Zodiacal Dust Mystery

By IASToppers | 2024-02-03 15:10:00

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NASA's Juno spacecraft, en route to Jupiter, encountered dust particles near Mars, damaging its solar panels.

- Leveraging this setback, scientists at the Physical Research Laboratory, Ahmedabad, delved into the data to uncover insights into the **origin of zodiacal dust**.

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Key highlights of the study:

- The study suggests **Mars's moons**, Phobos and Deimos, play a crucial role in contributing to the **cosmic dust that scatters sunlight**, forming the **zodiacal light**.
- Juno's solar panels were damaged by **fast-moving dust particles**.
- Dust encounters **between 1 and 5 Astronomical Units (AU)** were calculated **based on Juno's data.**
    - **1 AU** is the **distance between Earth and the Sun**, with Mars at 1.52 AU and Jupiter at 5.2 AU.

- In a publication of the Royal Astronomical Society, the data from the 2021 paper was utilized to compute the **potential number of dust particles** that **Juno encountered between 1 and 5 AU**.
- The 2021 paper documented a **peak in the number of dust particles impacting Juno at 1.5 AU**.
- Utilizing this data, calculations were conducted to determine the **dust flux between 1 and 5 AU**.
    - The flux is the number of dust particles flowing through a given area per second.
- Notably, **the flux at 1.5 AU** was observed to be **10 times higher than at other distances.**

Zodiacal Light and Dust Source:

- Researchers have established that **interplanetary dust** serves as the **origin of zodiacal light**, a phenomenon where **sunlight is scattered by this dust**.
    - The dust is believed to come **from comets and asteroids**.
- Observed from Earth, zodiacal light appears as a **faint**, **diffuse glow** on completely **dark nights**.
- This light is present along the **entire path of the ecliptic**, which is the Sun's apparent path in the sky over the course of a year.
- NASA's Juno spacecraft has **detected interplanetary particles** that suggest **Martian storms** fill the **solar system with dust**, causing the **zodiacal light**.

Source of Dust Flux:

- In the study, a comparison of the **dust flux near Mars** and the number of particles escaping the **two moons of Mars** led to the conclusion that these moons could be the potential source of the observed dust.
- Additionally, no other phenomenon in the vicinity was identified that could release a comparable amount of dust.

Study outcome:

- In the study, the researcher considered the **shapes of Mars's two moons**, factoring in gravitational effects, dust particle influences, spacecraft ejecta impacts, and other parameters in dust models.
- The estimated **net mass influx** rate at Deimos and Phobos was derived from these model outputs.
- By combining this information with **observational data**, the researcher identified a mechanism explaining how **Deimos and Phobos might contribute to the zodiacal dust**.

Role of Micrometeorites:

- Micrometeorites, extremely small dust particles weighing no more than one-ten-thousandth of a gram, have the potential to **move at high speeds** and **deliver a significant impact**.
- The study found that these micrometeorites **collide with Mars's moons**, much like they do with Earth.
- Unlike Earth, where they burn up and disintegrate in the atmosphere, Deimos and Phobos lack atmospheres.
- Consequently, most **micrometeorites slam into their surfaces**, creating **small clouds of dust.**
- Due to the low gravity of Phobos and Deimos (which have non-spherical shapes), dust particles can **easily escape from these moons**.
- Consequently, Phobos has **lost a greater amount of dust** through this mechanism.
- The **smaller dust particles escape into space**, while Mars's gravity attracts the larger ones.
- The latter accumulates in the form of a dust ring around Mars, maintaining an orbit that may drift closer to or farther from the planet over time.

About Mars's two Moons:

- Mars has two moons named **Deimos and Phobos.**
- In Greek mythology, Mars is the god of war, and the planet's moons are named after his twin sons, the **gods of dread and panic**, respectively.
- Both moons were discovered by the American astronomer **Asaph Hall in 1877.**

Phobos:

- Phobos, the larger of Mars's two moons, is gradually moving closer to the planet at a rate of six feet per century.
- Astronomers anticipate that, over time, Phobos will either **collide with Mars** or **disintegrate**, forming a ring around the planet.
- The most notable feature on Phobos is a 10-km-wide crater named in honor of Asaph Hall's wife,

Angeline Stickney.
    - Stickney crater is **half as wide as the entire moon**.
- On the **day side of Phobos**, the temperature is approximately -**4 degrees Celsius,** while just a few kilometers away on the night side, temperatures often plummet to an even lower -112 degrees Celsius.
- This substantial temperature difference, around 108 degrees Celsius, is attributed to the **fine dust covering Phobos' surface**, which lacks the **capacity to retain heat**.
- Additionally, **Phobos lacks an atmosphere** that could trap heat.

Deimos

- Deimos is different, it is believed that its actual surface is buried under almost 100 metres of dust.
- It is much fainter than Phobos and is barely visible from the surface of Mars.
- It has a **more distant and circular orbit**, taking about 30.3 hours to complete one orbit around Mars.

About NASA's Juno mission:

- NASA's Juno spacecraft was **launched in 2011** to **explore Jupiter and its moons**.
- It was built by **Lockheed Martin** and is operated by NASA's Jet Propulsion Laboratory.
- Juno is the second spacecraft to orbit Jupiter, after the nuclear powered **Galileo orbiter**, which orbited from 1995 to 2003.
- Juno is powered by **solar panels**.

