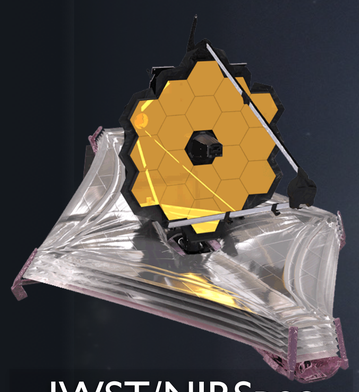
Water ice in the debris disk around HD 181327

Chen Xie[1]✉, Christine H. Chen[2,1], Carey M. Lisse[3], Dean C. Hines[2], Tracy Beck[2], Sarah K. Betti[2], Noemí Pinilla-Alonso[4,5], Carl Ingebretsen[1], Kadin Worthen[1], András Gáspár[6], Schuyler G. Wolff[6], Bryce T. Bolin[7,8], Laurent Pueyo[2], Marshall D. Perrin[2], John A. Stansberry[2] & Jarron M. Leisenring[6]



JWST/NIRSpec
GO 1563

HD 181327 is a young (~18.5 Myr) F6-type star at 47.7 pc, hosting a planetesimal belt containing dust particles and CO gas.

Background: Debris disks are exoplanetary systems that contain planets, minor bodies (asteroids, Kuiper belt objects, comets and so on) and μm-sized debris dust. Because water ice is the most common frozen volatile, it plays an essential role in the formation of planets and minor bodies. Although water ice has been commonly found in Kuiper belt objects and comets in the Solar System, no definitive evidence for water ice in debris disks has been obtained to date. Here, we report the discovery of water ice in the HD 181327 debris disk using the near-infrared spectrograph onboard the James Webb Space Telescope.

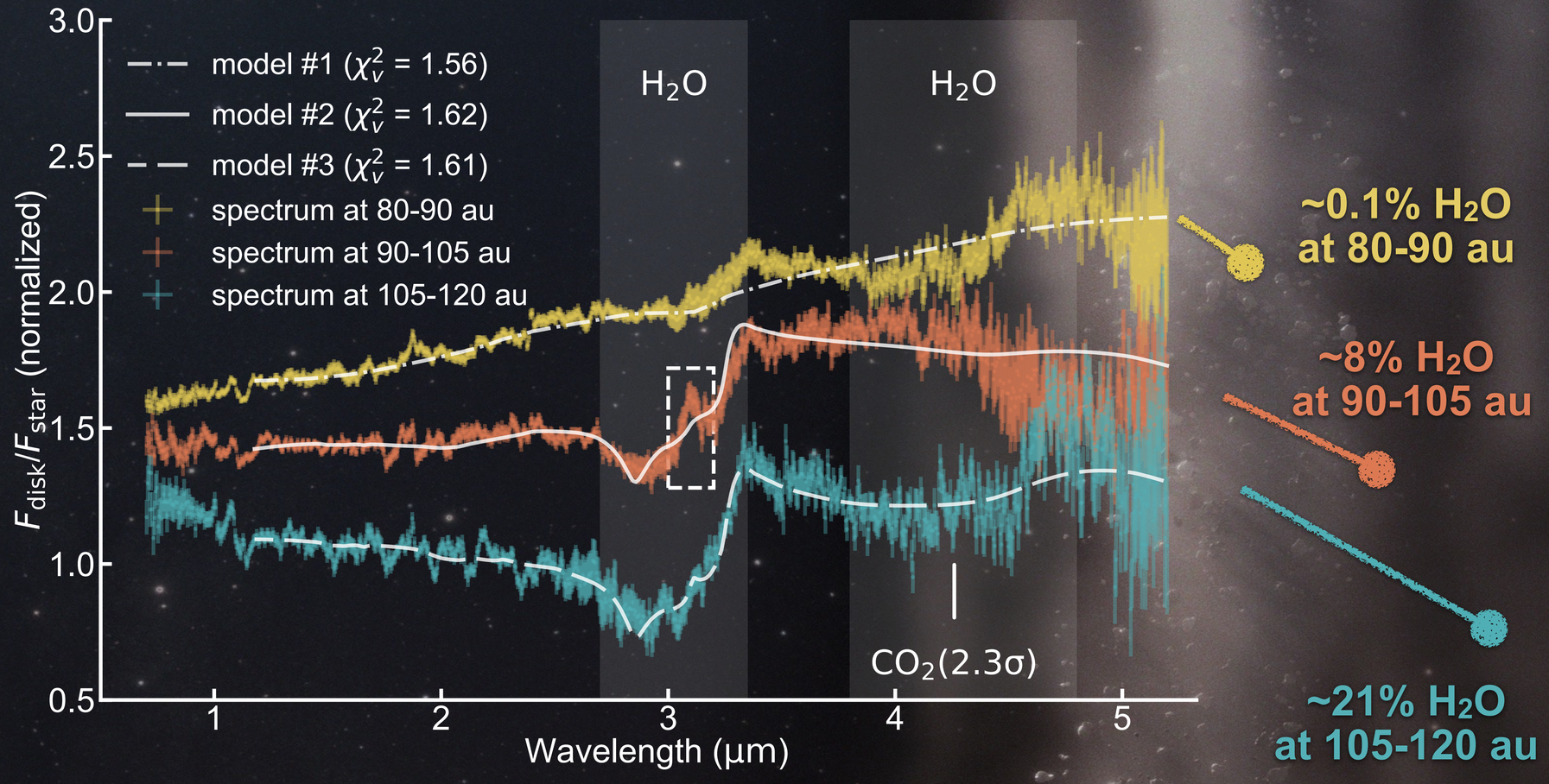


Fig. 1 | The disk reflectance spectrum extracted from 80–90 au lacks water-ice features, whereas that at 90–105 au shows the clear presence of water ice at ~3 μm and a Fresnel peak at 3.1 μm (dashed box). The spectrum at 105–120 au shows a deeper water-ice feature at 3 μm and the water-ice feature at ~4.5 μm. The best-fitting dust models are shown in white. Gradients in the water-ice feature as a function of stellocentric distance reveal a dynamic environment in which water ice is destroyed and replenished.

