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Synthetic muscle experiment will likely return to Earth in March

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A synthetic muscle experiment on board the International Space Station (ISS) that was developed with the help of Princeton Plasma Physicists Laboratory scientists is now tentatively scheduled to return to earth in March of 2016 on a new SpaceX-10 rocket. It would be returning eight months later than originally planned after an unmanned SpaceX Falcon 9 rocket headed for the ISS exploded a few minutes after liftoff in late June.

The rocket, carrying the Dragon capsule with 4,000 pounds of foods and supplies, was on its seventh resupply flight to the ISS. It was the third loss of a rocket bound for the ISS in the past year. In April, a Russian resupply ship exploded and in October an Orbital Sciences Corp. Antares rocket carrying a Cygnus cargo craft exploded shortly after liftoff.

The Synthetic Muscle material, developed by scientist Lenore Rasmussen at Ras Labs in Quincy, Massachusetts, lifted off on April 14 aboard the same rocket, which was carrying the Dragon spacecraft and some 4,300 pounds of supplies and payloads, including materials for research experiments to the U.S. National Laboratory. The experiment was slated to return to earth aboard the capsule in mid-July. But the material must now remain in space through March while Space X investigates the explosion and takes steps to prevent any future problems.

The additional time on board the Space Station means the material will be exposed to much more space radiation after several months in space than it would be in three months. "I would like to get the experiment back to see what happened but from a scientific point of view it's good to get the longer exposure," Rasmussen said. "It's not really a setback. It's just a delay."

Rasmussen worked closely with PPPL scientists to develop the material's ability to adhere to metal. She also tested the material for radiation resistance at PPPL laboratories last year when scientists exposed the material to 300,000 RAD of gamma radiation. The tests showed there was no change in the material integrity or electroactivity of the selected materials when exposed to high doses of radiation.

"There have only been 1,200 experiments on the whole planet that made it to the International Space Station and her package, with us helping, was one of them," said Charles Gentile, who collaborated with Rasmussen on the experiments at PPPL. "It shows PPPL is able to support collaborations on a broad spectrum in addition to fulfilling the needs of our mission to develop fusion energy."

Rasmussen was back at the Laboratory in late July to discuss future collaborations with Gentile and other scientists. One possibility would be to expose the material to extreme cold temperatures of 400 millikelvin by using a dilution refrigerator that is being used in the PTOLEMY project at PPPL that seeks to detect Big Bang neutrinos. The temperature is much colder than the temperature of space and is even colder than the temperature of liquid helium of about 4 kelvin.

Astronauts on the Space Station continue to take the material from its floating locker in the U.S. laboratory once a month and send back photographs to Rasmussen. "Everything looks good so far," Rasmussen said.

With the material still in space, Rasmussen must wait for research results that will tell her how well the material withstands the high radiation levels in space. If the material holds up well, it could be useful in developing robots for deep-space exploration such as trips to Mars. It could also be used for robots remediating sites on earth contaminated with high radiation that are too dangerous for humans.

While the material remains on the ISS, Rasmussen has also had to push back the deadline on a chapter in a book she is editing on electroactive polymers, which will include contributions from various experts in the field.

In the meanwhile, Rasmussen has been busy working on developing the synthetic material for use in prosthetic limbs and other applications. "Now I'm trying to make the materials even more electroactive but maintain that robustness," she said.

Rasmussen has also been developing a prototype of a self-adjusting prosthetic liner made from the material through a grant from the Pediatric Medical Device Consortium at the Children's Hospital of

Philadelphia. The electroactive polymer could make prosthetics more comfortable because the material would be capable of automatically adjusting as the vestigial limbs of amputees expand and contract during the day.

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