sparked by the success of last year's docking missions between the Mir and the U.S. shuttle, which convinced the Russians that they should squeeze more science out of their investment in Mir. "The experience we gained in 1994 and 1995 on Mir, and its good performance, showed us that we can support operations [beyond 1997] to the year 2000," says Yuri Koptev, who heads the Russian Space Agency. But RSA managers feared that they could not afford to both operate the 10-year-old Mir and build their portion of the station, a project that preserves Russian know-how and can be done at a lower cost than in the United States.

Russia's initial proposal was to use Mir as a platform on which to construct the international station. "We told them that support for the program would evaporate tomorrow if we changed things," one NASA negotiator says. The Russians also asked for a 2-year extension of the Mir-shuttle agreement, under which NASA pays Russia $100 million annually for use of Mir. "We rejected that in the first minutes of discussion," says Trafton.

Instead, NASA agreed to a variety of steps that will help Russia keep Mir alive. One would send the shuttle to Mir in 1998 to deliver supplies and scientific equipment. Another shuttle will rendezvous with Mir before carrying out its main scientific mission. A third shuttle flight is contemplated for 1999, says Koptev. NASA is also likely to pay Russia to rebuild its Soyuz capsule—which carries humans to and from Mir and eventually will serve as the lifeboat for the space station—to accommodate taller U.S. astronauts. And NASA will fly the Russian power module to the international station to reduce Russian launch costs. Koptev says that "we are satisfied [with] and grateful" for the plan, the details of which will be worked out next month.

In return, says Trafton, the United States gains continued access to Mir for biology and materials research. "It looks to us like a greater opportunity to do human experiments on Mir," says Harry Holloway, chief of NASA's life and microgravity sciences office. "We have all that equipment on Mir; this is a way to use it."

To pay for all this, says Trafton, NASA will have to dip into its reserves. Some of the money is expected to come from savings in the space shuttle program, as well as from technology and science offices like Holloway's that are involved in the station program. NASA Administrator Daniel Goldin says there could even be some direct payments to Russia. But "we're not talking big-time bucks," he says.

With NASA's overall budget in steep decline, however, even small-time bucks are in short supply. Holloway, for example, doesn't expect to get any more money to conduct science simultaneously on Mir and the station. Instead, he says some of the early station experiments may be conducted on Mir. The U.S. slots on the station could then be turned over to other partners in exchange for the resulting data or equipment.

These additional costs could also mean further delays. Trafton says NASA wants to postpone by 5 months, until June 2001, the launch of the $2 billion Japanese Experiment Module, and the large centrifuge that is important for a host of life sciences experiments will be delayed by 8 months. Europe's Columbus module is now scheduled for an early 2003 launch on the shuttle—although assembly is supposed to be completed in June 2002. These delays will mean a scientific drought during the first years of the program.

While political supporters say they are glad that Russia will remain part of the program, they are eager for details. Lewis, who visited Moscow last month with Representative James Sensenbrenner (R–WI) for talks on the station, says he wants to know how NASA plans to cope with its new responsibilities. That question is likely to dominate debate over the program in Congress this year. In the meantime, supporters and opponents of the program can agree on one thing: Its continued political health depends on two shaky propositions—the long-term stability of the Russian government, and NASA's ability to stay within budget.

–Andrew Lawler

ASTRONOMY

A Familiar Face for a Distant Galaxy?

Prodigies have a way of making people uncomfortable. And if one interpretation of a set of shadows in the light of a distant quasar is correct, astronomers have a major prodigy on their hands: an object that became a full-fledged spiral galaxy so early in life that the universe was less than 10% of its current age.

The possibility, raised by observations that a group of astronomers at the California Institute of Technology (Caltech) reported last month in *Astrophysical Journal Letters*, is disturbing on two counts: Other observations seem to show ordinary galaxies taking shape later in the history of the universe (see story, page 756), and theorists would have difficulty explaining how the nearly uniform soup of matter created in the big bang could have curdled into lumps the size of entire galaxies so soon after the beginning of time.

The Caltech group emphasizes that the interpretation sparking those concerns is "more a hypothesis than a fact," as astronomer Limin Lu puts it. What he, Wallace Sargent, Donna Womble, and Thomas Barlow actually observed when they pointed the 10-meter Keck telescope at a quasar—a mysterious light source near the very edge of the universe—was a series of dark absorption lines in the quasar's spectrum. These lines indicated wavelengths at which something along the line of sight to the quasar was soaking up its light, and their pattern implied that it was a dense cloud of hydrogen and a smattering of heavier elements forged in young stars. Those features are characteristic of a young, gas-rich galaxy.

Such absorbers have been seen in the light of quasars before, but never at such distances. The redshift of the absorbing cloud—a measure of how far its spectral lines have been displaced by the expansion of the universe—is 4.4, the highest ever measured for a young galaxy. That puts the galaxy near the edge of the visible universe and implies that it existed barely a billion years after the big bang.

Most theories of how structures formed in the universe suggest that at this early stage in cosmic history, galaxies could have been only a fraction of the size of our own. But clues in the new galaxy's spectral fingerprint suggest that it could rival the Milky Way in mass. Some of its lines are smeared out in a way that "is characteristic of what you'd expect of spiral galaxies," says Arthur Wolfe of the University of California, San Diego. The smearing suggests that the line of sight passes edgewise through a rotating disk, so that different points in the disk are moving at different speeds with respect to the line of sight.

From the rotation speed needed to account for the smearing, the Caltech group could infer how much mass it would take to keep the spinning galaxy from flying apart. Their figure—100 billion solar masses or more—is comparable to the mass of our own galaxy. And "if it is true that this is a nice, massive spiral," says Lu, "then it poses problems for the theories."

Wolfe, who has observed similar hints of rotation in the absorption lines from nearer clouds, thinks the big spirals and the problems they pose are real. But Lu notes that "there are lots of ways of making the gas move" that could account for the smeared spectral lines without such uncomfortable implications. And other astronomers aren't ready to acknowledge the prodigy just yet. Says Caltech's Charles Steidel: "I find it a little difficult to think that [spiral] disks like the ones we know and love today could have been in place at a redshift of 4.4."

–Tim Appenzeller