Station" at Haughton, to help field scientists learn how to interpret Mars-like terrain and test drills, robots, and other mission technology, Zubrin says. Lee, a Mars Society member along with other NASA scientists, is consulting on the structure, which could take 2 years to build and cost about $1 million in funds that Zubrin's group is raising.

At the moment, NASA has no comment on these grand plans. Officials are waiting for reports from Lee's team—based on two seasons of fieldwork funded by small grants from NASA, the National Research Council, and the National Geographic Society—before deciding on future support, says Carl Pilcher, the agency's science director for solar system exploration. But geologists who have seen Haughton are eager to do more work there. "Haughton has a lot of Mars-like geology in a very compact place," says astrogeologist James Rice of the University of Arizona, Tucson. "If I can't go to Mars, this may be as close as I can get." **–ROBERT IRION**

Robert Irion is a science writer in Santa Cruz, CA.

ASTRONOMY

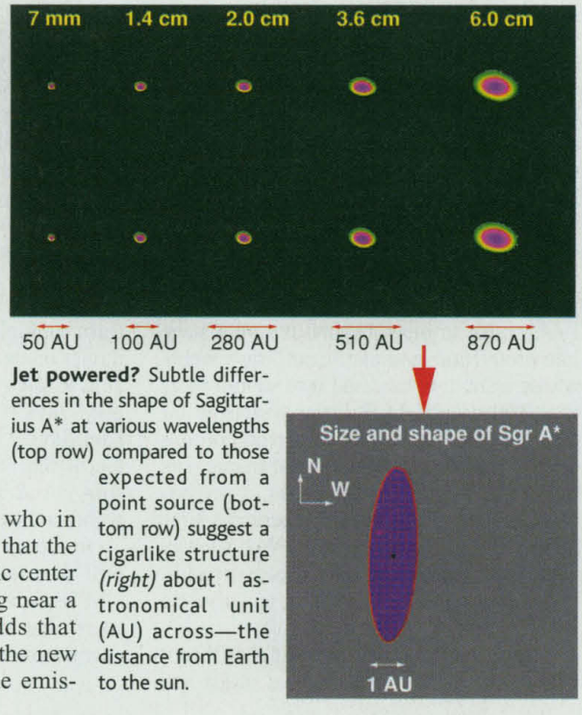
Probing the Milky Way's Black Heart

Astronomers have taken their closest look at the mysterious center of our galaxy—and uncovered a further mystery. At the very center of the galaxy lies a black hole with a mass millions of times greater than the sun's. The black hole is invisible, but just outside it, electrons torn from matter falling into the black hole gyrate around magnetic field lines, broadcasting radio waves. By mapping the radio emission with the Very Long Baseline Array, a system of linked telescopes that spans North America, a group of Taiwanese and American astronomers have found that the emitting region is drastically elongated, suggesting that the black hole is somehow shooting jets of material out of the plane of the galaxy.

"It's an interesting result," Cambridge University astronomer Martin Rees says of the map, which offers the most intimate view ever of the immediate surroundings of a giant black hole. Rees, who in 1982 was the first to suggest that the radio emission from the galactic center comes from hot gas circulating near a supermassive black hole, adds that "the jetlike shape inferred in the new observations suggests that the emission may come mainly from an outflow"—a conclusion that runs counter to many models of the radio source's structure.

From the tremendous speeds of the stars whirling around the Milky Way's central radio source, called Sagittarius A*, astronomers had calculated that it must harbor a black hole with a mass equivalent to 2.6 million suns. The region is invisible to optical telescopes because of intervening dust clouds, says team leader Kwok-Yung Lo of the Academia Sinica Institute of Astronomy and Astrophysics in Taipei, so the most detailed view of it comes from synchrotron radiation, the radio waves emitted by fast-moving electrons spiraling in a strong magnetic field. "The intrinsic size and structure of [the radio source] are crucial for our understanding of the immediate vicinity of the massive black hole," he says.

