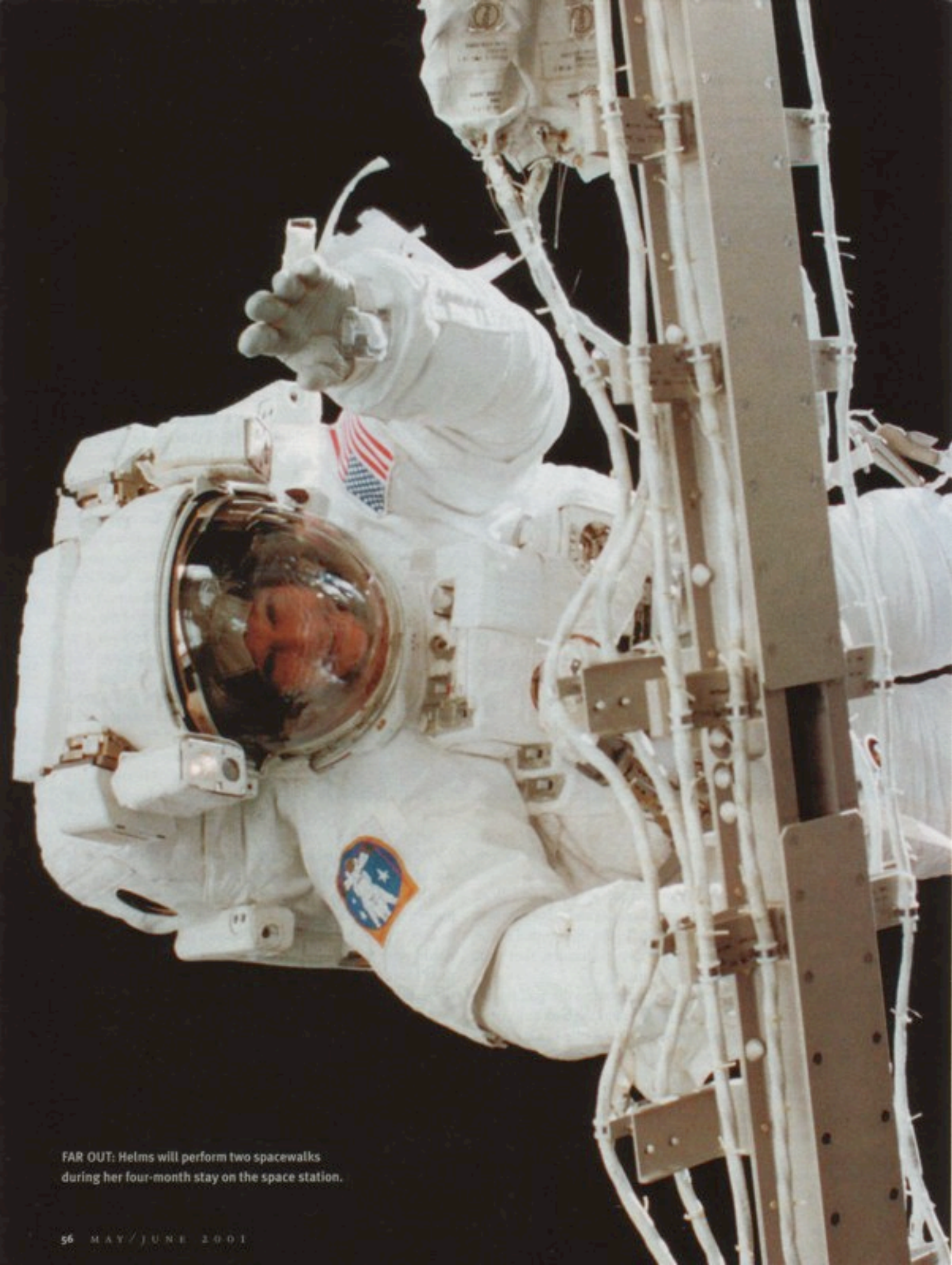
STANFORD features

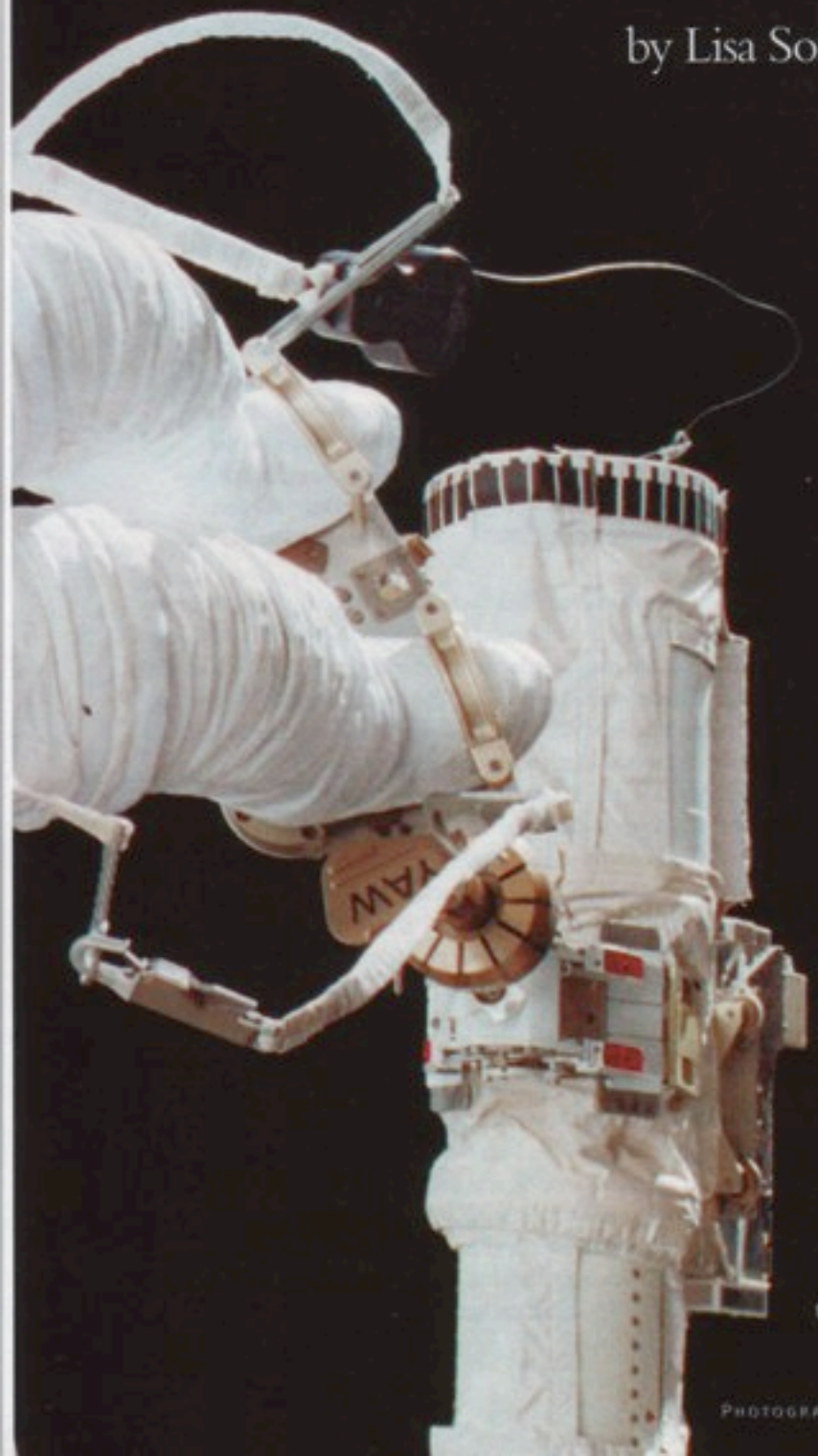


FAR OUT: Helms will perform two spacewalks during her four-month stay on the space station.

Susan Helms's new home suits her just fine. She has great views, nice neighbors and plenty of space.

walking on air

by Lisa Sonne



It's 3 a.m. on March 11 and Susan Helms is high. Really high.

She is floating 236 miles above Europe, traveling 17,500 miles an hour, with only a pressurized suit between her and the fatal vacuum of space. Seems like a good time to call home.

"Happy Birthday, Mom!" Helms radios back to Earth. "I couldn't think of a better way to spend your birthday."

Mom, Dori, is at home in Albuquerque, N.M., on the side of the globe that Helms can't see. Meanwhile, down below, Poland just went by.

Helms's long-distance call came in the middle of her first spacewalk, a record-setting jaunt around the International Space Station, the permanent orbiting outpost that welcomed its first inhabitants last November. She is a member of the second crew—and the first woman—to live aboard the station. Only five Americans have had more spaceflights than Helms, but this is the first time she has actually made a home in the heavens. She'll be up there until at least mid-July.

She and the other two members of the Expedition II crew, American Jim Voss and Russian

PHOTOGRAPHY BY NASA

commander Yury Usachev, are charged with taking care of the complex craft and overseeing its first phase of scientific experiments. Their venture will advance research in space and serve as an important step toward interplanetary travel, NASA officials say.

