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## Clues to planet formation revealed

ANN ARBOR, Mich., -- The most detailed measurements to date of the dusty disks around young stars confirm a new theory that the region where rocky planets such as Earth form is much farther away from the star than originally thought.

These first definitive measurements of planet-forming zones offer important clues to the initial conditions that give birth to planets. Understanding planet formation is key to understanding Earth's origins, yet this remains a mysterious process, said John Monnier, assistant professor of Astronomy at U-M and lead author on the paper, "The near-infrared size luminosity relations for Herbig Ae/Be disks" in a recent edition of *Astrophysical Journal*. Other key authors are Rafael Millan-Gabet and Rachel Akeson of the Michelson Science Center. Other key institutions include the Caltech-run, NASA Jet Propulsion Laboratory and the W.M. Keck Observatory in Kamuela, Hawaii.

Very young stars are surrounded by thick, rotating disks of gas and dust, which are expected to eventually disappear as material is either pulled into the star, is blown from the disk, or collects into larger pieces of debris. This transition marks the leap from star formation to planet formation.

The scientists examined the innermost region of such disks where the star's energy heats the dust to extremely high temperatures. These dusty disks are where the seeds of planets form, where dusty particles stick together and eventually grow to large masses.

However, if the dust orbits too close to the star it evaporates, shutting off any hope of planet formation. It's important to know where the evaporation begins since it has a dramatic effect on planet formation, Monnier said. The initial temperature and density of dust surrounding young stars are critical ingredients for advanced computer models of planet formation.

For the study, scientists looked at young stars that are about one and a half times the mass of the sun. "We can study these stars more in-depth because they are brighter and easier to see," than the fainter and smaller systems similar to the early solar system, Monnier said.

Those more massive systems nonetheless yield clues to how planets formed in our own solar system since the same physical processes operate.

In the last decade or so, beliefs about the systems that give way to planets have changed drastically with the onset of powerful observatories that can take more precise measurements, said Monnier.

For this work, scientists used the two largest telescopes in the world linked together to form the Keck Interferometer. This ultra-powerful duo acts as the ultimate “zoom lens” allowing astronomers to peer into planetary nurseries with 10X the detail of the Hubble Space Telescope. By combining the light from the two Keck Telescopes, we achieve the capabilities of a single telescope that spans a football field, but for a fraction of the cost, Monnier said.

The Keck Interferometer was funded by NASA and developed and operated by Jet Propulsion Lab, W.M. Keck Observatory, and the Michelson Science Center.

For more information on Monnier, see: [http:// www.astro.lsa.umich.edu/~monnier/](http://www.astro.lsa.umich.edu/~monnier/)

For U-M Department of Astronomy, see: <http://www.astro.lsa.umich.edu>

For the Keck Observatory, see: <http://www2.keck.hawaii.edu/>