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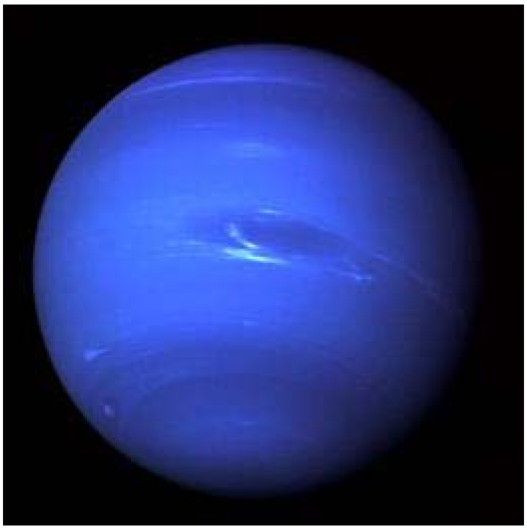
News

Comet strike could explain Neptune's air

Carbon monoxide in planet's atmosphere points to icy impact.

Eric Hand

Did a large, icy comet smash into Neptune two centuries ago? That's the picture that is emerging from the latest measurements of gases in the atmosphere of the giant blue planet.



An abundance of carbon monoxide in Neptune's atmosphere could be the result of a comet smash.

NASA/JPL

At a meeting this week of the American Astronomical Society in Miami, Florida, Paul Hartogh, a scientist on the Herschel mission, the European Space Agency's infrared observatory satellite, described the mission's first results for the Solar System. These include measurements of abnormally high levels of carbon monoxide in Neptune's stratosphere — a possible trace of a comet impact.

Emmanuel Lellouch, an astronomer at the Paris Observatory, first published the idea five years ago, on the basis of far less certain measurements made by a 30-metre radio telescope on the mountain Pico Veleta in Spain[1]. "We are becoming more confident," says Lellouch, who is a co-author with Hartogh on a forthcoming paper concerning the Herschel results in the journal *Astronomy & Astrophysics*.

A possible alternative explanation for the carbon monoxide abundance is that Neptune has a deep, stable reservoir of the gas that is slowly leaking out from its interior. But in his earlier measurements, Lellouch found twice as much carbon monoxide in the stratosphere as in the troposphere. Because the stratosphere is higher up in the planet's atmosphere, an internal source seems less likely.

"We're certain now that there must be an external source of carbon monoxide," says planetary physicist Leigh Fletcher of the University of Oxford in the UK, who was not involved in the research. Earlier this year, Fletcher published a study that describes even higher abundances of carbon monoxide in Neptune's atmosphere, measured by the Japanese infrared mission AKARI[2]. "The most spectacular method is having cometary icy body impacts," he says.

Hard rain

But Fletcher says that a second external source of the carbon monoxide is also possible: the steady rain of dust and micrometeorites that all planets feel. When these particles are eroded in Neptune's atmosphere, they are likely to deposit the water that they contain, along with small amounts of carbon monoxide. Yet Lellouch found Neptune's stratosphere to be far more enriched in carbon monoxide than water — which leads him to favour the comet theory. That's because the temperature of a comet impact is far higher than that for micrometeorites — providing an environment for 'shock chemistry', in which oxygen tied up in comet ices is liberated to form carbon monoxide.

Although Fletcher says that the chemistry of these interactions is still poorly understood, Lellouch points to the comet Shoemaker Levy 9, which in 1994 crashed into Jupiter and enriched its atmosphere with more carbon monoxide than water[3].

Lellouch says that the Herschel measurements are consistent with his original calculation[1], in which he proposed that a comet 2 kilometres wide struck the planet 200 years ago — a size and time period that would allow carbon monoxide to be distributed at the levels now seen in the stratosphere.

Because it is smaller, Neptune doesn't have the gravitational attraction of Jupiter, but its proximity to the Kuiper belt of Solar-System debris means that large icy bodies are more likely to be nearby, says Luke Dones, a planetary scientist at the Southwest Research Institute in Boulder, Colorado. He suggests that a 2-kilometre comet might hit Neptune every 2,000 years or so — which makes a strike in the past 200 years a bit of a surprise, but "perfectly plausible" he says.

CORRECTED: An earlier version of this story incorrectly stated that Paul Hartogh was the project scientist for the Herschel mission. In fact, Göran Pilbratt is the project scientist.

References

1. Lellouch, E., Moreno, R. & Paubert, G. *Astron. Astrophys.* **430,** L37-L40 (2005). | Article | ChemPort |
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3. Lellouch, E. *et al. Icarus* **159,** 112-131 (2002). | Article | ChemPort |

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