Planet formation starts before star reaches maturity

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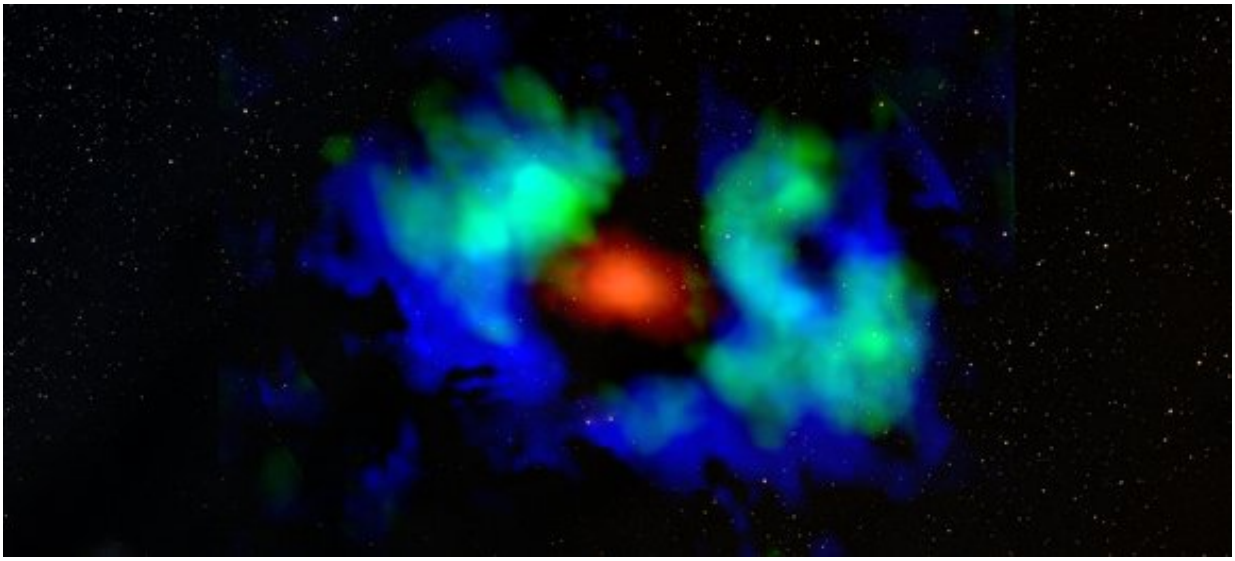


MC1A is a still developing star in the constellation Taurus. Red are areas with many dust particles. Green and blue are two types of carbon monoxide. The absence of green / blue carbon monoxide in the inner part indicates that dust particles in the young protoplanetary disk have grown from less than a thousandth of a millimeter to a millimeter. Credit: Jørgensen/Harsono/ESASky/ESAC [CC-BY-SA 3.0]

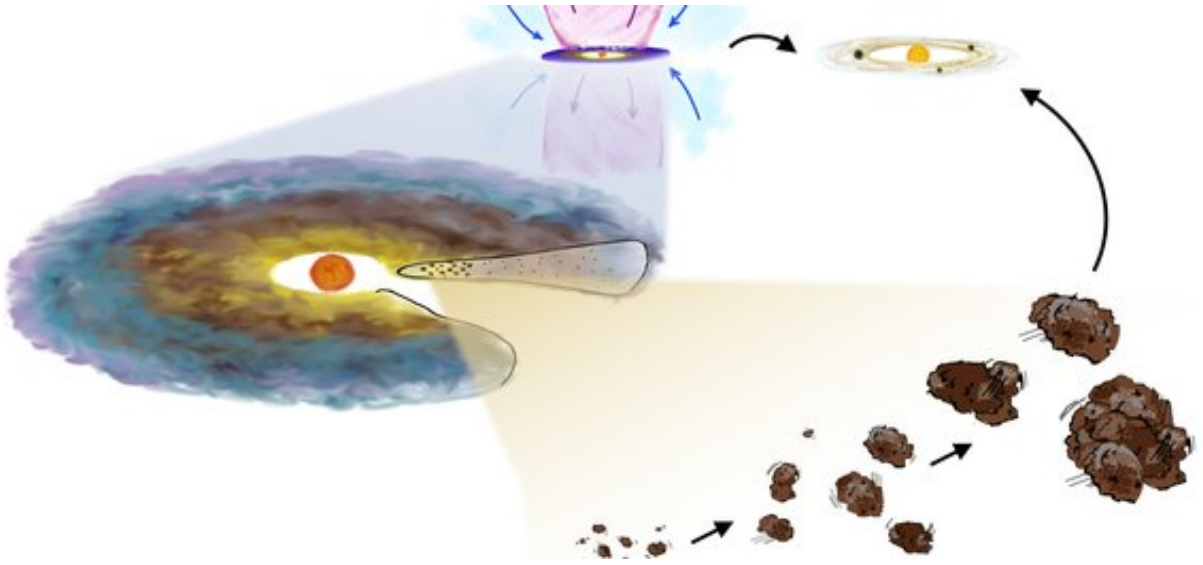
A European team of astronomers has discovered that dust particles around a star already coagulate before the star is fully grown. Dust particle growth is the first step in the formation of planets. The researchers from the Netherlands, Sweden and Denmark publish their

findings in *Nature Astronomy*.

In recent years, astronomers have discovered numerous planetary systems around other stars. Almost every star is likely to have at least one planet orbiting it. Some of the major questions are centered around how planetary systems form and how this process leads to the observed diversity of planets in numbers and masses. The results of a European research project suggest that planet formation starts very early in the star formation process.

The researchers used the Atacama Large Millimeter Array for their discovery. ALMA is a collection of 66 linked radio telescopes spread over 16 kilometer in the Atacama desert in Chile. The researchers pointed the telescope toward TMC1A, a still developing star in the constellation Taurus (the Bull).

The astronomers saw a striking lack of carbon monoxide radiation in a disc-shaped area near the star. They suspected that the radiation was blocked by big dust particles. Using numerical models, they could demonstrate that indeed the dust particles in the young protoplanetary disk have probably grown from a thousandth of a millimeter to a millimeter.



Artistic impression of a star with a protoplanetary disk and growing grains. Credit: Daria Dall'Olio [CC-BY-SA 3.0]

Lead researcher Daniel Harsono (Leiden University, the Netherlands) explains why this is so surprising: "The results indicate that planets already start forming while the star is still developing. The star is only half to three-quarters of its final mass. This is new."

Per Bjerkeli (Chalmers University, Sweden) highlights the implication of early grain growth: "It can be an explanation for the formation of giant planets that are comparable to Jupiter and Saturn. Only early protoplanetary discs contain sufficient mass to form giant planets."

Co-researcher Matthijs van der Wiel (ASTRON, Netherlands Institute for Radio Astronomy) is pleased with the clear and unambiguous observations. "This early particle growth could be an exception, of course. Maybe this young disk is very special."

In the future, the researchers want to look for tell-tale signs of planet

formation around other protostars in similar manner. Ultimately, the astronomers want to know more about when and how planets are formed.

More information: Daniel Harsono et al. Evidence for the start of planet formation in a young circumstellar disk, *Nature Astronomy* (2018). DOI: 10.1038/s41550-018-0497-x

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