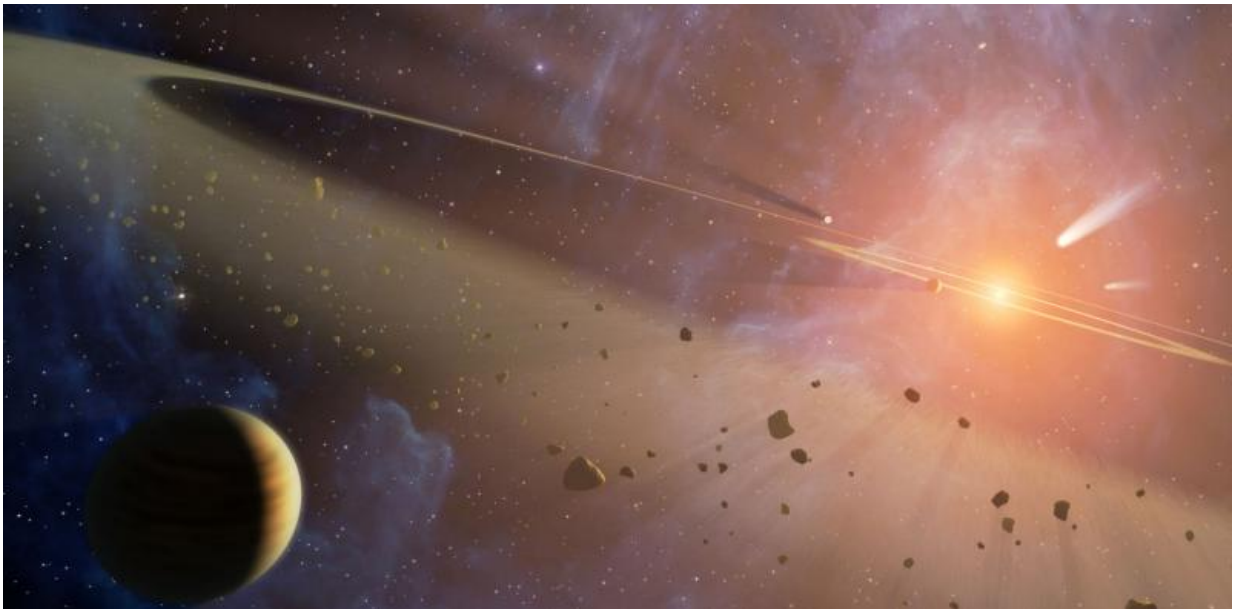


After Pluto there's still plenty of the solar system left to explore

July 23 2015, by Chris Arridge



Credit: NASA/JPL-Caltech, CC BY-NC

The past couple of years have been very exciting for space exploration. We've watched as spacecraft made visits to Mars, comet 67P and, just last week, Pluto, which for decades marked the edge of our solar system.

Given the fervour that surrounded last week's New Horizons mission, it's fair to wonder whether anything could be as exciting as flying past Pluto (with perhaps the exception of discovering alien life). We have a basic

understanding of our [solar system](#) – such as how moons, rings and planets interact in planetary systems, and what their atmospheres are made of. We also have theories about how the solar system was formed and has evolved. But we're far from finishing exploring our solar system and testing these theories. Several missions over the next decade and beyond will reveal new insights into our patch of the universe.

What's next?

New Horizons will continue to produce new discoveries as it transmits its measurements over the next year, but the next step is a fly-by of another [Kuiper Belt](#) object beyond the orbit of Pluto. The preferred candidate is a body designated [2014 MU69](#) that was discovered just [last year](#). If approval is granted later this year, a possible fly-by in 2019 could allow us to discovering more about this mysterious object and help us understand what happens at the very edge of our solar system and how it was formed.

In July 2016, [NASA's Juno mission](#) will enter orbit around Jupiter, the first spacecraft to do so since the end of the Galileo mission in 2003. Juno will study the interior of Jupiter, looking at its composition for information that could teach us about the formation of the solar system. It will also study [Jupiter's aurora](#) and how the planet connects with its [enormous magnetosphere](#), the largest physical structure in the solar system.

Europe's [ExoMars mission](#) aims to search for signatures of life on Mars using two spacecraft. The Trace Gas Orbiter, due to launch in 2016, will study the distribution of volatile gases such as water, methane and ozone in Mars' atmosphere, all of which could provide evidence for life. It will also act as a telecommunications relay for [a rover](#) that will be launched in 2018, which will drill two metres under the surface of the planet in search of similar biosignatures.



Brave new worlds. Credit: NASA, ESA, and G. Bacon, CC BY

There's more. The joint European-Japanese [BepiColombo mission](#) to Mercury will launch in 2017, with two spacecraft undertaking a detailed study of the planet's interior, surface and magnetosphere. And in 2018, Japan's [Hayabusa 2](#) spacecraft will arrive at [one of](#) the [Apollo asteroids](#) that cross the Earth's orbit and, after surveying it for a year, will return samples to Earth in 2020.

