Solving the Uranus Mystery using 40 Years Old Data

MOST of our knowledge about Uranus, the seventh planet of our solar system, is accredited to 5.5 hours of data collected by the Voyager 2 spacecraft in 1986. These observations have baffled scientists for decades because they challenge some of the fundamental laws of Physics. However, a new study led by astronomers from the California Institute of Technology has now revealed that the data may have been modified by a fortuitous sun storm that impacted Uranus just before Voyager 2 approached it. If proven to be correct, these new findings will have strong implications for future space missions planned for the mysterious blue planet.

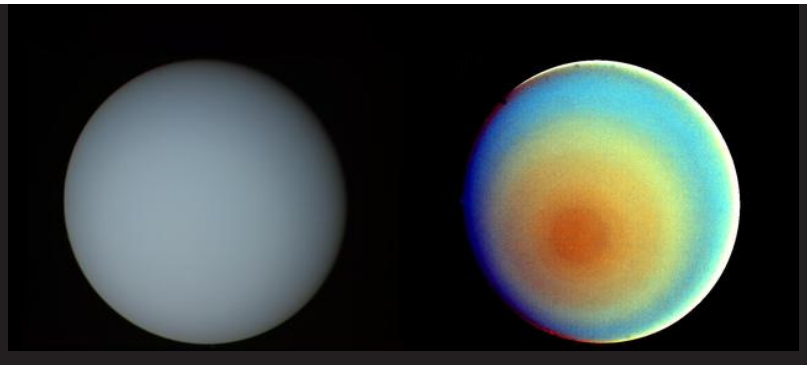

Image Credit: NASA/JPL

Uranus as seen by the Voyager 2 spacecraft in January 1986. On the left is a true colour image of Uranus. The bluish-green colour is due to the absorption of red light by methane gas in Uranus' atmosphere. On the right is a false colour image showing different layers of the atmosphere by exaggerating the contrast seen in images taken using different filters.

Uranus is the third largest planet in our solar system. It is covered with a thick layer of clouds, which makes it impossible to observe many features on its surface. It takes 84 Earth years to go around the Sun and revolves from east to west, unlike most other planets in the solar system. Uranus is an ice giant, which means it does not really have a proper surface but is a mix of liquids rotating together. Observations even from Earth show that the planet has a ring system just like Saturn, even though its rings are much thinner and dark.

The atmosphere of Uranus is primarily composed of Hydrogen, Helium and small quantities of Methane. It is the latter that imparts this ice giant a bluish-green hue like a blue marble.

The Voyager 2 spacecraft took flight in 1977 and began observing Uranus in November 1985. It soon discovered two new rings, ten new moons, and the nine previously known rings and five moons. Besides discovering other members of the Uranian system, Voyager 2 also found that the planet has a very oblique and off-centred magnetic field, and an eccentric magnetosphere — the region around a planet where its magnetic field has the strongest influence.

Uranus axis of rotation is so inclined to its orbit, that it looks like the planet is lying on its side as it goes around the Sun. This strange arrangement with Uranus at the centre and its rings and moons intricately orbiting it meant that Voyager 2 had to hit the bull's eye as it flew past it. In the short time it had to encounter the Uranian system, Voyager 2 discovered that the magnetic field lines of Uranus were filled with electrons, but otherwise, there was no sign of plasma, that is, charged particles, in its atmosphere. Since then, scientists have been trying to figure out a valid source of the electrons from Uranus and its moons.

A recent study published in *Nature Astronomy* (January 2025) by Jasinski *et al*. now proposes an interesting solution to this 40 years old puzzle. The astronomers from the California Institute of Technology re-analysed the 1986 data from the Voyager 2 spacecraft along with data for the Sun. They find clear evidence showing that Uranus was hit by a strong Sun storm just before Voyager 2 encountered it. This result presents a finite possibility that the Sun storm blew away the atmospheric plasma from Uranus, leaving it empty just before Voyager 2 began its observations.

If this is the case, this new study has strong implications for future space missions, particularly NASA's "Uranus Orbiter and Probe" (UOP) mission, which is planned to fly to Uranus in the next few years. Planetary scientists around the globe are eagerly waiting for this mission because it is expected to reach Uranus by 2050, at the time of its equinox, when the entire ice giant and its moons will be illuminated by sunlight. Unlike the 1986 encounter of Voyager 2, this mission will provide a never-before-seen view of the Uranian system.

Since Uranus is under the influence of solar storms for a significant 5% of the time, it remains to be seen whether the new data will be any different from that of Voyager 2. In the meantime, UOP is also supported by scientists studying exoplanets and planetary atmospheres because almost a third of >5000 exoplanets discovered so far are gas giants just like Uranus and Neptune. A better understanding of Uranus will, therefore, open new avenues to explore habitable planets beyond our solar system.

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