James Webb telescope finds ice older than the star it orbits

The structure of the water ice also pointed in this direction. When water freezes at moderate temperatures, its molecules settle into an orderly crystal lattice, and crystalline ice produces a sharp peak in the spectrum just above 3 micrometers. That peak was absent at Beta Pictoris. The ice is almost entirely amorphous, a disordered, glass-like solid that forms when water molecules freeze so fast and so cold that they stick wherever they land. The team estimates that less than 7 percent of the water ice in the system is crystalline, which is somewhat surprising.

Models predicted that ice in debris disks should mostly be crystalline. For amorphous ice to stay in that form, it has to remain colder than about 100 Kelvin, or minus 173° Celsius. Otherwise, something has to keep breaking up its crystal structure, such as high-energy ultraviolet light, cosmic rays, or particles streaming from the star. Either way, the researchers concluded the ice most likely formed in the interstellar medium, long before the planets of Beta Pictoris began to take shape.

The remaining question was how the icy grains got spread so evenly across the disk.

Constant collisions

The team argues that this even ice distribution requires frequent collisions among planetesimals. Each collision would

release fresh icy dust, including ice that had been buried and protected deep inside the colliding bodies, replenishing what the starlight destroys. We already have evidence that such collisions do happen. Earlier infrared images revealed a curved, lopsided streak of dust in the southwestern arm of the disk, thought to be debris from a violent collision a little less than halfway out from the star.

Betti’s team’s findings support the idea that the disk’s carbon monoxide gas comes from colliding icy bodies and offer an explanation of how ice can survive in an environment constantly exposed to ultraviolet light. What the team could not do is determine exactly how much crystalline ice is present or rule out other molecules hiding in the mixture.

But if a young planetary system 64 light-years away may have started with much the same icy ingredients as ours, then primordial, interstellar ice might be a common ingredient of planetary systems in general. This means the raw materials for water-rich, potentially habitable worlds might be common, too.

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