The death of a planet nursery?

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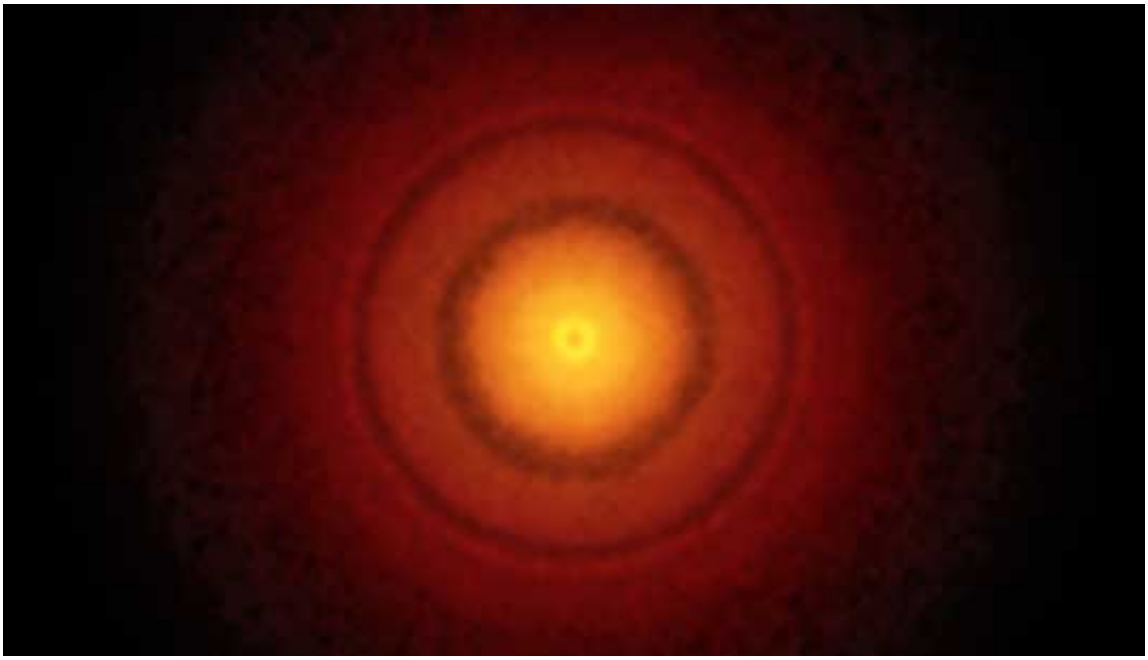

Planetary disk around the star known as TW Hydrae. Credit: S. Andrews (Harvard-Smithsonian CfA); B. Saxton (NRAO/AUI/NSF); ALMA (ESO/NAOJ/NRAO

The dusty disk surrounding the star TW Hydrae exhibits circular features that may signal the formation of protoplanets. LMU astrophysicist Barbara Ercolano argues, however, that the innermost actually points to the impending dispersal of the disk.

When the maps appeared at the end of March, experts were electrified. The images revealed an orange-red disk pitted with circular gaps that

looked like the grooves in an old-fashioned long-playing record. But this was no throwback to the psychedelic Sixties. It was a detailed portrait of a so-called protoplanetary disk, made up of gas and dust grains, associated with a young star – the kind of structure out of which planets could be expected to form. Not only that, the maps showed that the disk around the star known as TW Hydrae exhibits several clearly defined gaps. Astronomers speculated that these gaps might indicate the presence of protoplanets, which had pushed away the material along their orbital paths. And to make the story even more seductive, one prominent gap is located at approximately the same distance from TW Hydrae as Earth is from the Sun – raising the possibility that this putative exoplanet could be an Earth-like one.

Now an international team led by Professor Barbara Ercolano at LMU's Astronomical Observatory has compared the new observations with theoretical models of planet formation. The study indicates that the prominent gap in the TW Hydrae system is unlikely to be due to the action of an actively accreting protoplanet. Instead, the team attributes the feature to a process known as photoevaporation. Photoevaporation occurs when the intense radiation emitted by the parent star heats the gas, allowing it to fly away from the disk. But although hopes of a new exo-Earth orbiting in the inner gap of TW Hydrae may themselves have evaporated, the system nevertheless provides the opportunity to observe the dissipation of a circumstellar disk in unprecedented detail. The new findings appear in the journal *Monthly Notices of the Royal Astronomical Society* (*MNRAS*).

Only 175 light-years from Earth

The dusty disk that girdles TW Hydrae has long been a favored object of observation. The star lies only 175 light-years from Earth, and is it relatively young (around 106 years old). Moreover, the disk is oriented almost perpendicular to our line of sight, affording a well-nigh ideal

view of its structure. The spectacular images released in March were made with the Atacama Large Millimeter/submillimeter Array (ALMA), an array of detectors in the desert of Northern Chile. Together, they form a radiotelescope with unparalleled resolving power that can detect the radiation from dust grains in the millimeter size range.

Photoevaporation is one of the major forces that shape the fate of circumstellar disks. Not only can it destroy such disks —which typically have a life expectancy of around 10 million years—it can also stop young planets being drawn by gravity and by the interaction with the surrounding disc gas into their parent star. The gaps caused by the action of photoevaporation on the disk, park the planets at their location by removing the gas, allowing the small dusty clumps to grow into fully fledged planets and steering them into stable orbits. However, in the case of the TW Hydrae system, Barbara Ercolano believes that the inner gap revealed by the ALMA maps is not caused by a planet, but represents an early stage in the dissipation of the disk. This view is based on the fact that many characteristic features of the disk around TW Hydrae, such as the distance between the gap and the star, the overall mass accretion rate, and the size and density distributions of the particles, are in very good agreement with the predictions of her photoevaporation model.

More information: Barbara Ercolano et al. A photo-evaporative gap in the closest planet forming disc, *Monthly Notices of the Royal Astronomical Society: Letters* (2016). DOI: 10.1093/mnrasl/slw188

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