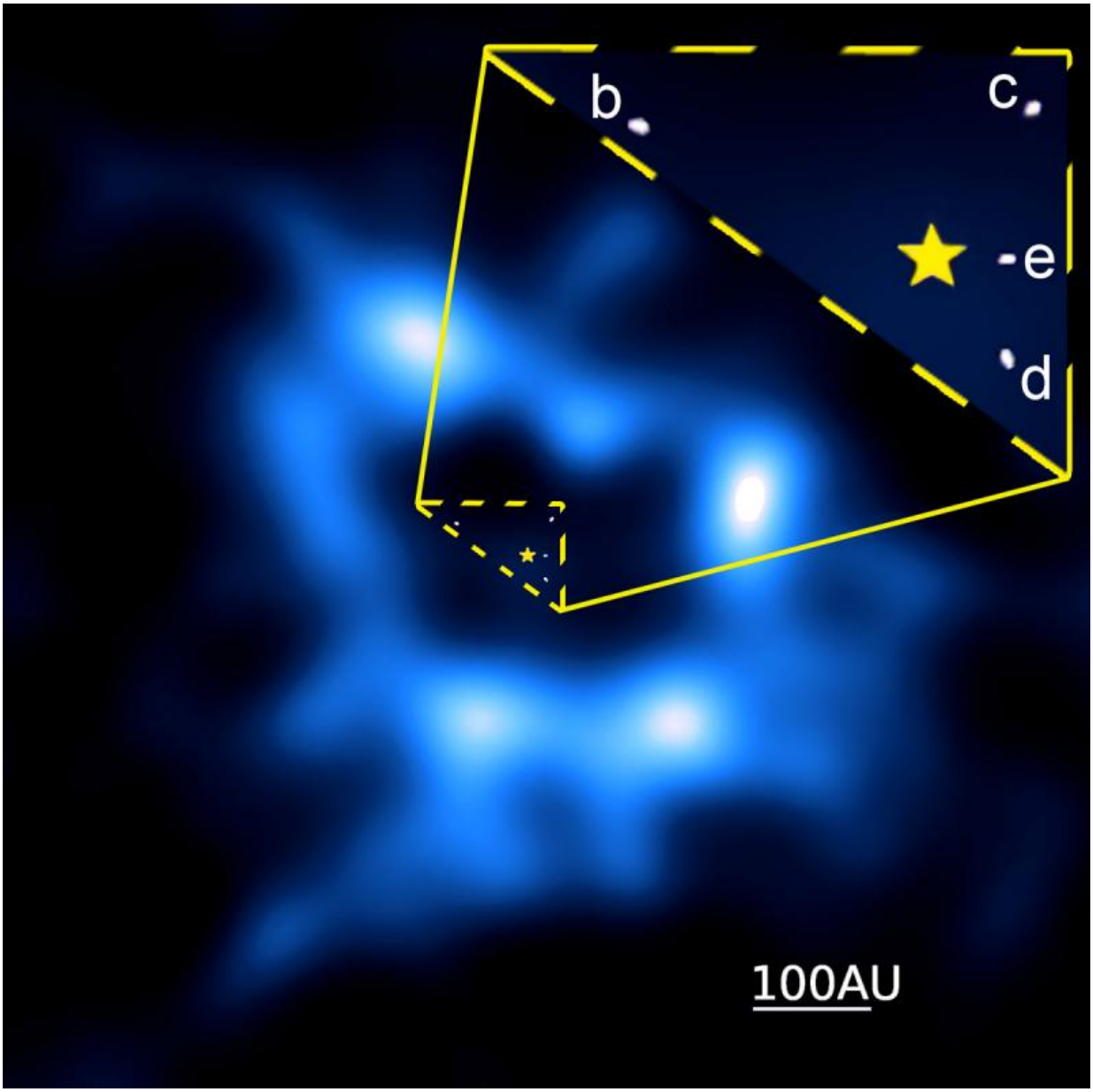
Cometary belt around distant multi-planet system hints at hidden or wandering planets

May 18 2016



An ALMA image of the star HR8799 (centre) and its surroundings. The inset shows the star and the four directly imaged exoplanets. The newly imaged disk, with its previously unseen irregularities, is shown here in blue. The line marker indicates a distance of 100 Astronomical Units (AU), where 1 AU is the average distance from the Earth to the Sun. Credit: Booth et al., ALMA (NRAO/ESO/NAOJ)

Astronomers using the Atacama Large Millimeter/submillimeter Array (ALMA) radio observatory in Chile have made the first high-resolution image of the belt of comets (a region analogous to the Kuiper belt in our own Solar System, where Pluto and may smaller objects are found) around HR 8799, the only star where multiple planets have been imaged directly. The shape of this dusty disk, particularly its inner edge, is surprisingly inconsistent with the orbits of the planets, suggesting that either they changed position over time or there is at least one more planet in the system yet to be discovered. The astronomers report their results in a paper in *Monthly Notices of the Royal Astronomical Society*.

"These data really allow us to see the inner edge of this disk for the first time," explains Mark Booth from Pontificia Universidad Católica de Chile and lead author of the study. "By studying the interactions between the planets and the disk, this new observation shows that either the planets that we see have had different orbits in the past or there is at least one more planet in the system that is too small to have been detected."

The disk, which fills a region 150 to 420 times the Sun-Earth distance, is produced by the ongoing collisions of cometary bodies in the outer reaches of this star system. ALMA was able to image the emission from millimetre-size pieces of debris in the disk; according to the researchers, the small size of these dust grains suggests that the planets in the system

are larger than Jupiter. Previous observations with other telescopes did not detect this discrepancy in the disk.

It is not clear if this difference is due to the low resolution of the previous observations or because different wavelengths are sensitive to different grain sizes, which would be distributed slightly differently. HR 8799 is a young star approximately 1.5 times the mass of the Sun located 129 light-years from Earth in the direction of the constellation Pegasus.

"This is the very first time that a multi-planet system with orbiting dust is imaged, allowing for direct comparison with the formation and dynamics of our own Solar System," explains Antonio Hales, co-author of the study from the National Radio Astronomy Observatory in Charlottesville, Virginia, in the United States.

More information: Mark Booth et al. Resolving the planetesimal belt of HR 8799 with ALMA, *Monthly Notices of the Royal Astronomical Society: Letters* (2016). DOI: 10.1093/mnrasl/slw040

Provided by Royal Astronomical Society