SPACE SCIENCE

Researchers Hold Their Breath Over Mir Repair

The collision that punched a hole in Mir's Spektr module on 25 June dealt a serious blow to some experiments being carried out on the space station and put the future of the aging station in doubt. Indeed, researchers are now worrying whether planned experiments will ever make it into space.

Valeri Ryumin, head of the collaborative research program between NASA and the Russian Space Agency (RSA), told *Science* that the collision brought to a halt as much as 35% of current experiments on board Mir. Some were irreparably damaged by the sudden shutdown, but others will continue when new materials are brought up by the Soyuz craft in August and the space shuttle in September. "I hope that after the repair work is completed in the Spektr module, the level of the research will be restored," Ryumin says. A Russian-French mission planned to begin in August has been postponed, however, and some members of the U.S. Congress are openly questioning whether NASA should continue to participate in experiments aboard Mir.

Continued U.S. participation is vital because much of the research on Mir is supported by $400 million from U.S. coffers in a collaborative program between RSA and NASA. This work, currently coordinated on board by NASA astronaut Michael Foale, began in June 1995 when the Atlantis space shuttle docked for the first time with Mir. The sixth shuttle visit brought Foale into orbit, and the next—scheduled to carry Foale's replacement, Wendy Lawrence—is slated for September if NASA determines that Mir is safe.

The bulk of the life sciences equipment provided by NASA is inside the damaged and airless Spektr module. As a result, most of NASA's human life sciences work has ground to a halt. Blood samples in Spektr, for example, are likely lost, although the state of equipment such as the bicycle ergometer and cardiovascular monitor is unknown. Experiments in other parts of the station are also suffering because damage to Spektr's solar arrays has caused a 50% drop in electrical output. "Every day is a battle for amps," says John Charles, a NASA physiologist serving as the U.S. mission scientist.

Since the accident, crew members have had little time for science, because they are spending most of their waking hours simply maintaining the station. But Charles says some research is still getting done, such as a study that explores how sleep in space differs from that on Earth. And the crew is still providing sporadic light to a greenhouse experiment in the Priroda module. On 23 July, for example, Foale planted a second generation of mustard seeds grown aboard Mir as part of an effort to understand the generational effects of microgravity on plant development. He also spent part of the next day photographing the formation of crystals in a colloidal gel as part of a materials science experiment that explores the physics of the suspension process in the absence of gravity. Pre- and postflight studies on bone density changes and muscle loss will not be affected by the problems on Mir, Charles adds.

NASA

Uncertain future. Mir's damaged and airless Spektr module contains numerous experiments.

The power problems have, however, grounded French astronaut Leopold Eyharts, who was due to fly to the station on the August Soyuz flight for a 3-week research mission. RSA head Yuri Koptev says the French mission would make no sense now, because the experiments could not run until the power supplies are repaired. As a result, Eyharts's stay on Mir, dubbed the Pegasus mission, has been postponed until January. "We just wanted to make sure the research program is fulfilled. That's why we preferred to put off the launch of Leopold Eyharts's mission," says Jean-Yves Le Gall, deputy director of the French space agency CNES.

Pegasus builds on a Russian-French mission named Cassiopeia that flew last August. The mission is scheduled to study cardiovascular function and adaptation to microgravity; neuroscience; reproductive biology; the behavior of fluids in microgravity; and the mechanical behavior of structures in space. One experiment, designed by a team led by neuroscientist Alain Berthoz of the Collège de France in Paris, will explore the perception and control of force through a kind of tactile virtual reality. "The control of sensory motor systems is deeply influenced by the presence of gravity, far more so than people are prepared to accept," says Berthoz. The Pegasus equipment was first lofted to Mir for Cassiopeia, and it was not damaged in the accident, says Claudie Andre-Deshays, the French cosmonaut on Cassiopeia. The Russian cosmonauts will also continue to gather long-term data between the two French missions.

Although Eyharts will not be on the 5 August Soyuz flight, the other two cosmonauts—Anatoly Solovyov and Pavel Vinogradov—will go up as planned to try to repair the Spektr module. Their work plan, says Koptev, includes six spacewalks: First, they will mend the power supplies; then they will examine the exterior surface of Spektr and patch the two holes. "First of all, they need to ensure that the module is once again hermetically sealed, and only after this can they proceed with internal work. Entering the narrow module in a space suit is dangerous and difficult," says Koptev.

Despite the Russians' confidence that they can repair Mir, the accident has crystallized fears on Capitol Hill that the research effort and the foreign policy benefits of working with Russia could be endangering U.S. lives. "It may be higher risk than it's worth," NASA Inspector-General Roberta Goss told a Senate panel on 24 July. And Senator John McCain (R–AZ), who chairs the Commerce Committee which oversees NASA, warned NASA Administrator Daniel Goldin that astronaut safety must be paramount.

Goldin insisted at the hearing that the program has been a boon for designers of the international space station by providing real-life experience. For example, he says NASA will ensure that the international station has a fail-safe docking system that can handle the different U.S., Russian, European, and Japanese spacecraft visiting the orbiting lab. But he added that NASA will not decide whether Lawrence will replace Foale until shortly before Atlantis's September flight. White House officials are also putting a brave face on the recent events, saying that even if future research on Mir is limited because of the problems on the station, the program has been worth it. "We're well along with the work we wanted to do on Mir," says Jack Gibbons, President Bill Clinton's science adviser. "We've gained a lot of experience that's invaluable."

–Andrew Lawler, Elena Savelyeva, and Helen Gavaghan

Savelyeva and Gavaghan are writers in Moscow and Hebden Bridge, U.K., respectively.