

# New Scientist

WEEKLY 4 April 2026

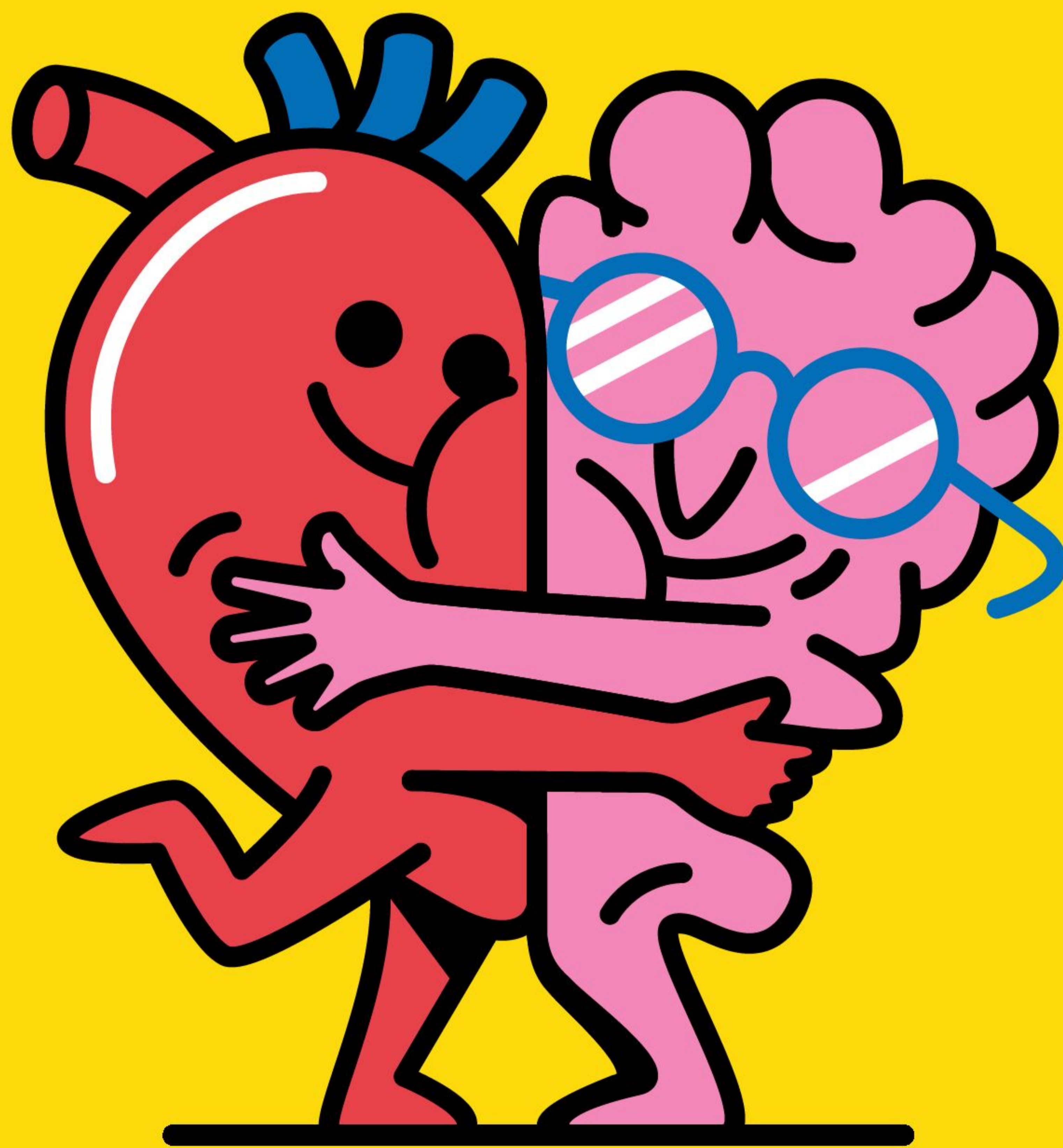
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## Solar system

# Rewriting Earth's origin story

Computer simulations are making us think again about how our solar system's rocky planets – Mercury, Venus, Earth and Mars – first formed, discovers **Leah Crane**

THE inner solar system may have formed differently from how we have long thought it must have. For decades, researchers have thought that the rocky planets formed from a single disc of dust and debris in the early solar system, but new simulations indicate there might have been two separate discs of material.

