NASA awards CU-Boulder $3.3 million for concept study for mission to Venus

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A proposal by CU-Boulder for a mission to Venus has been selected as one of three finalists by NASA for an upcoming solar system exploration expedition. Credit: Larry Esposito, University of Colorado/NASA

NASA has awarded the University of Colorado at Boulder $3.3 million for a detailed, one-year concept study for a lander mission to Venus to study the history of its surface, climate and atmosphere and to predict its ultimate fate in the solar system.

The CU-Boulder-led mission would allow scientists to better compare Venus with other terrestrial planets -- including Earth, Mars and Mercury -- as well as planets recently discovered orbiting stars in other solar systems, said CU-Boulder Professor Larry Esposito, science team leader on the Venus mission proposal. While Venus and Earth were similar at birth, Venus has since turned into "Earth's evil twin" because of its extremely harsh and inhospitable conditions, said Esposito of CU-Boulder's Laboratory for Atmospheric and Space Physics.

The concept study by CU-Boulder to land a spacecraft on Venus is one of three space exploration projects selected as finalists by NASA today for a $650 million solar system mission to launch no later than 2018. The other proposals selected for further study include one led by the University of Arizona to rendezvous with and orbit a primitive asteroid and one led by Washington University in St. Louis to land near the moon's south pole and return lunar materials to Earth for study.

"It has been 25 years since a spacecraft last landed on Venus, and our curiosity and scientific capabilities have increased dramatically," said Esposito. "This mission will be a big step forward in understanding planetary evolution both in our own solar system and in planetary systems around other stars."

As part of CU-Boulder's proposed Surface and Atmosphere Geochemical Explorer, or SAGE mission, the lander would descend onto the flank of an active volcano on Venus known as Mielikki Mons, which is about 200 miles across and 4,800 feet in altitude. Once the lander was in place, instruments on the spacecraft would dig down about four inches into the surface, then zap the soils with two lasers and a vacuum tube shooting large pulses of neutrons, which would bounce back data to the lander with information on the surface composition and texture, said Esposito.

The lander would be constructed to survive the harsh conditions on Venus for three hours or more, said Esposito, a professor in the astrophysical and planetary sciences department. "Venus has gone terribly bad since it first formed," he said. "The surface pressure is 100 times that of Earth and its temperature is similar to that of a self-cleaning oven. We are very interested in what sent Venus down this hellish path, including its runaway global warming."

Venus also has a toxic atmosphere filled with carbon dioxide gases and acid rain, he said. "Understanding the physical and chemical reasons for this uncontrolled warming may help scientists better understand the eventual fate of Earth."

Instruments proposed to fly on SAGE include a flyby camera, temperature, pressure, dynamics and wind speed hardware, a tunable laser spectrometer to measure stable isotope ratios and a neutral mass spectrometer to measure gases. The lander also would carry descent and panoramic cameras, a microscopic camera, a neutron-activated gamma ray spectrometer and a third spectrometer to measure surface and subsurface composition minerals and elements, he said.

"The minerals that make up the Venus upper crust are still unknown," said Esposito. "The new information would allow our scientific team to better compare Venus to the other terrestrial planets in our solar system and beyond."

The proposed Venus mission will build on data collected by the European Space Agency's Venus Express Mission, an orbiter launched in 2005 that is carrying a camera, two spectrometers, a radio science experiment and a space plasma and atom-detecting instrument. Esposito, who is a co-investigator of the European mission, said Venus Express has detected several volcanoes with possible recent lava flows, and data from the mission was used to select the proposed landing site for the CU-Boulder mission.

CU-Boulder would provide the science leadership, data archiving, education and public outreach effort for the proposed SAGE mission. SAGE partners include NASA's Jet Propulsion Laboratory in Pasadena, which would provide the SAGE project management; Lockheed Martin of Denver which would build the carrier spacecraft; the NASA Ames Research Center in Moffet Field, Calif.; NASA's Goddard Spaceflight Center in Greenbelt Md.; and NASA's Langley Research Center in Hampton, Va.

SAGE's robotic arm for digging into the surface of Venus would be contributed by the Canadian Space Agency, said Esposito.

In 1983 Esposito used data from a CU-Boulder instrument that flew on NASA's Pioneer Venus spacecraft to uncover evidence that a massive volcanic eruption poured large amounts of sulfur dioxide into the upper atmosphere and was 10 times more powerful than any volcanic eruptions on Earth in the past century. Esposito also led a team that took the first images of Venus with the Hubble Space Telescope in 1995.

Esposito also is the science team leader for a $12.5 million CU-Boulder Ultraviolet Imaging Spectrograph that is riding on the Cassini spacecraft now touring Saturn and its moons system.

Provided by University of Colorado at Boulder