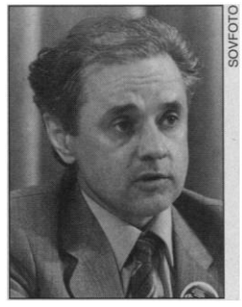
Russian Space Science Limps On

An ambitious list of projects, many of which include collaborations with Western researchers, is being held together with a shoestring—and some outside help

Just a couple of years ago, the Soviet Union boasted a space program that was arguably second to none. The Soviets had a functioning space station in orbit, run by a changing roster of international astronauts, while the U.S. National Aeronautics and Space Administration (NASA) had little more than an ever-changing plan that hadn't flown further than the U.S. Congress. As NASA nursed its wounds after the 1986 Challenger disaster, Soviet engineers were racking up launch after successful launch from their Baikonur cosmodrome—and Western space scientists were eagerly signing up to join planned Soviet missions in astronomy and planetary science.

But now, life at Moscow's Space Research Institute (IKI), the nerve center of the former Soviet space science program, is very different. Astrophysicists earn less than bus drivers, and many researchers, faced with an annual rate of inflation pushing 1000%, spend as much time thinking about how to buy the basic necessities of life as they do planning for space launches. All this is unnerving to Western researchers, as they wait anxiously to see whether the projects they had been counting on to get their own instruments into space will survive. The surprising message from scientists in close touch with their Soviet colleagues, however, is don't panic—yet.

"People are asking, 'Has it all ground to a standstill?' " says Alan Wells, a British space scientist from the University of Leicester who is a regular visitor to IKI. The answer he gives is an emphatic no. And last week, at the end of a month-long visit to the United States, IKI director Albert Galeev was presenting an upbeat picture to Western space scientists, assuring them that he has the backing of Boris Yeltsin's Russian government. Galeev pointed out, for example, that Yeltsin has asked him to prepare a long-term space science plan—something that's not been done for 2 years. Some missions may be postponed, some have already been lost. But through sheer determination, and with a little leverage provided by the hard currency that Russian space scientists are beginning to win through unorthodox deals with Western agencies (see box and p. 1510), senior IKI officials hope they can keep at least their flagship missions alive. "In principle," Galeev told *Science*, "all of the [planned] projects stay in the future program."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Albert Galeev

In practice, however, Galeev is likely to find himself stretching out launch schedules and applying triage to the grandiose collection of projects Russia has inherited from the Soviet space program. The biggest and most technically challenging of those projects are the Mars 94 and Mars 96 missions—which feature Mars orbiters, a balloon with instruments to study Martian atmospheric chemistry, and a rover to range over the planet's surface. Then there's the Spectrum series of three high-energy astrophysics satellites, one for each of the x-ray, radio, and ultraviolet spectra, the first of which could be launched by 1995. In space plasma physics, there's Interball—two satellites to study the solar wind and its interaction with Earth's magnetosphere. And cosmologists are counting on a 1994 launch for the Relikt-II probe, which should confirm or deny the existence of the anisotropy—or ripples—in the microwave background found by NASA's Cosmic Background Explorer (COBE). Even if some of these projects are dropped or de-

Western Agencies Bend the Rules

As Russian researchers struggle to preserve as much as possible of the former Soviet Union's once grandiose space science program, even small donations of hard currency from the West can help tip the balance for individual projects. In Europe, government agencies are doing their bit, relaxing usually strict rules that prohibit the transfer of funds from one country to another for international projects.

CNES, the French space agency, led the way, agreeing earlier this year to help fund a ground station at Evpatoria in Ukraine, which is receiving data from Granat—a satellite that could be a victim of its own success. Planned to last only 8 months from its 1989 launch, Granat is still going strong, yielding stunning gamma-ray observations of sources including the galactic center, but it's now costing money that the Russian space scientists who operate the ground station hadn't budgeted for.

In mid-April, DLR, the German air and space transport research agency, followed the French lead and agreed to provide Moscow's Space Research Institute (IKI) with $250,000 to help keep the Mars 94 mission on schedule, in return for access to technology developed for the Mars 96 planetary rover. The European Space Agency also recently bought into the Mars 94 mission, providing $4.5 million worth of on-board computer memory, in return for access to data. And CNES is now arranging to transfer up to $1.8 million to a Moscow bank account for possible use for the Mars mission. Genevieve Debouzy, CNES's head of space science, says that the aim is to "guarantee against inflation of the ruble." The money won't necessarily be used, she says, but it should allow IKI to assure its industrial contractors that they will get paid, even if the ruble becomes worthless.

Even NASA, which has lagged behind the European agencies in collaborating with the Soviets—and now the Russians—is contemplating deals of its own. Don Miller, an official in NASA's international relations division, says that the agency is interested in paying to use two 72-meter dishes—one at Evpatoria, the other at Ussurisk in eastern Siberia—to supplement NASA's own Deep Space Network in tracking the Galileo mission to Jupiter. "It may be a way of getting a lot of data that would otherwise be lost," he says.

While isolated contracts like these can't provide the long-term financial security that Russian space science desperately needs, they might keep some missions on the launch schedule—and some research teams intact.

–P.A.

layed, what's left would still amount to an ambitious space science program.

One general rule appears to be emerging: Money talks, and Western hard currency talks loudest of all. Galeev claims that the degree of Western investment isn't the only factor in deciding launch schedules for the Russian space program, but, he says, "officials and the Academy [of Sciences] understand that we should fulfill our promises" to Western collaborators.

