

Aboard the first spacecraft to the trojan asteroids—NASA Ralph's next adventure

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Illustration of Lucy. Credit: SwRI

Ralph, one of NASA's most well-traveled space explorers, has voyaged far and accomplished much: on the New Horizons mission, Ralph obtained stunning flyby images of Jupiter and its moons; this was followed by a visit to Pluto where Ralph took the first high-definition

pictures of the iconic minor planet. And, in 2021, Ralph journeys with the Lucy mission to Jupiter's Trojan asteroids.

Ralph, however, is not an impossibly accomplished astronaut—it is a scientific instrument that has made many discoveries since it first launched aboard the New Horizons spacecraft in 2006. Given a name and not an acronym, Ralph enables the study of the composition and atmospheres of celestial objects.

New Horizon's Ralph—which was the first mission to visit Pluto and its moons—will fly by another Kuiper Belt object called 2014 MU69 (nicknamed Ultima Thule) in January 2019. Ralph's observations of 2014 MU69 will provide unique insights into this small, icy world.

The Lucy spacecraft carries a near-twin of Ralph, called L'Ralph ("Lucy Ralph"). This instrument will investigate Jupiter's Trojan asteroids, which are remnants from the early days of the solar system. The L'Ralph instrument suite will study this diverse group of bodies; Lucy will fly by six Trojans and one Main Belt asteroid—more than any other previous asteroid mission. L'Ralph will detect the Trojan asteroids' chemical fingerprints.

The Lucy mission payload will investigate the Trojans using: the Long Range Reconnaissance Imager (L'LORRI), the Thermal Emission Spectrometer (L'TES), and L'Ralph. L'LORRI will take high-definition photos of the Trojans, and L'TES will analyze the heat given off of the Trojans' surface structures. L'Ralph, meanwhile, allows scientists to interpret data provided by the Sun's reflected light that are the fingerprints of different elements and compounds. These data could provide clues about how organic molecules form in primitive bodies, a process that might also have led to the emergence of life on Earth.

L'Ralph's instrument suite contains the Multi-spectral Visible Imaging

Camera (MVIC) and the Linear Etalon Imaging Spectral Array (LEISA), both of which are fed by the same optics, meaning that Ralph can observe both visible and infrared wavelengths. These dual capabilities are what makes Ralph and its cousin L'Ralph so special, according to Dennis Reuter, the instrument principal investigator for L'Ralph. "Most instruments can image visible or infrared wavelengths, but L'Ralph can do both," said Reuter. "We fit everything into this one small package." At NASA's Goddard Space Flight Center in Greenbelt, Maryland, Reuter is also the instrument scientist for Ralph on New Horizons.

L'Ralph needs to have many capabilities in a small, light body structure to keep the spacecraft efficient and the mission productive. "The key to instrument design for spacecraft is that you want to keep everything as simple as you can possibly keep it," said Lucy Project Scientist Keith Noll, who is also located at Goddard. "L'Ralph splits light as a function of wavelength: shorter wavelengths of visible light are sent in one direction and the infrared light goes in another direction. You build a picture as the spacecraft flies along."

Infrared telescopes are vital for modern astronomy: infrared radiation, though at wavelengths too long for the human eye to see, can be sensed by humans as heat. But breaking this infrared radiation into its constituent "colors," a process called spectroscopy, is where the infrared instruments like L'Ralph LEISA become necessary. In conjunction with L'Ralph MVIC's multi-color mapping ability, L'Ralph LEISA will allow scientists to detect the presence of surface compounds including ices and minerals made from various compounds and, particularly, organic materials.

If the L'Ralph [instrument](#) suite finds these substances, it will provide key information on the material that replenished the Earth's atmospheres and oceans, after its hot and violent beginnings.

In comparison to the Ralph that flies with New Horizons, Lucy's L'Ralph has enhanced technology. It can detect a broader spectrum of electromagnetic radiation, it has a moving mirror that reflects light into L'Ralph instead of requiring movements of the entire spacecraft, and Ralph's infrared detectors are 2,000 pixels square, compared to New Horizons Ralph's 256 by 256, allowing for images with more detail.

Originally paired with the ultraviolet spectrometer Alice, Ralph was named for Ralph Kramden of the television show "The Honeymooners," a character whose wife was named Alice. "Since L'Ralph is using the same concept as the Ralph on New Horizons, when we did the proposal, we wanted to connect them," Reuter said. Ralph's lineage was born.

As one Ralph advances deeper into the Kuiper Belt and another prepares for its voyage to the Trojan Asteroids, both instruments are tasked with examining some of the oldest bodies in our solar system. Each second of flyby brings us many steps closer to answering an ancient question: how did we get here? Perhaps L'Ralph will help us find this long-awaited answer.

Source: NASA

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