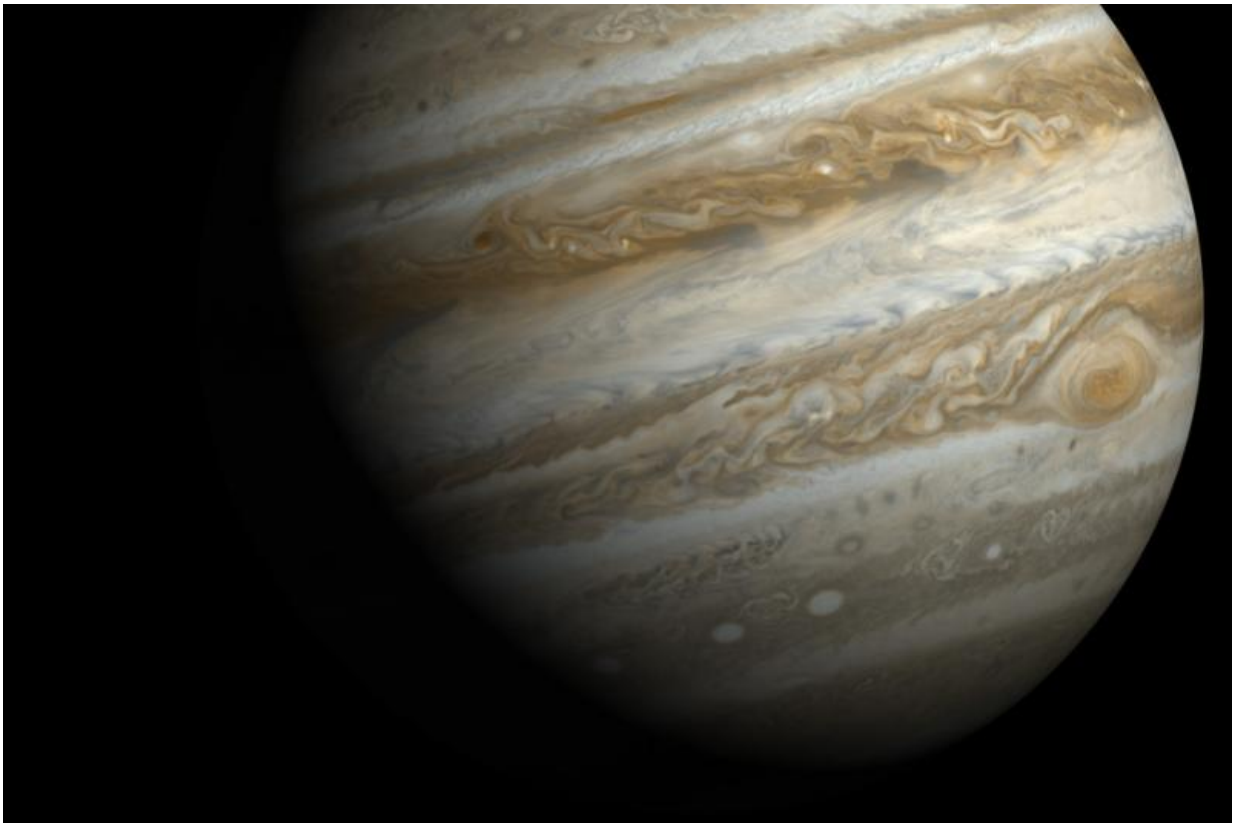
What we know about Jupiter

July 5 2016, by Tanya Hill



Jupiter and its Great Red Spot. Credit: NASA, ESA, and M. Kornmesser., CC BY

Look towards the north-west after sunset (south-west in the northern hemisphere) and there is currently one bright point of light that easily stands out relative to everything around it. That is the planet Jupiter, shining with an intense and steady glow.

After a journey of five years, and decades in the planning, NASA's Juno spacecraft has achieved orbit around Jupiter. Soon begins the next stage in humanity's quest to explore the largest of the gas giants in our solar system. But what do we know of Jupiter to date?

