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Solar system

# The Lucy spacecraft has set off on a journey to study Trojan asteroids

Leah Crane

NASA's latest mission to study the Trojan asteroids launched on 16 October from Cape Canaveral, Florida, aboard an Atlas V rocket. The Lucy spacecraft will be the first to visit them up close.

The Trojan asteroids circle the sun in two swarms that share Jupiter's orbit like a police escort for the planet, one moving ahead of Jupiter and the other just behind it. They are some of the most pristine relics from the early solar system, thought to be leftovers from the process that formed the outer planets.

"They're held there by the gravitational effect of Jupiter and the sun, so if you put an object there early in the solar system history, it [will be] stable forever," said mission leader Hal Levison at Southwest Research Institute in Texas during a press conference on 13 October. "These things really are the fossils of what planets form from."

Despite their importance, the asteroids' strange orbits mean that we have never studied them up close. To get there, Lucy will follow



SOUTHWEST RESEARCH INSTITUTE/NASA

## Illustration of the Lucy probe passing one of the Trojan asteroids

a complex trajectory over 12 years. First, it will make two fly-bys of Earth to build up momentum, which will toss it towards the leading swarm of asteroids.

On its way there, it will pass a non-Trojan asteroid in 2025 named (52246) Donaldjohanson after the discoverer of Lucy, a famous fossilised skeleton of a human ancestor for which the

mission is named. Once the spacecraft reaches the leading swarm, it will examine four Trojan asteroids, one of which has its own moon.

Finally, Lucy will swoop past Earth again and visit a pair of asteroids in the trailing swarm in 2033. After that, if all goes well, it will keep flying back and forth between the two clouds of Trojans every six years until the solar-powered spacecraft deteriorates.

Lucy carries three scientific instruments. One will measure

the heat coming off the asteroids to figure out their surface properties, while another will examine light bouncing off them to learn about their make-up. The third

**"These asteroids in Jupiter's orbit really are the fossils of what planets form from"**

instrument is a camera that will take detailed colour images.

The spacecraft will visit all three main kinds of Trojans, which are defined by the colour and reflectivity of their surfaces. The three types may indicate different compositions or birthplaces of these asteroids, which could help us understand where in the solar system they formed and how they were tossed around as the giant planets migrated to their current locations.

"If you want to understand what this population is telling us about how the planets formed, you need to understand that diversity, and that is what Lucy is intended to do," said Levison. ■

Military technology

## Robot dog armed with a sniper rifle goes on display

THE US military may be getting a dog-like quadruped robot armed with a sniper rifle. The robot, developed by Ghost Robotics of Philadelphia, is a new version of its Vision series of legged robots.

The US Air Force is testing an unarmed version of these robots for the Tyndall Air Force Base in Florida. Ghost Robotics displayed the armed version at the annual meeting of the Association of the United States Army in Washington DC last week.

Ghost Robotics has been developing quadruped robots since 2015 and has previously displayed versions fitted with additions including arms for bomb disposal and a disruptor, a shotgun-like device for disabling bombs.

The robots are highly mobile, able to cross rugged terrain that might be difficult for wheeled and tracked machines, and can operate with a high degree of autonomy.

However, Ghost Robotics CEO Jiren Parikh is quick to dismiss any ideas that the sniper rifle is an autonomous weapon system.

"It is fully controlled by a remote operator," says Parikh. "There is a



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human controlling the weapon, there is no autonomy or AI."

He says that the robot was chosen by customers for its ability to move in difficult terrain, allowing it to take up a suitable firing position for sniper shots. This applies equally

The robot is fitted with a powerful 6.5 millimetre sniper rifle, controlled by a human operator

outdoors and in urban settings where, for example, it can climb stairs. Meanwhile, the operator can stay concealed out of the line of fire.

Parikh notes that while there were numerous uncrewed tracked and wheeled vehicles with weapons at the same show, his has been singled out. He suggests that it triggers an emotional reaction as it looks like an animal, and because of decades of science fiction movies about dangerous robots. ■

David Hambling