Models featuring a single disc or ring of material around the young sun tend to be unable to recreate several features of the solar system as we observe it. For one, Earth seems to be made of two different kinds of rocks, which wouldn't

make sense if they all came from the same ring. Also, single-ring models tend to end up with Mercury and Mars too big, Venus and Earth too close together and the compositions of Earth and Mars too similar.

Bill Bottke at the Southwest Research Institute in Colorado and his colleagues built a series of detailed simulations of various ways the planets could have formed from a single reservoir of material and evolved afterwards, but the problems persisted.

"We spent six months at the computer, nothing was working,

so we made a desperation play. We said, why don't we try a second reservoir?" said Bottke while presenting this work at the Lunar and Planetary Science Conference in Texas on 16 March.

**"We're using a lot of supercomputer time to try every reasonable possibility"**

"It turned out this model not only did a great job of making the terrestrial planets, but it also did a pretty good job of explaining some things that

had been bothering us."

The best-fitting model had two separate discs, one at about half the current distance from the sun to Earth, and the other at about 1.7 times the sun-Earth distance. This simulation ended up with all the planets at the correct sizes and distances apart (*The Astronomical Journal*, doi.org/qw3s).

It also fits the compositions of Earth, the moon and Mars. "We think that Earth predominantly formed from [inner solar system] material, and only the last bit came from the outer solar system," said Jan Hellmann at the Max Planck Institute for Solar System Research in Germany during another presentation on the same day of the conference.

If Earth formed from the inner disc, with slight contributions from the outer disc, as Bottke's model predicts, it would match those expectations. Mars, on the other hand, would form mostly from the outer disc, which accounts for the differences between the composition of the two planets.

There is some concern that the model requires very specific initial conditions to reproduce the inner solar system correctly, and it isn't 100 per cent clear why those conditions would have the required values. "Slight changes in the shape of the disc can give you major differences in where the terrestrial planets go," said Bottke.

The researchers are now working to refine their model and explore its other implications for the solar system.

"We're using a lot of supercomputer time to try every reasonable possibility," said Bottke.

If it works, this new explanation could account for all sorts of solar system mysteries, from strange asteroids to unexplained rocks on the lunar surface. ■