Earlier attempts to gauge the size and shape of the radio source were unsuccessful because of scattering by interstellar electrons, which made the radio source look larger than it really is, just as a streetlight looks larger when viewed in the mist. However, these blurring effects vary with wavelength. By combining near-simultaneous measurements at five different radio wavelengths, Lo and his colleagues—Zhi-Qiang Shen from Taiwan and Jun-Hui Zhao and Paul Ho of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts—were able to extract the true size and structure of the source from the scattering. The team presented the results last month at a workshop on the galactic center in Tucson, Arizona, and will publish them in the November *Astrophysical Journal Letters*.



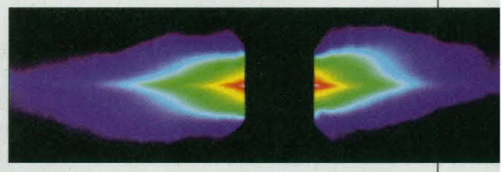
Jet powered? Subtle differences in the shape of Sagittarius A* at various wavelengths (top row) compared to those expected from a point source (bottom row) suggest a cigarlike structure *(right)* about 1 astronomical unit (AU) across—the distance from Earth to the sun.

CREDITS: (TOP) C. A. SCHULTZ/CSC/STSCI/NASA; (BOTTOM) J.-H. ZHAO *ET AL.*

ScienceScope

PH.D. FOR ET?

Budding scientists who want to join the search for extraterrestrial life can now get a leg up on the competition. The University of Washington (UW), Seattle, is creating what it claims is the first Ph.D. program in astrobiology. About a dozen students are expected to start their studies, which will range from microbiology to aeronautics, in fall 1999. Fieldwork, alas, is limited to Earth. "Everyone will have to get their hands dirty," says UW astronomer Woodruff Sullivan.



Protoplanetary disk around Beta Pictoris may harbor Earth-like bodies.

Some new blood might be welcome at NASA, where officials are still sorting out their astrobiology initiative, which links 11 scientific teams in a virtual research center (*Science*, 29 May, p. 1338). Administrative infighting has dogged the effort, which NASA says could limp without a leader into next year. Complains one researcher: "The team is playing without a coach."

AUSTRALIA PLANS R&D SUMMIT

Australian voters may have opted for the status quo in last week's elections, but their country's science policy could be on the verge of major changes.

The hard-fought campaign, which ended with Prime Minister John Howard's ruling Liberal-National coalition winning a narrow majority over the Labour party, featured promises from both sides to invigorate the country's sluggish R&D efforts through increased funding and tax incentives. The scientific community will have a chance to offer its advice to the government at a national innovation summit early next year.

"Things are not working," says Peter Cullen, president of the Federation of Australian Scientific and Technological Societies, who welcomes the summit. "This is an opportunity to take stock." Adds Vicki Sara, chair of the Australian Research Council, "The government has missed the boat" on what's needed to turn research into new products. "We need to create a seamless web of activity between all the players."

Contributors: David Malakoff, Robert F. Service, Elizabeth Finkel

In the plane of the galaxy, they found, the radio source measures 150 million kilometers across—about the distance from Earth to the sun and about 10 times the calculated diameter of the black hole itself. In the perpendicular direction, the source stretches nearly four times that distance. Those proportions imply that the black hole is somehow spurting out material, probably in two opposite directions. But Lo says that the observations don't support a number of scenarios that astronomers have invoked to explain radio emission from Sagittarius A*.

For instance, the so-called coupled disk-jet model, which holds that the radio emission is from jets of material expelled from a disk of material that is spiraling into the black hole, predicts a smaller jet for the Milky Way's black hole than Lo and his colleagues have measured. In another popular model, the synchrotron radiation is from extremely hot electrons in the inner parts of an accretion disk, but because the electrons would occupy a near-spherical region, the model is hard to reconcile with the observed elongated shape, says Lo.

Rees cautions that there is a slight chance that the elongated shape is not genuine. It might instead be due to scattering in a preferred direction, as a result of asymmetric turbulence in the gas surrounding the black hole. But with the galactic-center black hole only 26,000 light-years away, Lo and other radio astronomers have a good chance of ultimately sorting out its puzzles. **–GOVERT SCHILLING**

Govert Schilling is an astronomy writer in Utrecht, the Netherlands.

