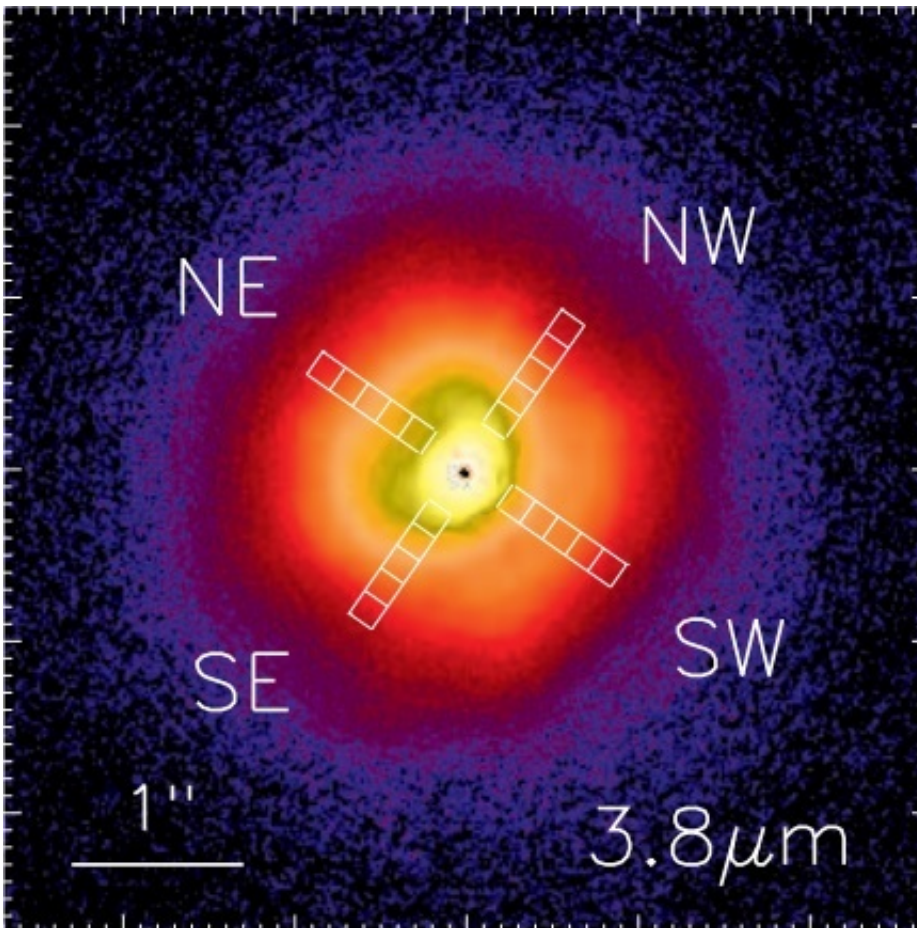


# Water ice detected at the surface of a distant star's disk

April 7 2016, by Tomasz Nowakowski



Positions of the spectra extracted region shown in the L' image of HD100546 disk. A  $0.162''$  square regions were set along the major (SE-NW) and minor (SW-NE) axis of the disk at the position of  $0.360''$ ,  $0.522''$ ,  $0.684''$ ,  $0.846''$ , and  $1.008''$  from the central star. Credit: Honda et al., 2016.

(Phys.org)—A team of Japanese astronomers has recently discovered water ice at the surface of a distant star's disk. Using the Near-Infrared Coronagraphic Imager (NICI) installed on the Gemini South Telescope in Chile, the researchers, led by Mitsuhiro Honda at the Kurume University School of Medicine's Department of Physics, found that a circumstellar disk around the star HD 100546 contains water ice grains. The findings are reported in a paper published online on Mar. 31 in the arXiv repository.

HD 100546 is a 10 million-year-old star located some 320 light years from the Earth. It is accompanied by a fairly flat circumstellar disk in an advanced evolutionary state residing at a distance of 0.2 to four AU, and again from 13 to a few hundred AU from the star. The Hubble Space Telescope revealed that the disk features some complex spiral patterns. However, the nature and origin of these patterns remains uncertain.

The star was observed using NICI on Mar. 31, 2012. This instrument is a coronagraphic camera designed to survey for and image large, extra-solar gaseous planets. It allows astronomers to search for large Jupiter planets around nearby stars by spectrally differencing two images taken in or next to strong, near-infrared methane features found in the atmosphere of large, Jovian-type planets.

The scientists extracted the [scattered light](#) spectra of different regions of the [protoplanetary disk](#) around HD 100546. Scattered light observations complement thermal observations and constrain models based on spectroscopic data. NICI helped them unveil the 3.1  $\mu\text{m}$  absorption feature in the scattered light spectrum of the observed disk. They link this feature with the presence of [water ice](#) grains.

According to the research team, the shallowness of this ice absorption feature can be explained by the loss of [ice grains](#) at the disk surface.

"In almost all the regions, relatively shallow three  $\mu\text{m}$  absorption feature is present in their spectra likely due to water ice grains, indicating that the water ice grains present in the disk surface," the paper reads.

Previous studies claimed that the water ice grains can be quickly destroyed at the disk surface around stars like HD 100546 due to a strong ultraviolet photodesorption.

The discovery made by Honda and colleagues could provide new insights on planet formation theories as water ice is believed to play many important roles in the process of forming planetesimals. For instance, ice enhances the surface density of solid material in the cold outer part of a protoplanetary disk, which promotes the formation of massive cores of gaseous planets.

"The ice sublimation/condensation front called snowline is considered to be the boundary of the forming regions of the terrestrial and Jovian planets. Snowline is also suggested as a possible forming site of the planetesimals," the researchers wrote in the paper.

The astronomers noted that in order to comprehensively understand the water ice distribution in the protoplanetary disks, other effects on the depth of water ice absorption should be investigated in future theoretical studies. They suggest that further investigations should focus on the grain size, shape and its structure, as well as ice/rock ratio (abundance), dust settling, turbulent mixing, and so on.

"Further observations with better photometric accuracy are strongly desired," the scientists concluded.

**More information:** Water ice at the surface of HD 100546 disk, arXiv:1603.09512 [astro-ph.EP] [arxiv.org/abs/1603.09512](https://arxiv.org/abs/1603.09512)

## Abstract

We made near infrared multicolor imaging observations of a disk around Herbig Be star HD100546 using Gemini/NICI. K (2.2, $\mu\text{m}$ ), H<sub>2</sub>O ice (3.06, $\mu\text{m}$ ), and L'(3.8, $\mu\text{m}$ ) disk images were obtained and we found the 3.1, $\mu\text{m}$  absorption feature in the scattered light spectrum, likely due to water ice grains at the disk surface. We compared the observed depth of the ice absorption feature with the disk model based on cite{Oka2012} including water ice photodesorption effect by stellar UV photons. The observed absorption depth can be explained by the both disk models with/without photodesorption effect within the measurement accuracy, but slightly favors the model with photodesorption effects, implying that the UV photons play an important role on the survival/destruction of ice grains at the Herbig Ae/Be disk surface. Further improvement on the accuracy of the observations of the water ice absorption depth is needed to constrain the disk models.

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