Planets Prefer Safe Neighborhoods

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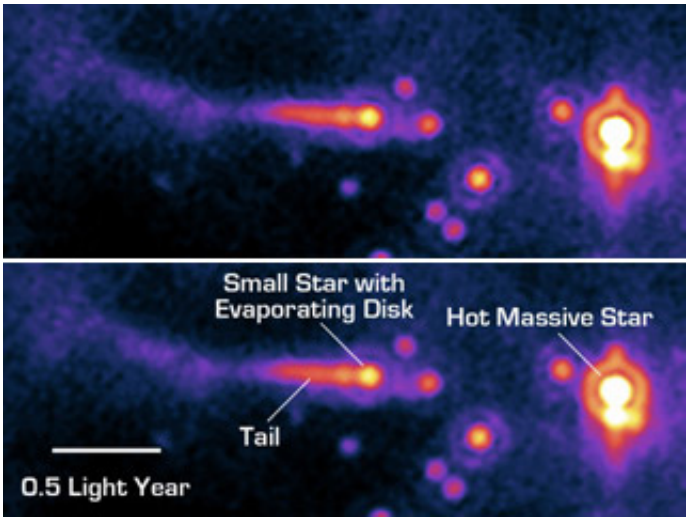

The potential planet forming disk (or “protoplanetary disk”) of a sun-like star is being violently ripped away by the powerful winds of a nearby hot O-type star in this image from NASA's Spitzer Space Telescope. At up to 100 times the mass of sun-like stars, O stars are the most massive and energetic stars in the universe. The O star can be seen to the right of the image, as the large orange spot with the white center. To the left, the comet like structure is actually a neighboring solar system that is being destroyed by the O star's powerful winds and intense ultraviolet light. In a process called "photoevaporation," immense output from the O star heats up the nearby protoplanetary disk so much that gas and dust boil off, and the disk can no longer hold together. Photon (or light) blasts from the O star then strip the potential planet forming disk off its neighbor star by blowing away evaporated material. This effect is illustrated in the smaller system's comet like structure. The system is located about 2,450 light-years away in the star forming cloud IC 1396. The image was taken with Spitzer's Multiband Imaging Photometer instrument at 24 microns. The picture is a pseudo color stretch representing intensity. Yellow and white represent hot areas, whereas purple and blue represent relatively cooler, fainter regions.

A star must live in a relatively tranquil cosmic neighborhood to foster planet formation, say astronomers using NASA's Spitzer Space Telescope. A team of scientists from the University of Arizona's Steward Observatory, Tucson, came to this conclusion after watching intense ultraviolet light and powerful winds from O-type stars rip away the potential planet-forming disks, or protoplanetary disks, around stars like our sun.

At up to 100 times the mass of the sun, O stars are the most massive and energetic stars in the universe. They are at least a million times more powerful than the sun.

According to Zoltan Balog, lead author of the team's paper, the super-sensitive infrared eyes of Spitzer are ideal for capturing the "photoevaporation" of these planet-forming disks. In this process, immense output from the O star heats the disks that are surrounding nearby sun-like stars so much that gas and dust boil off (much like the evaporation of boiling water), and the disk can no longer hold together. Photon (or light) blasts from the O star then blow away the evaporated material, potentially stripping the sun-like stars of their ability to form planets.

"We can see that these systems take on a cometary structure as they are being blown away and destroyed," Balog said.

"No other telescope has ever captured the photoevaporation of a protoplanetary disk in this much detail," added Kate Su, who is a co-author on Balog's paper.

The photoevaporation process is very similar to the one that forms the tail of a comet as it swings by the inner solar system, only a lot more

violent and on a far larger scale, Su said.

"Every time a particle of light from the O star hits a dust grain in the nearby protoplanetary disk, the light particle pushes the dust grain away from its host star," Su said. "This is very similar to how comet tails form."

"Unfortunately these sun-like stars just got a little too close to the fire," George Rieke said. Rieke is also a co-author on the paper and the principal investigator for Spitzer's Multiband Imaging Photometer (MIPS) instrument, which made the new observations.

Ultimately, the astronomers hope to determine whether all stars have planets, and if not, how a star loses the ability to form them. The Spitzer findings will help astronomers understand what regulates the process of planet formation.

Team members say that originally they were looking for "diskless stars" in their survey, stars that had ventured too close to an O star and no longer had any disk left. With so many O stars in the region, they didn't expect that a protoplanetary disk would survive for very long. However, they found something different – stars that had recently blundered into the hostile neighborhood of an O star and were still in the process of losing their disks.

"To see protoplanetary disks in an area where no one expected to see one is very exciting," Balog said. "But to see a disk in the process of evaporating is even more thrilling."

Balog's paper was recently accepted for publication in *Astrophysical Journal*. He is currently is at the University of Arizona on leave from the Department of Optics and Quantum Electronics, University of Szeged, Hungary. UA astronomers James Muzerolle and Erick T. Young

collaborated with Balog, Rieke and Su in the observations.

Source: University of Arizona