NASA-supported solar sail could take science to new heights

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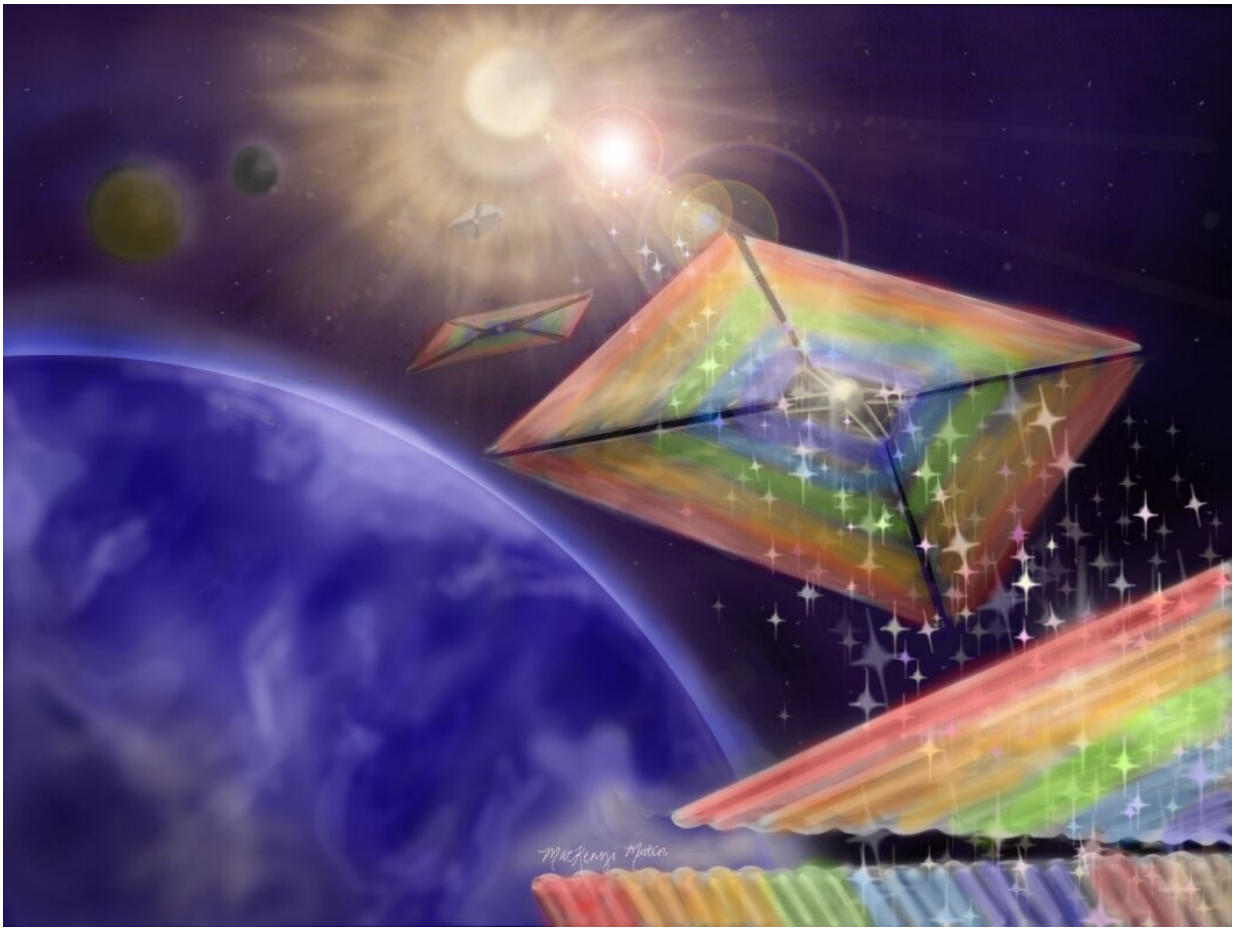

Diffractive solar sails, depicted in this conceptual illustration, could enable missions to hard-to-reach places, like orbits over the Sun's poles. Credit: MacKenzi Martin

As NASA's exploration continues to push boundaries, a new solar sail concept selected by the agency for development toward a demonstration mission could carry science to new destinations.

The Diffractive Solar Sailing project was selected for Phase III study under the NASA Innovative Advanced Concepts (NIAC) program. Phase III aims to strategically transition NIAC concepts with the highest potential impact for NASA, other government agencies, or commercial partners.

"As we venture farther out into the cosmos than ever before, we'll need innovative, cutting-edge technologies to drive our missions," said NASA Administrator Bill Nelson. "The NASA Innovative Advanced Concepts program helps to unlock visionary ideas—like novel solar sails—and bring them closer to reality."

Like a sailboat using wind to cross the ocean, solar sails use the pressure exerted by sunlight to propel a craft through space. Existing reflective solar sail designs are typically very large and very thin, and they are limited by the direction of the sunlight, forcing tradeoffs between power and navigation. Diffractive lightsails would use small gratings embedded in thin films to take advantage of a property of light called diffraction, which causes light to spread out when it passes through a narrow opening. This would allow the spacecraft to make more efficient use of sunlight without sacrificing maneuverability.

"Exploring the universe means we need new instruments, new ideas, and new ways of going places," said Jim Reuter, associate administrator for NASA's Space Technology Mission Directorate (STMD) at NASA Headquarters in Washington. "Our goal is to invest in those technologies throughout their lifecycle to support a robust ecosystem of innovation."

The new Phase III award will give the research team $2 million over two

years to continue technology development in preparation for a potential future demonstration mission. The project is led by Amber Dubill of the Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland.

"NIAC allows us to foster some of the most creative technology concepts in aerospace," said Mike LaPointe, acting program executive for the NIAC program at NASA Headquarters. "Our goal is to change the possible, and diffractive solar sailing promises to do just that for a number of exciting new mission applications."

Diffractive lightsailing would extend solar sail capability beyond what's possible with missions in development today. The project is led by Amber Dubill of the Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland. The feasibility of the concept was previously studied under NIAC's Phase I and Phase II awards, led by Dr. Grover Swartzlander of Rochester Institute of Technology in New York, who continues as a co-investigator on the project. Les Johnson, lead for two of NASA's upcoming solar sail missions at NASA's Marshall Space Flight Center in Huntsville, Alabama, also is a co-investigator. Under the earlier awards, the team designed, created, and tested different types of diffractive sail materials; conducted experiments; and designed new navigation and control schemes for a potential diffractive lightsail mission orbiting the Sun's poles.

Work under Phase III will optimize the sail material and perform ground tests in support of this conceptual solar mission. Orbits passing over the Sun's north and south poles are difficult to achieve using conventional spacecraft propulsion. Lightweight diffractive lightsails, propelled by the constant pressure of sunlight, could place a constellation of science spacecraft in orbit around the Sun's poles to advance our understanding of the Sun and improve our space weather forecasting capabilities.

"Diffractive solar sailing is a modern take on the decades old vision of lightsails. While this technology can improve a multitude of mission architectures, it is poised to highly impact the heliophysics community's need for unique solar observation capabilities," said Dubill. "With our team's combined expertise in optics, aerospace, traditional solar sailing, and metamaterials, we hope to allow scientists to see the Sun as never before."

Provided by NASA's Goddard Space Flight Center