That means the two Mars missions are better placed than most Russian space missions: Agencies from some 20 Western countries have already committed large sums of money to them, including some $150 million from Germany alone. But foreign scientists working on Mars 94 are skeptical that IKI can hold to its official schedule. "I would not bet on a 1994 launch," says Gerhard Neukum of the Institute for Planetary Exploration in Oberpfaffenhofen, and the principal investigator for two German cameras that are key elements of the Mars 94 payload. If the launch is delayed, the next available window is in 1996—and that would give the spacecraft a much less favorable trajectory to Mars. To make space for extra fuel, Neukum reckons that "three to four major instruments, at least" would then be lost. That would be a blow. Planetary scientists are hoping that the two Russian-led missions will resolve questions about Mars' history as an Earth-like, possibly life-bearing, planet and they are counting on the spacecraft carrying a full roster of experiments.

Relikt-II, which has little foreign participation, is the most likely casualty of a policy that stresses the need for foreign involvement and foreign cash. Roald Sagdeev, former IKI director and now a physics professor at the University of Maryland, believes the project is in serious trouble. If Relikt-II is lost, says Sagdeev, Russian science would be deprived of a high-profile opportunity to replicate the COBE observations using a more sensitive radiometer.

Some projects are clearly down and out, even if not officially declared dead. The old Soviet program featured a probe called Regatta, which was to observe solar flares from the L1 Lagrangian point. But funding for this project has now dried up, says Galeev. Cutbacks in flights to the Mir space station have also hurt the East bloc collaborations that formed the backbone of the station's science program. And internal rivalry within the Commonwealth of Independent States isn't helping. Sagdeev says that a solar physics mission called Coronas is now caught up in the "hidden economic war" that's being waged between Russia and Ukraine. The problem: The satellite platform is being built at a plant in Dnepropetrovsk, Ukraine, but there's been no final agreement on a contract to pay for the work.

Other missions are likely to be more secure, says Sagdeev, provided they don't lie too far in the future. Scarce Russian resources will likely be concentrated into projects that can be most easily completed, meaning higher risks for projects further down the pipeline. That means the two Interball probes—already delayed, but now slated for launch in 1993—should be safe, he says. But Sagdeev is less than confident about the complete series of Spectrum satellites, which even on IKI's most optimistic schedule won't be launched until the late 1990s.

Although IKI director Galeev is adamant that "the budget is sufficient to carry all three [Spectrum] projects," Sagdeev fears that only one may actually get into orbit—a prospect that has sparked intense competition among groups to get the first launch spot, currently scheduled for 1995. Over the past month, a commission of the Russian Academy of Sciences has been judging the technical merits of the three Spectrum missions to decide which should go first, and the verdict was recently delivered to academy president Yuri Osipov. If early rumors are correct, Spectrum-X will get the nod. "The dust is just settling from a really bloody fight, from which Spectrum-X is coming out on top," says Robert Novick, a Spectrum-X principal investigator from Columbia University. Novick says that Spectrum-X will observe the underexplored but highly active x-ray sky. One thing Spectrum-X has going for it: Some $150 million worth of Western involvement—far more than has been pledged to either of its two competitors, Radioastron and Spectrum-UV.

CHARLENE ANDERSON/THE PLANETARY SOCIETY

Rolling along. The Mars 96 mission, which will use a miniature rover tested in the Mojave Desert, is likely to go ahead.

Galeev has good reason to keep as many missions on the launch schedule as possible: As long as there's a good chance that planned missions will fly, most of IKI's key teams will remain intact. So far, in fact, in spite of the chaos in Moscow and the appalling salaries, there's not yet a serious brain drain to the West from IKI and the other leading Russian space centers. Galeev says that IKI has lost a handful of senior theoreticians, but because its strength is in experimental work, "it's not changing the face of the institute." But if projects are canceled, Sagdeev warns of an exodus of Russian space scientists—either to centers in the West, or to better paid jobs in Russia.

In the short-term, at least, the survival of the Russian space science program will depend on the skill of researchers at IKI and other centers in eking out a shoestring budget. Many Western researchers say that if they were forced to back a group to triumph through adversity, they'd bet on Galeev's IKI team. "These are people who get things done," says Herbert Schnopper, director of the Danish Space Research Institute at Lyngby, where researchers are working on two x-ray telescopes for the Spectrum-X astronomy mission. Livio Scarsi, a Spectrum-X principal investigator from the Italian National Research Council's Institute for Cosmic Physics in Palermo, says that the Russians, like the southern Italians, are sometimes seen as unreliable partners by researchers used to a less chaotic environment. But both, he believes, "have the human capability to get through their difficulties."

–Peter Aldhous

Major Russian Space Science Projects: Where They Stand

Mission	Purpose	Planned Launch	Status
Mars 94	Planetary exploration	1994	Delay to 1996?
Mars 96	Planetary exploration	1996	On track
Relikt-II	Microwave background observation	1994	Vulnerable
Interball	Solar-terrestrial plasma physics	1993	On track
Spectrum-X	X- and gamma-ray astronomy	1995?	On track
Radioastron	Radioastronomy	N/K	Uncertain
Spectrum-UV	Ultraviolet astronomy	N/K	Uncertain
Regatta	Solar observation	N/K	Abandoned?