Topic of the week for discussion: 7th July to 13th July 2016

Topic: Discovery with Juno

Topic Introduction

In yet another remarkable achievement, the National Aeronautics and Space Administration's **Juno spacecraft** has successfully **entered the orbit around Jupiter** without being knocked down by the planet's intense magnetic field and radiation. That the spacecraft, which **had travelled 2.8 billion km since its launch on August 5, 2011**, passed through a spot that was originally planned for, when it came closest to the planet provides a measure of the level of success of the mission. Juno, with a **diameter of 11.5 ft**, is not the first spacecraft to enter into orbit around Jupiter. But unlike its predecessor, **the Galileo spacecraft** that explored the planet between **1995 and 2003**, Juno will study Jupiter much more thoroughly given the array of **nine scientific instruments** that it carries on board. The most important difference between the two missions is **Juno's ability to see below the dense cloud cover of Jupiter**; only a probe of Galileo entered the planet's atmosphere. Getting as close as 5,000 km from the cloud tops and being able to see through the clouds will make it possible for **Juno's camera, Junocam**, to take close-up photos of the poles and other points of interest. **The main objectives** of the mission are **to understand the origin and evolution of Jupiter**, to find out if the planet, like **Earth, has a solid rocky core**, to **uncover the source of its intense magnetic field**, to **measure water** and **ammonia** in deep atmosphere, and to **observe the auroras**.

Though the nine instruments will be turned on by **the end of the week**, the first full set of observations will not take place before the **end of August** when the spacecraft comes close to Jupiter on its first orbit; science experiments will begin in full earnest in **mid-October** when it gets into a **14-day orbit**. Juno will orbit the planet from **pole-to-pole**, minimizing the amount of radiation exposure, but the orbit will ultimately shift due to Jupiter's intense gravitational field, making the spacecraft pass through more intense regions of radiation. Though shielded by a **titanium vault**, the radiation from Jupiter will slowly but surely compromise the instruments by the time it finishes its mission in **February 2018**. But before this happens, scientists expect to collect enough information to further our understanding of how the giant planet was formed some 4.5 billion years ago, and of the origins of the solar system. The amount of water it contains and the nature of its core will provide clues about where the planet formed early in the system's life span. After orbiting the planet **37 times** and returning invaluable scientific information, Juno will incinerate in Jupiter's atmosphere in early 2018 as the Galileo spacecraft did.

Things to Know About Juno's Rendezvous with Jupiter:

1. This will become fastest human-made craft ever: A combination of the gravitational tug of Jupiter, an orbit just **2,900 miles** above the surface of the planet, and its initial launch velocity will have the craft zipping along at **129,000 mph**.

2. Juno is the sixth craft to visit Jupiter, and the first new visitor in decades: The exploration of Jupiter began in **1973** when **Pioneer 10** flew by the gas giant. **Pioneer 11** flew the next year. **Pioneer 10** was meant to study **Jupiter's radiation** for future missions. In the process of this study, the craft was damaged (though not destroyed) by the unexpectedly harsh radiation. A few years later, **Voyagers 1 and 2** performed flybys in **1979**, the first in March and the next in July. Those crafts took breathtaking photos of the systems and gave the first hints that Jupiter's moon**, Europa**, may harbor an ocean. NASA didn't send an orbiter to Jupiter until **Galileo was launched in 1989**, taking a more leisurely pace to Jupiter than any previous visitors in order to enable a gravitational capture.

The probe arrived in 1995 and studied the planet and its moons for eight years before plunging to its death into Jupiter in 2003 to ensure none of the moons became contaminated, as Europa and Ganymede (and to a lesser extent, Callisto) are believed to have oceans and the possibility of life. Juno, originally launched in 2011, is the second orbiter and will concentrate mostly on studying Jupiter itself.

Dozens of spacecraft have been sent on interplanetary missions **since the 1962** launch of the **Mariner 2 mission to Venus**, the first spacecraft to visit another planet. But some have made more of an impact - on science and the public imagination - than others.

Here is a list of some greatest missions sent beyond the Earth-Moon system:

Voyagers 1 and 2 (launched 1977): Taken together, NASA's two Voyager spacecraft have to be ranked as the greatest interplanetary mission in history, returning a wealth of information about the outer planets, their moons and rings. **Voyager 2 is the only spacecraft that has seen Uranus and Neptune up close**, and like its sister spacecraft Voyager 1, it also flew **by Jupiter and Saturn**. The two Voyagers are also likely to be the first spacecraft to enter interstellar space, which they may reach within a decade.

Viking 1 and 2 (1975) :The **Viking mission** put two spacecraft in orbit around **Mars and two landers on the planet's surface**. Cameras on the orbiters mapped the planet, while the landers took images from the ground (in 1976, Viking 1 took the first pictures ever transmitted from the Martian surface).

Cassini-Huygens mission to Saturn (1997): The **Cassini spacecraft** has been in orbit **around Saturn since 1 July 2004**, returning high-resolution images and other data about the planet and its rings and moons. The Huygens probe separated from the main spacecraft and became the first probe to land on the moon of another planet when it touched down on Saturn's moon, **Titan**. The Cassini spacecraft **discovered plumes of water vapour** spewing from another of Saturn's moons, **Enceladus**, raising the possibility that **liquid water may provide** conditions favourable to life beneath the moon's surface. Cassini-Huygens is a joint mission by NASA and the European Space Agency (ESA).

Magellan to Venus (1989): The Magellan mission mapped the planet's surface using cloud-penetrating radar, providing the most complete view of the planet ever obtained. The small number of impact craters detected on its surface suggested a massive volcanic episode about 500 million years ago resurfaced the planet, although some scientists now think that picture is too simplistic, and much of the surface may be older.

Mars Express (2003): Despite the failure of the Beagle 2 lander, which was part of ESA's Mars Express mission, the Mars Express orbiter has been highly successful since it went into Mars orbit on 25 December 2003. It has returned detailed 3D imagery of the Martian surface, and its radar instrument has detected hints of frozen water buried underground – and possibly within land formations at the equator.

NEAR (1996): The 'Near' Earth Asteroid Rendezvous mission achieved the first landing on an asteroid when the 'NEAR' spacecraft touched down on 433 Eros on 12 February 2001.

Read further:

http://edition.cnn.com/2016/07/04/world/juno-jupiter-nasa/

http://www.usatoday.com/story/tech/2016/07/05/juno-spacecraft-enters-jupiter-orbit/86696330/

https://www.newscientist.com/blog/space/2007/11/10-greatest-space-probes-ever-flown.html

http://blogs.discovermagazine.com/d-brief/2016/06/30/5-things-to-know-about-junos-rendezvous-with-jupiter/#.V3ynrxL2TCM