Brightest, biggest, first

Jupiter's brightness in the night sky is due to its enormous size. It is by far the biggest planet of the solar system, containing more than double the mass of all the other planets, moons, comets and asteroids combined.

Its great size suggests that Jupiter was also the first planet to form around the sun. The planets emerged out of the debris left over when an interstellar cloud of gas and dust coalesced to form our star. Early in its life, the young sun generated a wind that blew away most of the remaining interstellar cloud, but Jupiter was able to hold on to that history.

Locked up in Jupiter, therefore, is the recipe for how a solar system is made – the ingredients from which the planets and other smaller bodies came to be, and the processes and conditions that enabled this material to come together to form such amazing and diverse worlds.

King of the planets

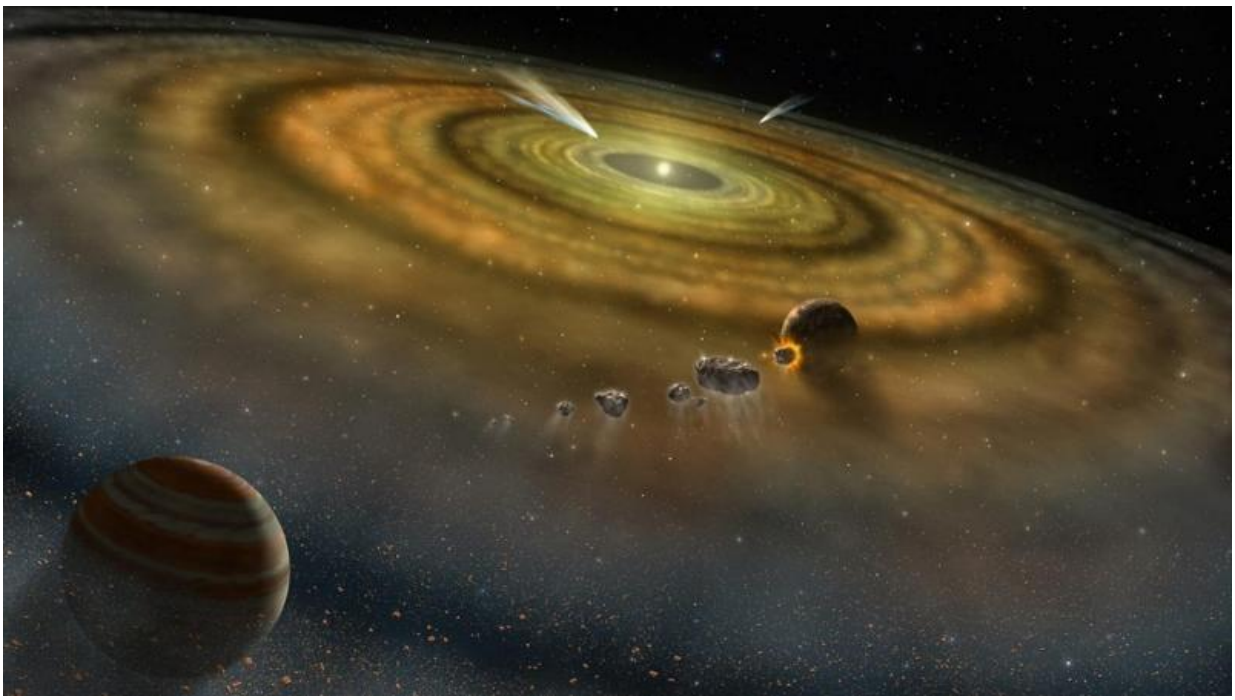
Jupiter, along with Mercury, Venus, Mars and Saturn, have all been observed since ancient times as they are easily visible in the night sky. Different cultures who studied the stars also realised that these objects were unique; they did not stay fixed in their relative patterns or constellations as the stars did but moved according to different rules.

They were referred to as the wandering stars by the ancient Greeks and derived from this term came the name planet.

It is remarkable just how aptly Jupiter is named. We are now aware that Jupiter is the largest and most massive of the planets so it is fitting to be named for the Roman king of the gods, who was also the god of the sky. While in Greek mythology, Jupiter's counterpart is Zeus, the supreme god of ancient Greece.