GRANTS MANAGEMENT

NSF Spells Out an Electronic Future

The National Science Foundation (NSF) has pledged to go electronic with its entire grantsmaking process by October 2000. The agency plans to handle all grant applications, reviews, financial reports, and other communications about awards through an interactive World Wide Web–based system. The new policy, announced last month, puts NSF at the head of the pack of federal research agencies moving toward a paperless system of doing business, and it has added urgency to efforts to ensure that different agencies develop compatible digital systems for handling research grants.

NSF's new deadline has been welcomed by academic research administrators, who have been urging NSF and other agencies to speed up and clarify their efforts to move research administration online. "It's fantastic," says Pamela Webb, director of sponsored programs for the University of California, Santa Barbara. "Even if they don't make it [by 2000], it sends a strong message that this is the way the government is going and that universities need to get on board."

NSF's system will be based on FastLane, a prototype Web-based system begun in 1994 (www.fastlane.nsf.gov). The agency has already required universities to use FastLane for certain competitions, and some institutions also have used it to meet various reporting and administrative responsibilities for other grants. In a letter last month to university presidents and other grantees (Important Notice 123), NSF director Rita Colwell invites the research community to help NSF go all the way—to "a fully integrated electronic proposal and award system that will provide a quick, secure, paperless record and transaction mechanism for all NSF awards, from program announcement to award closeout, by October 2000."

Coming soon. NSF has set deadlines for doing its business electronically on its FastLane Web site.

NSF officials say that going fully digital is the only way the agency and the community can manage a growing workload. "FastLane started out as a demonstration project, and now it's becoming the way we do business," says Jean Feldman, head of policy for NSF's grants and contracts office. "We think we can meet the deadline, but success also depends on how ready the community is."

University administrators say they are generally pleased with FastLane. "It's the first project to move beyond the pilot stage into production, and that's neat," says Webb, whose institution has used it to submit more than 100 proposals. But the system is far from perfect. Institutions must redo portions of an application to capture and manipulate the data for internal purposes, a serious handicap for institutions that generate large numbers of proposals. And the Web site can be slow in responding during peak periods. More significantly, FastLane is only one version of an all-electronic world.

Other agencies are pursuing different paths tailored both to their own needs and those of the communities they serve. The National Institutes of Health is developing a system, called NIH Commons, which recognizes that its large and diverse base of grantees may not want an interactive, Web-based system like FastLane. It is registering schools now for a test using noncompetitive grant renewals (www-commons.dcrt.nih.gov). Other agencies do the bulk of their R&D business with contractors, often large companies with intricate accounting procedures, that may be more comfortable with an existing technology known as electronic data interchange.

To prevent an electronic Tower of Babel from developing, a consortium of 11 federal agencies and 65 private institutions is working on a project called the Federal Commons that aims to provide an electronic translation service between different systems. The goal is to offer institutions a common menu for interacting with the government, from which they would choose the system that suits their needs. For example, a university that uses a Web-based system might submit its proposal to NIH via NSF, which would convert it to a format compatible with NIH's system before sending it along. And it might be routed through another agency's server for other aspects of federal grants management.

Such a division of labor would allow universities to put their resources into perfecting a single form of communication, while faculty members would be spared having to learn multiple systems. "If a Federal Commons comes off, and I think it will, you'll be able to pick and choose what interface to use," says Northwestern University's Barbara Siegel, chair of the executive committee of the Federal Demonstration Partnership. "And the government will present a common face to the world."

In the meantime, Siegel says, she's glad NSF has taken the first step. "Now that NSF's plan is out on the street, we have something to point to. It should help focus attention on what needs to be done."

–JEFFREY MERVIS

LIFE IN THE FASTLANE

Research component	Required by:
Annual and final project reports	October 1999
Award notifications and requests	January 2000
Payments and financial reports	October 2000
Peer review of proposals	October 2000
Proposal submissions	October 2000

SOURCE: NSF