The station itself is an experiment. Built in stages—construction began in 1998 with the deployment of Russia's Zarya module—the International Space Station is financed by 16 countries. When completed (expected in 2006), it will have up to six state-of-the-art laboratories powered by nearly an acre of solar panels. The space shuttle, a NASA workhorse since the mid-'80s, has become a high-tech ferry, transporting astronauts and equipment to the station, where it docks in a special port just like Han Solo and company in *Star Wars*.

As a flight engineer, Helms, MS '85, serves as the station's computer expert and oversees a suite of equipment in the U.S.-made Destiny module.

The crew's projects include growing plants and crystals, studying space radiation, making Earth observations and learning how microgravity affects the human body. They're also investigating what happens—psychologically and physically—to people living in a confining, isolated craft.

Helms, interviewed a few days before her March 7 shuttle launch, said she wants to prove that humans can make space a home. "We have to understand how to live out there—what's required, what you can get away with, what you can and can't leave behind."

THE HIGH LIFE: Helms, the flight engineer, will monitor equipment on the station and also keep a close watch on herself—scientists want more information about the physiological effects of long-term weightlessness. She and crewmates Voss, far left, and Usachev, center, did part of their training in Russia.

Helms, 43, grew up expecting to fly, but under a lower ceiling. Her father, an Air Force colonel, as she is now, inspired her to be a pilot. A Portland, Ore., native, she graduated in 1980 from the Air Force Academy, but poor eyesight kept her out of the pilot's seat. Instead she became a weapons expert, working with the F-15 and F-16 fighter aircraft.

She came to Stanford in 1984 to study engineering and soon set her sights higher. One day early on, she heard a talk by Sally Ride, '73, MS '75, PhD '78, the first woman in space. "Right then and there," says Helms, she knew she wanted to be an astronaut.

After earning her master's in 1985, Helms instructed cadets at the Academy and later became a flight test engineer.

She was accepted into NASA's astronaut candidate program in 1990, joining a class replete with Stanford alumni, including Eileen Collins, MS '86 (first female shuttle commander); Ellen Ochoa, MS '81, PhD '85 (first Hispanic woman in space) and Jeff Wisoff, MS '82, PhD '86 (husband of astronaut Tammy Jernigan, '81, MS '83, and currently deputy chief of ISS operations).

Helms's duties on her first shuttle mission in 1993 ranged from helping deploy a satellite to filming the crew playing with toys—part of a live physics demonstration beamed to a nationwide audience of schoolkids. On missions in 1994 and 1996, she operated the shuttle's external robotic arm and led life-science investigations—important experience for her future space station work.

She was chosen for an ISS mission in 1997 and jokes that her selection over other talented astronauts was related to her size. "I fit in the Soyuz space capsule," she says, referring to the Russian-made vehicle the crew will use as a lifeboat if the space station malfunctions. "The Soyuz is anthropomorphically challenging. We have a lot of tall astronauts who don't fit."

Helms thought she would be on the space station by 1999, but her training time doubled as the economics, politics and logistics of the most complex international "start-up" ever delayed flight schedules. Much of that training took place in Russia. American astronauts scheduled for ISS duty had to learn the language, equipment and systems of the country whose Mir station had established the benchmarks for long-term space missions. Mir, which Russia safely crashed into the Pacific in March, orbited Earth for 15 years.

Helms says her Russian experience was ironic, given her military background and the fact that she entered the astronaut program at about the same time the former Soviet Union dissolved. "During the Cold War, when I was a part of the military, the Russians were our sworn enemies," she says. "Then, here I am transplanted in the middle of everything they are doing, working in bases that used to be super-secret, in space capsules that 15 years ago I would have been shot for seeing."

A major component of the training was the Russian winter survival camp. Helms, Voss and Usachev were left with a Soyuz mock-up and limited supplies in a subarctic region to simulate what might happen if they were forced to evacuate the space station and crashed in a remote area. "It was cold," Helms recalls, "but fun."

The months of U.S. training prior to her launch this spring were grueling—like a combination of PhD study and NFL conditioning. "It's a real endurance run," says Gail Barnette, a NASA trainer. "The astronauts have at least 10 hours of simulations

and training exercises every day, and that doesn't count the study time they need."

To prepare for her spacewalks, Helms trained for several weeks at NASA's neutral-buoyancy lab in Houston, a 6-million-gallon pool into which life-size models of parts of the shuttle and space station were lowered. Water is the best environment for simulating long periods of weightlessness, and Helms needed to get comfortable "floating" on and around the spacecraft. She was immersed in the pool wearing a 180-pound, $1 million "Michelin Man" suit to handle cables and connectors, work the robotic arm and move along the ship's exterior. The suit was specially weighted to provide the same body angles that Helms would experience in space.