But Jupiter is not the brightest of the planets, that record is held by Venus. However, Jupiter and Venus are very different in how they wander across the sky. Nowadays we can explain that difference by where they are positioned in the solar system.

Venus, being an inner planet, remains close to the sun, appearing as the evening star after sunset or the morning star before sunrise. Whereas Jupiter, being an outer planet, can wander across the entire sky.



Jupiter holds the secrets to the early solar system. Credit: NASA/ FUSE / Lynette Cook

This motion, along with the planet's brightness, would've helped to mark Jupiter as the king of the planets.

Revolutions around Jupiter

In the year 1610, from late January through to early March, the astronomer Galileo used his new telescope to observe Jupiter. He easily identified and tracked first three, and then four bright points of light. They formed a straight line either side of Jupiter, but their positions were constantly and steadily changing relative to the planet.

Galileo in his publication Sidereus Nuncius, confidently and quite correctly explained this motion as the objects being in orbit around Jupiter. Here was proof that everything in heaven did not orbit the Earth, which at the time led to conflict between Galileo and the Catholic Church.

Galileo had discovered Jupiter's four major moons – Io, Europa, Ganymede and Callisto – each worlds within their own right and often referred to as the Galilean moons.

Since that time numerous more moons have been discovered and in the past few decades the count has jumped to 67 known satellites, the greatest number of any planet. It's no wonder Jupiter is often called a mini-system of its own.

The Great Red Spot

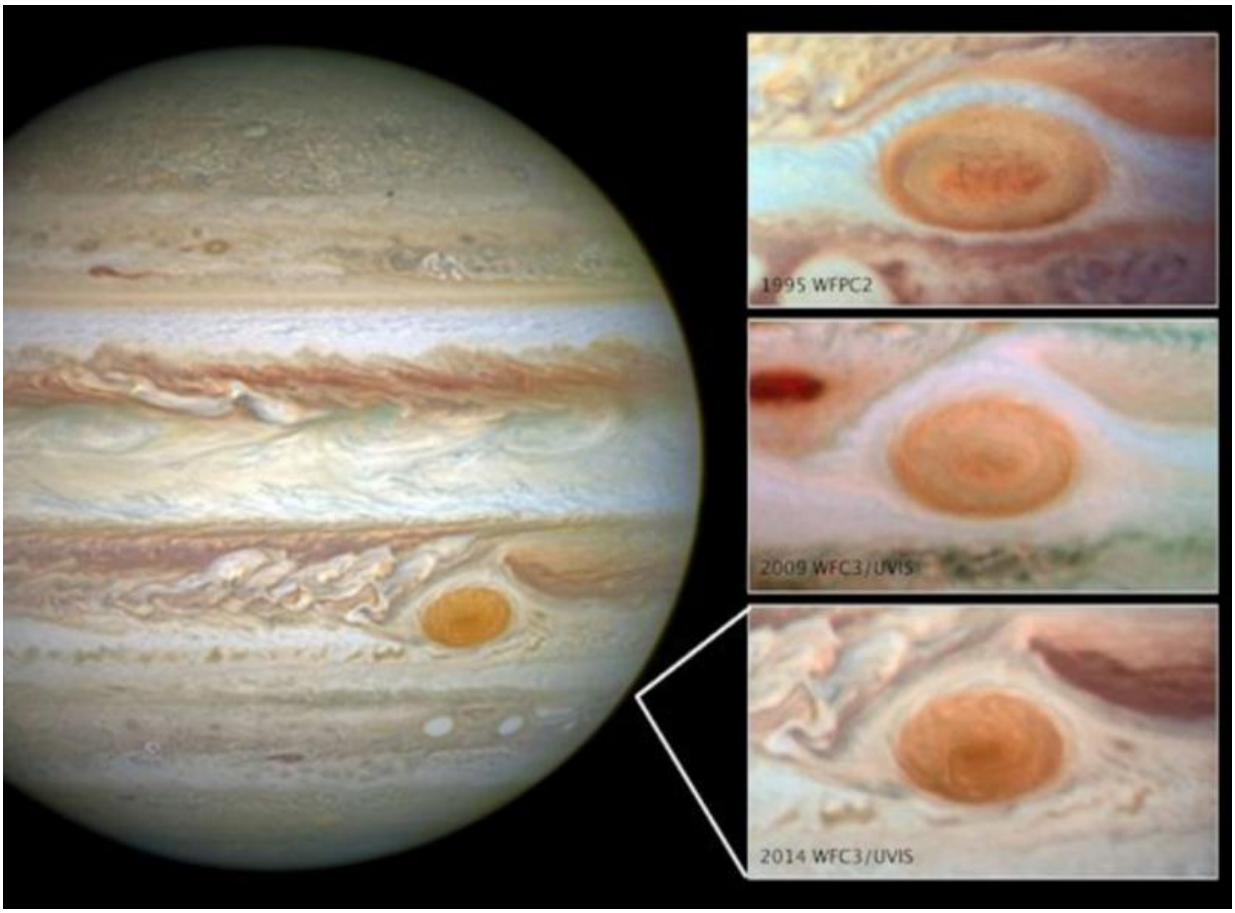
Saturn has its rings, Earth has its blue oceans and Jupiter has its vibrant and swirling bands of clouds. Jupiter rotates very quickly, spinning once every 10 hours. This drives the dynamic weather patterns seen in