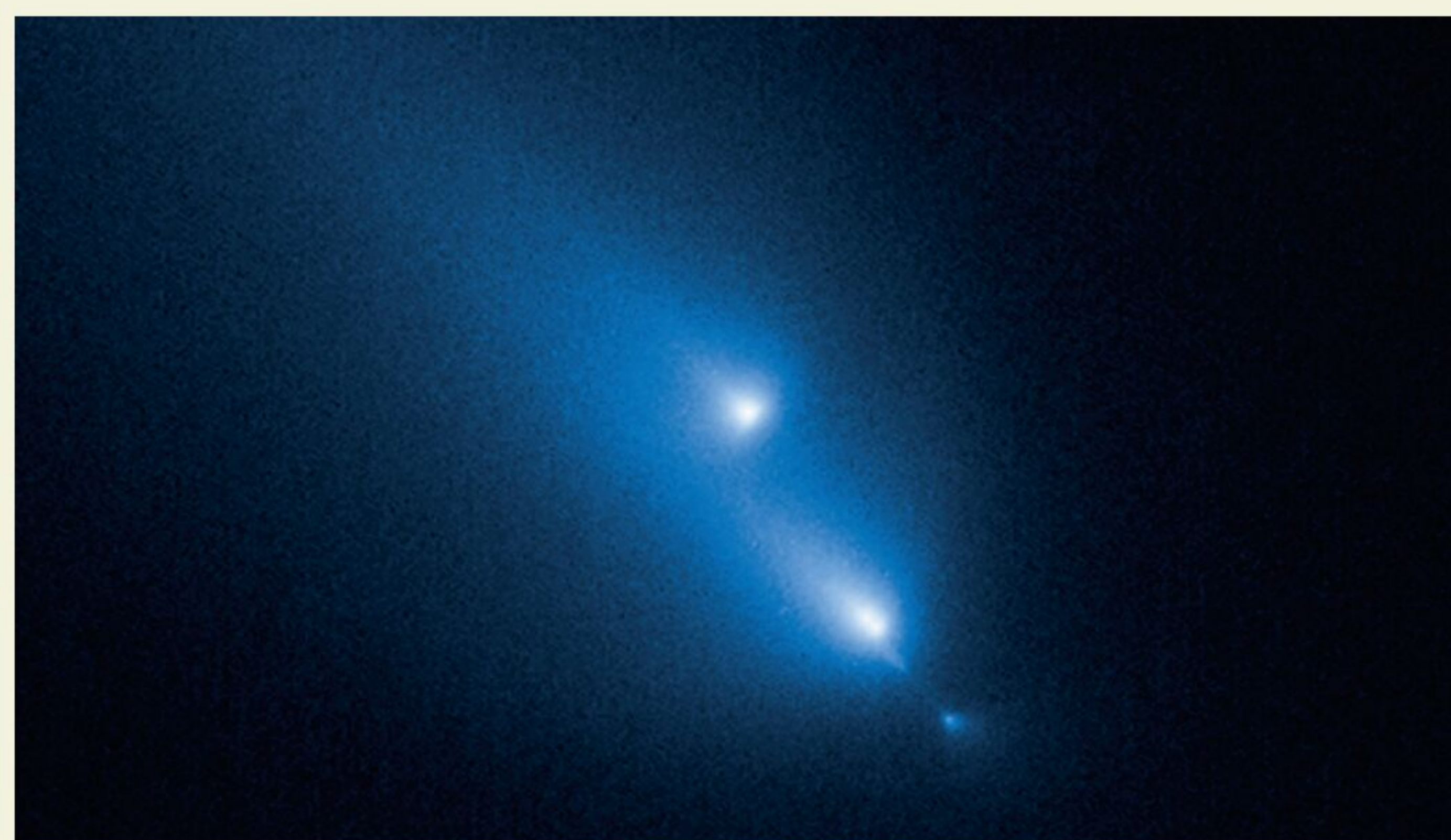
## Disintegrating comet could reveal solar system's secrets

While computer simulations can tell us more about how the planets formed (see main story), a chance sighting of a disintegrating comet could provide a crucial window into the history of the solar system.

John Noonan at Auburn University in Alabama and his colleagues had planned to observe a different comet with the Hubble Space Telescope, but limitations to the spacecraft's ability to turn quickly made that impossible, so they found a new target: a comet called C/2025 K1 (ATLAS). When they pointed Hubble at K1, they saw not a single comet but four fragments (*Icarus*, doi.org/hbs3hk).

"The amount of sheer luck that came into acquiring these images cannot be overstated," says Noonan.

We have never taken such clear pictures of a comet that's just broken up before, because it is hard to predict when one will start to crack and even harder to point a space telescope at one just in time. Thanks to the high resolution of the images, the researchers



The Hubble Space Telescope captured this image of comet C/2025 K1 breaking apart

managed to calculate when K1 began to fragment, about a week before the pictures were taken.

Comets are made of pristine ice from the early days of solar system formation, but their exteriors are eroded over time by sunlight and other space radiation. To get at those pristine ices, which could tell us about the environment that formed the planets, we have to look under the surface, which is exactly

what a fragmenting comet allows.

When a comet breaks, the ices inside it are expected to start sublimating, turning into gas and floating off. But that doesn't seem to be what happened in this case – it took about two days after K1 broke up for it to brighten, which is typically seen as a sign of sunshine lighting up sublimated gas and dust.

Noonan and his team are working to analyse the rest of their data on K1, which should both explain the delay and reveal the makeup of the comet's insides.