She also had to get accustomed to the unusual orbital light patterns. Since the shuttle and space station circle Earth every 90 minutes, astronauts on a six-hour space walk experience four "nights" and four "days." To simulate this, Helms flipped on her helmet light at 45-minute intervals. She was in the water a lot—at least 10 hours of training are required for every hour of spacewalk planned.

And then there are the tests. All of the astronauts on the space station are—like their predecessors in orbit, on the moon and on Mir—human guinea pigs. They will be poked, prodded and probed as scientists study the effects of space on their bodies. UCSF scientist Thomas Lang will compare measurements of crew members' hip and spinal bones a year from now with measurements taken before and after their Expedition II flight to determine the degree to which a return to Earth restores bone density that space has stolen. The study could affect decisions about the frequency and duration of crew assignments in the future.

Susan Helms may be serving her country and advancing science, but she couldn't leave Earth without paying her taxes. It's an aspect of space travel seldom mentioned amid talk of the gee-whiz gadgetry and innovative study—astronauts on a months-long gig in space have a lot of mundane details to attend to.

In addition to preparing her IRS forms early, Helms canceled her magazine subscriptions, sent off birthday gifts in advance and gave up her apartment and put all of her belongings in storage. "Some people think it's interesting that Susan will be the first woman to live aboard Station. I think it's more interesting that she will be the first *single* person," says Steve Smith, '81, MS '82, MBA '87, deputy chief of the Astronaut Office. "We have to think now about how to support astronauts who don't have spouses on the ground to take care of the roof when it leaks or to process absentee ballots," he says.

Naturally, there are sacrifices involved when leaving one's earthly abode. A cat-lover and an accomplished musician (she is a keyboardist of an all-astronaut rock band called MaxQ), Helms has to learn to live without pets and keyboards. But these deprivations are no big deal, she says. Nor is the fact that she is, in Earth terms, homeless. "It's because of my Stanford experience that I know I can do this. The level of distraction there was minimized and I could concentrate on being at Stanford and enjoying the experience. I won't be missing home [in the space station] because it will *be* home."

She *was* allowed to pack 10 paperbacks, and chose some voluminous classics (*Gone With the Wind, Vanity Fair, War and Peace*) and a couple of Russian detective novels to keep her Russian fresh.

Much of Helms's time will be devoted to taking care of herself. She is taking calcium supplements and exercising intensively to help compensate for the loss of bone density and the muscle atrophy that astronauts experience in a weightless environment. She spends at least two hours each day running on treadmills (tethered to the machine to keep from floating away) and doing strengthening exercises.

But space life does have its charms. "Wrinkles go away," says Helms, because the lack of gravity allows fluids to fill in the fine lines of the face. And she'll get taller. Without gravity to compress the cartilage between vertebrae, the spine elongates, lengthening the torso. This effect, combined with the weightlessness of clothing, is so pronounced that astronauts use velcro to keep their shirts tucked in.

Four shuttle teams are scheduled to visit the space station during Helms's stay, carrying structural pieces, equipment and supplies. A Canadian-built robotic arm was to be delivered and installed in April by spacewalking Scott Parazynski, '83, MD '89, and crewmates. Helms will need weeks of practice maneuvering the 57-foot arm, because in June she will use it to lift an airlock module out of the shuttle's payload bay and attach it to the station. In an intricate choreography, she will finesse a joystick while relying on camera-fed video images to guide her as two spacewalkers assist outside the station.

When the airlock is in place, the station will reach a milestone of self-sufficiency: astronauts will be able to walk in space without using the shuttle's airlock for the required depressurization. With the new robotic arm functioning, the station can serve as the base for its own construction.

Parazynski, who served as John Glenn's flight doctor when the septuagenarian senator flew on the shuttle in 1998, calls Helms a "pioneer and pathfinder." But she's not all business. "She has a wonderful sense of humor and a good outlook," he says. Her lighter side came through on March 25 when, floating unencumbered, hair flying, she introduced Academy Awards host Steve Martin at the outset of the show. The segment had been taped during the shuttle crew's trip en route to the ISS.

Eight hundred million TV viewers aside, Helms would rather not be in the spotlight. Her greatest fear, she says, is "becoming a celebrity, losing my privacy, like Sally Ride."

"Right now, I'm an ordinary person in extraordinary circumstances," she says. "I just want to be viewed as any other government employee."

With a pretty good view out the office window. ⊡

Heads Up

The International Space Station is 17 stories tall, visible with the naked eye in the night sky—a moving orb brighter than most stars. To find out when it will be passing over your hometown, go to www.spaceflight.nasa.gov/realdata/sightings/index.html

To locate the space station's current position, log onto www.spaceflight.nasa.gov/realdata/tracking/index.html

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