Jupiter's cloud tops.

One of the big questions regarding Jupiter is just how deep do these clouds descend?

Furthermore, in recent times Jupiter's iconic Great Red Spot has been found to be shrinking. This massive storm system measuring about twice the size of Earth, has been a feature of the planet since it was first observed in 1664.

But recent observations from the Hubble Space Telescope show that the storm may now be less than half the size of some historical measurements. Since the 1930s astronomers have tracked this downsizing but more recently, the shrinking appears to be happening more rapidly.



The shrinking Great Red Spot over 20 years. Credit: NASA

Radiation Hazard

Jupiter has the strongest magnetic field of all the planets. At Jupiter's poles the magnetic field is 20,000 times stronger than Earth's and the field extends for millions of kilometres in space, even reaching past the orbit of Saturn.

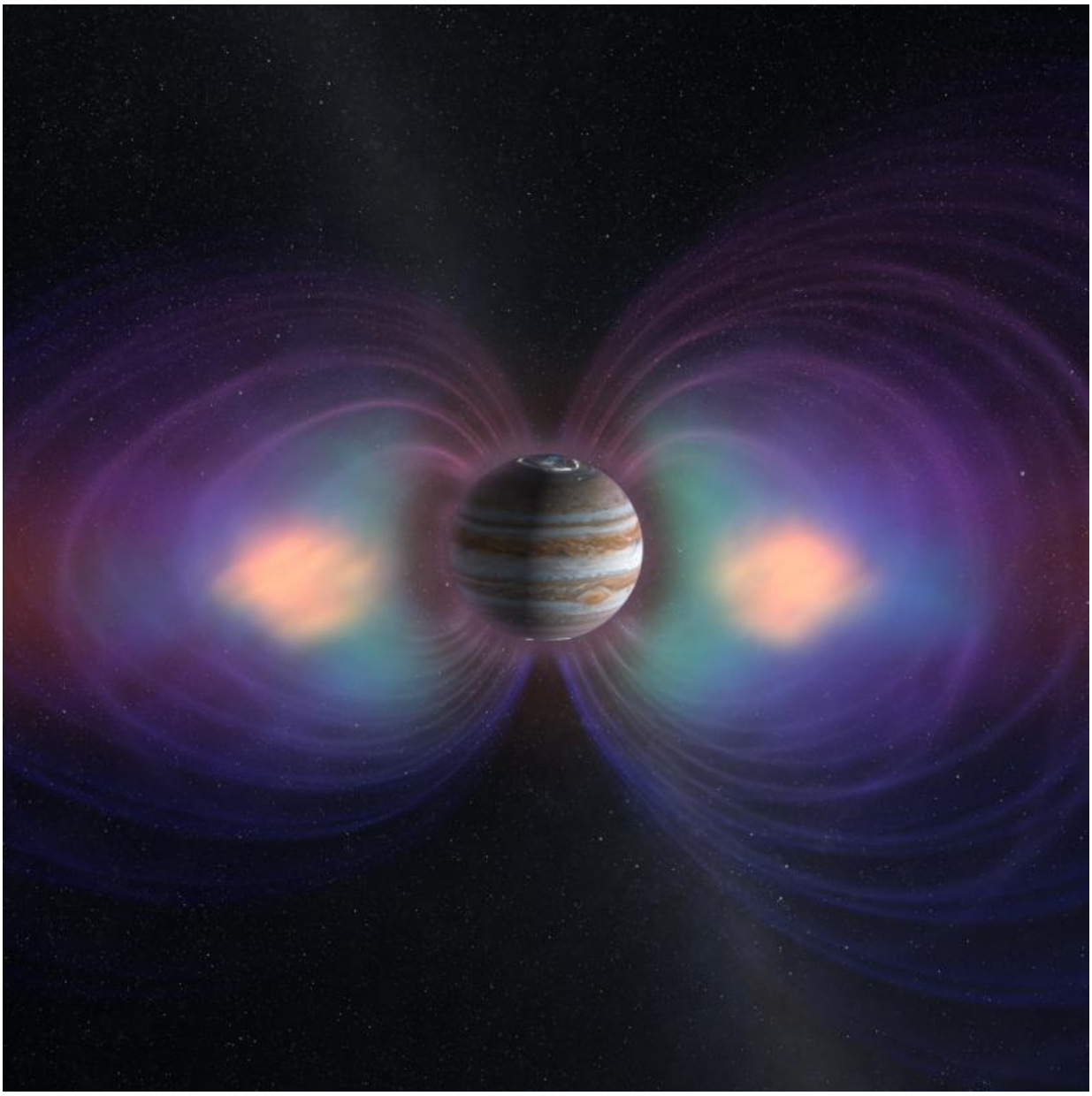
The dynamo powering Jupiter's magnetic field is thought to be a layer of liquid hydrogen deep within the planet. Hydrogen is under such high pressure inside Jupiter that it becomes a liquid. As such, it takes on the

characteristics of a metal; it can conduct electricity because the electrons within the hydrogen atoms are able to move around.

With the addition of Jupiter's fast spin, it's the perfect combination to create the powerful magnetic field.

This magnetic field traps charged particles - electrons, protons and ions - some originating from the solar wind but also flying in from Jupiter's Galilean moons, particularly volcanic Io.

Some of the particles are funnelled towards Jupiter's poles, creating Jupiter's impressive aurora that are 100 times brighter than the aurora experienced on Earth.