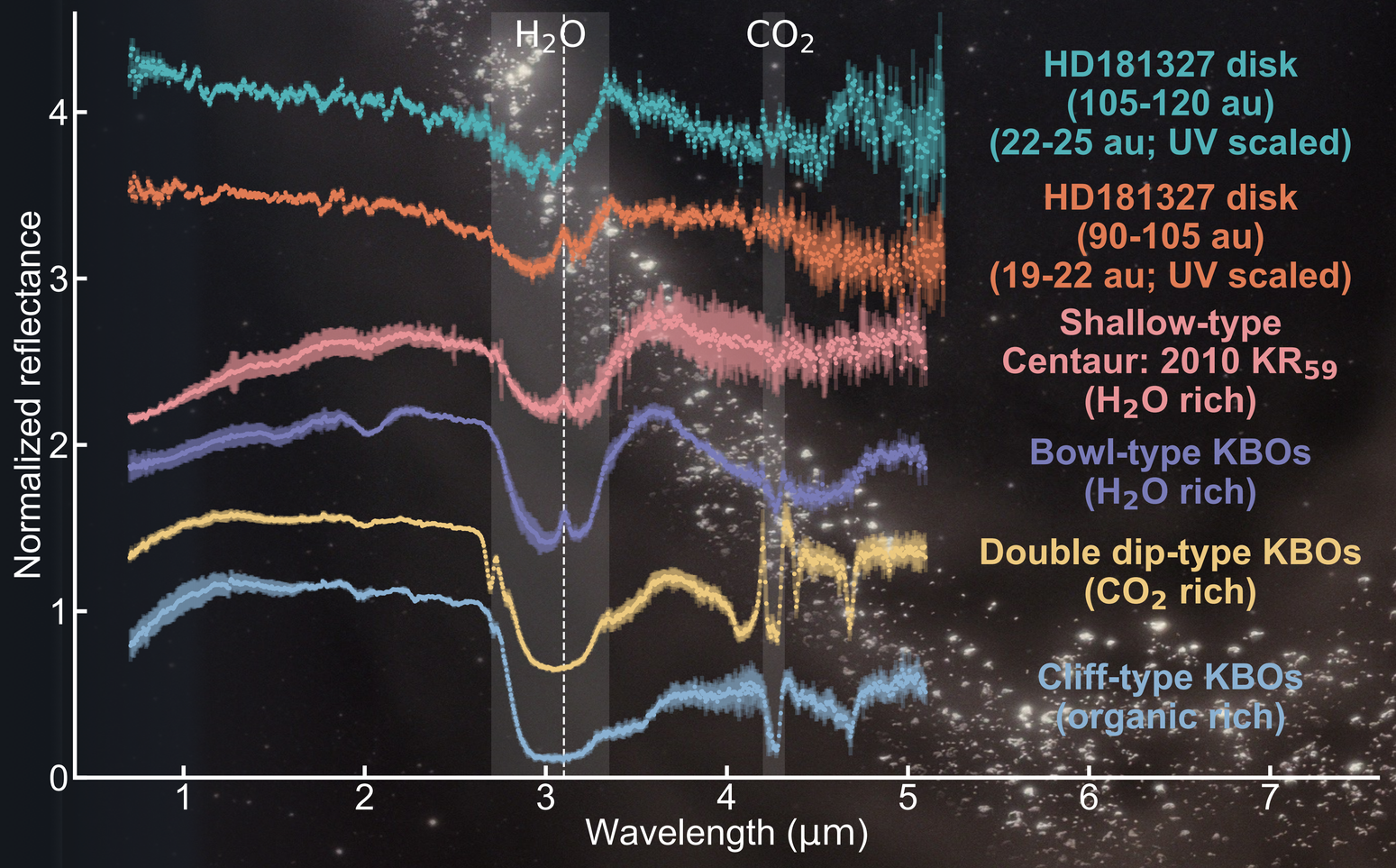


Fig. 2 | The spectra of water-ice-rich KBOs and the disk (continuum-removed) are similar in terms of water ice, which is noteworthy because the two spectra came from different sources (μm-sized dust grains in a debris disk beyond the snow line and the surface regolith of icy bodies in the Solar System). The KBO spectra adopted from Pinilla-Alonso et al. 2024 (JWST GO 2418).

[1]William H. Miller III Department of Physics and Astronomy, Johns Hopkins University, Baltimore, MD, USA. [2]Space Telescope Science Institute, Baltimore, MD, USA. [3]Applied Physics Laboratory, Johns Hopkins University, Laurel, MD, USA. [4]Institute of Space Sciences and Technologies of Asturias, University of Oviedo, Oviedo, Spain. [5]Department of Physics, University of Central Florida, Orlando, FL, USA. [6]Steward Observatory and the Department of Astronomy, The University of Arizona Tucson, Tucson, AZ, USA. [7]Goddard Space Flight Center, Greenbelt, MD, USA. [8]Eureka Scientific, Oakland, CA, USA. ✉e-mail: **cxie21@jh.edu**

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