Further into the future, we have a big first to look forward to. In 2022,

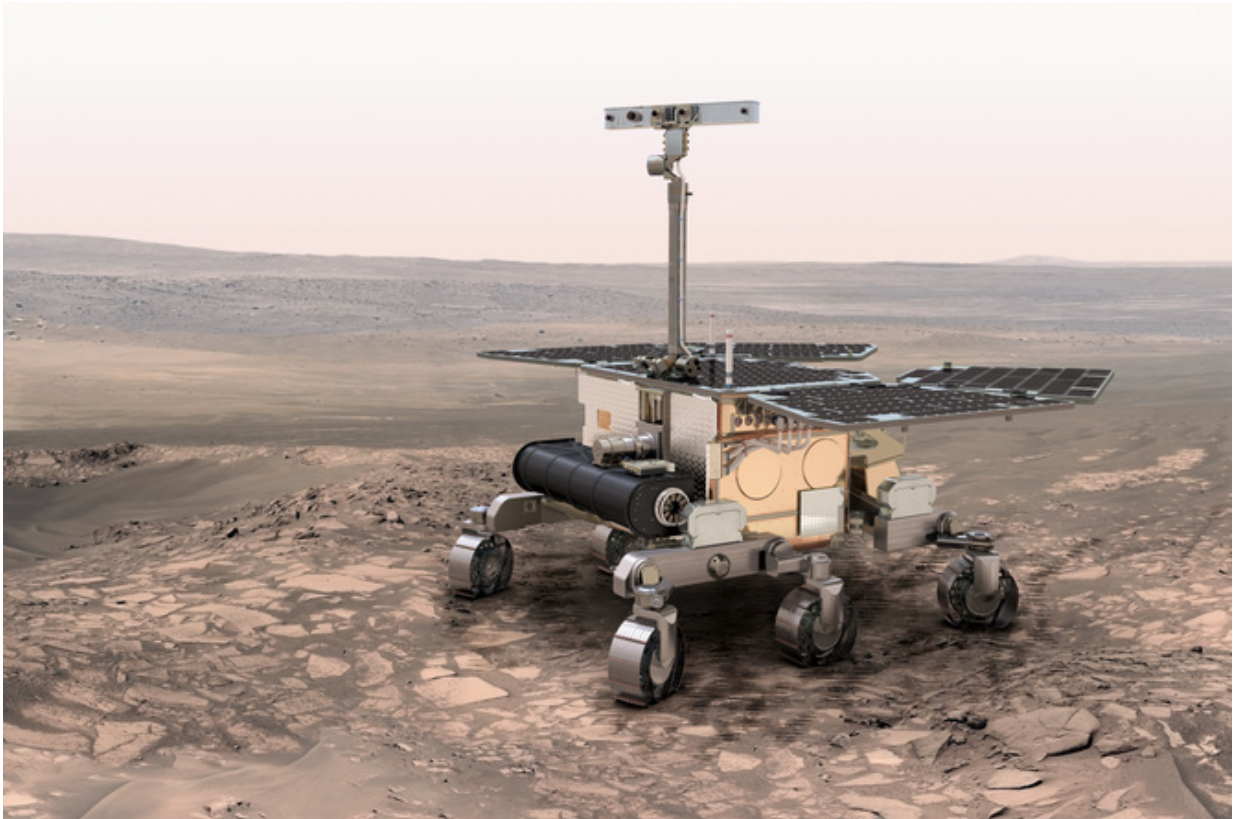
the European Space Agency (ESA) will send the [Jupiter Icy Moon Explorer \(JUICE\)](#) mission on a 10-year journey [to Ganymede](#), the largest moon in the Solar System. This will be the first time we have put a [spacecraft in orbit around the moon](#) of a giant planet. JUICE's primary aim is to study whether the moons of giant planets can be viable locations for life. A NASA mission called [Europa Clipper](#) will also explore another of Jupiter's moons, Europa, in the late 2020s/early 2030s.

Even with all of these planned missions, there are plenty of other corners of the solar system worth visiting again. Many scientists are not satisfied with simply making measurements from afar but want to get samples back from our moon, Mars and its moon Phobos. These so-called sample return missions still require a huge amount of technology development that will push our capabilities much further. But they are also a stepping stone to [human exploration](#) as robotic exploration allows us to test technology and reconnoitre distant hostile environments before we send humans.

Comets also continue to be a focus of attention for space scientists because there is no typical comet. "[Main-belt comets](#)", for example, are a recently discovered class of comet which reside in the asteroid belt and may hold the keys to understanding the source of Earth's water. The recent [discovery of volcanic activity on Venus](#) is also tempting atmospheric scientists and geologists to look again at Earth's "evil twin".

The outer solar system beyond Saturn is still very poorly explored. Uranus and Neptune have only received single fly-bys, similar to New Horizons at Pluto, with visits in 1986 and 1989 respectively. These ice [giant planets](#) form a unique class of planet and are quite different to the gas giants, Jupiter and Saturn. Scientists have been arguing for a [return to the ice giants](#) for the last decade. Triton, the largest moon of Neptune is of particular interest because it is suspected to be a Kuiper Belt object

that has been pulled into orbit in a similar way to the origins of Pluto. Without radically new technology, Triton is the only opportunity we have to encounter a Pluto-type object multiple times.



Move over Curiosity, here comes ExoMars. Credit: ESA

What's the point?

It is part of the human condition to explore and ask questions about [where we came from](#). Many of science's big questions, such as: "how did our Solar System evolve?" and "is there life beyond Earth?" aren't easy to answer without exploring the universe. One of Philae's main science

questions was to try to unravel why certain biological molecules are shaped the way they are.

These answers also come with a cost. New Horizons cost around US\$700m (£450m), although this only works out at about US\$2 (£1.30) for each US citizen. But this cash wasn't just launched into space. The money for [space exploration](#) goes to the same industries that support other sectors we rely on, such as global communications, weather observations and navigation. The same scientists also educate the next generation of scientists and engineers who in turn will ask those same big questions and seek answers amongst the planets.

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