Jupiter’s inner magnetosphere and the bright radiation belts. Credit: NASA/JPL

Other particles become trapped by the magnetic field giving rise to Jupiter's radiation belts, an insanely intense version of the Earth's van Allen belts. Jupiter's magnetic field accelerates these particles to such a degree that they zip up and down the belt at nearly the speed of light,

creating the most hazardous radiation zone in the solar system.

Breaking all the records

Jupiter is the largest, most massive, fastest rotating, most hazardous planet of the solar system. It has the strongest magnetic field and the greatest number of known satellites. It has held onto the pristine gas from the interstellar cloud that gave rise to our sun.

Its strong gravitational influence has helped to move material around our solar system, potentially scattering ice, water and organic molecules from the outer cold regions of the solar system into the inner solar system where it could be captured by the Earth.

The first planets to be found orbiting around other stars were hot Jupiters, an apt description for exoplanets with masses similar to Jupiter that orbit very close to their stars and therefore have high surface temperatures.

One of the most long-standing questions that the Juno spacecraft will answer is how did Jupiter form? Did it begin with a rocky core that then attracted an enormous atmosphere or was Jupiter's origin more akin to a star and could it possibly have collapsed directly out of the solar nebula remaining gaseous right through to its core?

The next 18 months are set to be very interesting as the Juno spacecraft increases our understanding of the great gas giant, Jupiter.

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