POPULAR SCIENCE

Want More?

Data from 1997 just gave us new insight into Europa—our best chance at finding alien life

Confirming hints picked up by the Hubble just a few years ago.

By MARY BETH GRIGGS MAY 14, 2018

On December 19, 1997, NASA's Galileo spacecraft passed 125 miles over the surface of Europa, one of Jupiter's moons. Two of its instruments, the magnetometer and the plasma wave spectrometer, produced a small blip in their data. Compared to the vast quantities of other, more obviously fascinating data that the spacecraft sent back, this short shift seemed like an incredibly minor reading—nothing compared to evidence of a global ocean hidden beneath Europa's vast icy shell, or massive volcanic activity on the nearby moon Io, or the huge radiation belt surrounding Jupiter itself.

The blip passed swiftly into obscurity, hidden in plain sight amidst reams of data sent back before Galileo crashed into Jupiter in 2003, ending its mission.

More than 20 years later, those readings are getting their due: the quick blips may confirm the existence of water plumes stretching up from Europa's icy surface into space. These mysterious blasts of liquid are great news for scientists; future missions could dip through them to taste and sniff at Europa's subsurface ocean. This would allow us to hunt for molecules that could support the evolution of life—and perhaps even find traces of alien microbes—without designing a robot capable of drilling into an icy crust of unknown depth. The research is now available in a study published in *Nature Astronomy*.

The first indications that Europa might send water spouting into space came from the Hubble Space Telescope, which took images of what *might* be a plume back in 2013. But the image was faint, and the evidence wasn't strong enough to definitively say one way or another whether the plume existed. In 2016 new images from Hubble offered more tantalizing hints of a plume, but again, it wasn't quite good enough. To get some concrete answers, researchers would need to get more sensitive readings from either a telescope or something that was actually close enough to Europa to investigate further. All of a sudden, Galileo's data became the subject of renewed focus.

Bill Kurth, a co-investigator on Galileo's plasma wave science instrument, put together a paper in 2001 comparing its data collection during each of the close flybys of Europa. In part, the instrument recorded data about the density of electrons around the spacecraft—the higher the density, the more matter Galileo was flying through.

"The Europa 12 flyby had a density in the environment around Europa that was something like a factor of five higher than the other flybys, which was interesting by itself," Kurth says. Also in the data was another spike that implied a higher density. “At the time, we didn’t make much of that. I suppose we could have postulated a plume or another source of plasma, but there was little other evidence to support an interpretation like that, so we didn’t say much about it."

The idea to look back and compare Galileo's data to the somewhat controversial Hubble pictures didn't arise until last year. The *New York Times* reports that Melissa McGrath, a scientist at the Search for Extraterrestrial Intelligence (SETI) institute, noticed those high-density areas. In a talk at a scientific meeting, she pointed out that one occurred near the equator, almost in the same area as the potential plumes picked up by Hubble.

Xianzhe Jia, a planetary scientist from the University of Michigan, was intrigued when he heard McGrath speak on the subject at a conference. He was working on models showing how plasma interacts with bodies in the solar system, including Europa. He decided to dive into the data to see if Galileo's readings could confirm a plunge through Hubble's presumed plumes. Along with other researchers, including Kurth, Jia started to look at Galileo's findings with fresh eyes.

“To be honest the data was just sitting there publicly for 20 years. The Hubble detection is one of the main drivers that really led us to do this,” says Jia, lead author of the new study. Jia's model shows that a plume coming off Europa could persist and produce conditions that would line up with the measurements taken by Galileo as it passed through a plume, which researchers estimate was about 620 miles across. The results aren't a direct observation of a plume, but rather present such a scenario as the best explanation for the existing data. Direct confirmation of a plume will require evidence from a future mission.

Why didn’t they look earlier? In addition to not having the impetus of those Hubble pictures to take a closer look, the computer models needed to accurately interpret the data just didn’t exist yet. “We need good models to make sense of the data and that needed development—that was something not available 20 years ago,” Jia says.

It took time to develop the computer models used in this most recent study to definitively identify the signature of the plume. Jia and colleagues at the University of Michigan slowly took observations from the distant reaches of the solar system and cobbled them into a coherent picture that could be used to interpret data just like Galileo brought back.

Those models will likely be used again in the not-too-distant future. Jia is a co-investigator on the Europa Clipper mission, which will send a spacecraft to take a closer look at Europa. Equipped with instruments more sensitive than its outer-solar-system predecessors, including Cassini, Clipper will pass around Europa at low orbits, taking detailed measurements of the moon—and potentially its plumes. It is equipped to take detailed analysis of a plume if it does fly through one, which is a tantalizing prospect for planetary scientists eager to know more about the moon’s interior.

“This moon seems to have a global subsurface ocean, but this ocean is covered by ice and we don’t know how thick this ice is. It could be a few kilometers, it could be 10 kilometers, we don’t have a good constraint on the thickness of the ice cover,” Jia says. “In order to directly sample the ocean you’d either have to drill down through the ice. As you can imagine, that’s not an easy thing to do in a very remote environment. Another possibility would be if this ocean is able to eject its material through plumes into space, then that provides a great opportunity for a spacecraft going into this plume and collecting material coming off from this ocean.”

“If you had to summarize the scientific goal of Clipper, I would say it is to understand Europa as a habitable world. Does it have the ingredients of life, are the conditions in the ocean that would promote the existence of life?” Kurth says. “Bottom line, here's a pristine place in the solar system that has liquid water—is it possible that life could have arisen there?"

Researchers currently think that these plumes are likely intermittent, and their exact source within the moon is still unclear—are they from the ocean itself or another subsurface reservoir within the crust? Do they contain organic compounds, building blocks of life that could make Europa an even more attractive target for future alien-seeking planetary missions? To find out more, we'll have to actually get there.

The Europa Clipper mission received more funding from Congress last week, keeping it on track for a potential launch as early as 2022, though final decisions on the launch vehicle are not likely to be made before a review of the project in late 2019.

Armed with this new data, researchers will likely continue to gaze at Europa through telescopes like the Hubble (and the perpetually displayed James Webb Space Telescope—once it launches), and will keep looking through all the data that they've already compiled to see what other secrets might be lurking in the readings. As we hunt for alien life on our solar system's watery moons, we may find some of our most surprising answers lurking in data sitting right here at home.