other fields—including marine biology, energy, and transportation—will also receive special treatment.

Huge increases in research spending during the 1980s under the former Socialist government pushed government funding for R&D to 0.9% of GDP in 1992. Since then, Spain's economy has faltered, and R&D funding has stagnated or slipped slightly each year. "We are quite behind other developed countries," says Jesús Avila, a researcher at the Center for Molecular Biology in Madrid. Researchers hope that the 1999 budget will reverse this trend and bring Spain nearer to the European Union average of 1.9% of GDP. "We must continue this trend," says Fernando Aldana, director of the Office of Science and Technology in Madrid, which oversees distribution of the government's science funds and authored the R&D request. "Spain can only achieve competitiveness through the sustainable growth of the investment in R&D."

The main concern among researchers is to find work for the large numbers of young scientists who were trained during the Socialist-led science boom in the 1980s and cannot now find permanent positions or get adequate funding (*Science*, 20 March, p. 1844). "The big groups have money, but the new ones—some of them very good—must be funded to avoid a disastrous situation in the future," says Avila.

–ALICIA RIVERA

Alicia Rivera is a science writer in Madrid.

U.S. R&D BUDGET

Three Spending Bills Bolster Research

Congress last week sent a mostly upbeat message to researchers that it is ready to give basic science a fresh infusion of cash for the 1999 fiscal year, which officially began on 1 October. It put the finishing touches on a trio of spending bills that would give the National Science Foundation (NSF) a 7% increase, science spending at the Department of Energy (DOE) a 10% boost, and basic research at the Department of Defense a 6% rise. "We're delighted," says DOE science chief Martha Krebs, echoing reaction from the research community to the new spending levels.

The numbers were hammered out by House-Senate conference committees that negotiated compromises between different versions of the bills passed by each chamber, and in some cases have already been approved by both bodies. Not all of the research agencies covered by the bills were lifted by the rising tide, however. NASA and the Environmental Protection Agency (EPA), for example, received essentially flat science budgets from House and Senate conferees. And as *Science* went to press, Congress had not yet decided what to do with three other key funding bills—including one that could give the National Institutes of Health a double-digit increase—that have become mired in election-year politicking.

White House officials say President Clinton is likely to sign the bills that emerged last week, once Congress has completed its work. Here are some highlights:

• **NSF:** Officials are very happy with the conferees' 7% solution to their $3.67 billion budget and the relatively free hand it gives them. The 8.8% increase in the research account, to $2.77 billion, is less than the Administration's 12% request, but it allows for healthy growth in programs ranging from human-computer interactions to life in extreme environments. Legislators agreed to drop proposed Senate earmarks for several research centers, although they directed NSF to spend $22 million more than it requested to support Arctic research and added $10 million to the $40 million plant genome initiative begun last year by congressional directive. They also added $10 million to a $38 million program to help 18 "have-not" states as part of a broader concern for schools outside the top 100 grant recipients.

Congress was more specific about how it would like NSF's $663 million education and training directorate to grow. It boosted the directorate's budget by $30 million, but told NSF to spend $13.5 million of the increase on two programs to increase minority participation in science and $10 million on informal science education. On major facilities, legislators once again ignored NSF's request for $21 million for a Polar Cap Observatory in Canada, although they tacked $17 million onto NSF's request for $22 million to nearly complete financing of its $145 million renovation of the South Pole station.

• **DOE:** Legislators not only gave DOE's science programs a $217 million boost, to $2.7 billion, but also moved fusion energy from its politically exposed position as a separate budget item into a new four-division Office of Science covering existing energy research programs. Krebs says the change, which also added $1.6 million to the Administration's request for fusion, reflects DOE's success in retooling the $223 million fusion program to emphasize university research rather than technology demonstration. The new office's $809 million Basic Energy Sciences account includes a $130 million boost to begin construction of the Spallation Neutron Source, a $1.3 billion facility scheduled to open in 2005 at Oak Ridge National Laboratory in

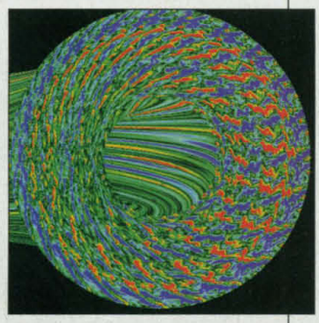
CREDIT: R. E. WALTZ AND G. D. KERBEL/NUMERICAL TOKAMAK PROJECT

ScienceScope

TURN OUT THE LIGHTS, THE ITER'S OVER

The U.S. Department of Energy is recalling its fusion scientists from their posts in Germany and Japan, where they have spent the last 3 years working on the moribund International Thermonuclear Experimental Reactor (ITER). Congress ended U.S. contributions to the $10 billion project last week (see p. 210), prompting DOE to order more than a dozen scientists back to their home institutions by 16 November. The recall completes a withdrawal begun in July, when it became clear that Congress wouldn't provide enough money to support the 36 U.S. researchers assigned to the project.

The retreat "has created a pretty depressed mood here," says physicist Ron Parker, who will be leaving his post at the ITER site in Garching, Germany, to return to the Massachusetts Institute of Technology. He calls Congress' decision to pull out "completely destructive. But at some point you have to put disappointment behind you and move on to new challenges."



ITER won't get the chance to test this simulation of tokamak turbulence.

CHEMIST TAPPED TO HEAD GENOMICS INSTITUTE

The Swiss life sciences giant Novartis is expected to name University of California, Berkeley, chemist Peter Schultz as the director of its new Novartis Institute for Functional Genomics. Last spring, the company announced that its philanthropic arm—the Novartis Research Foundation—would spend $250 million over 10 years to bankroll the San Diego–based institute. The center is expected to hire some 100 researchers to sort out the function of newly discovered genes as a basis for new drugs.

Schultz has pioneered the use of techniques such as combinatorial chemistry and DNA chips for drug development. His appointment is "a good hire for Novartis and a tough break for Berkeley," says Harvard University biologist Tim Mitchison. "He's not someone to let anything stand in his way."

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

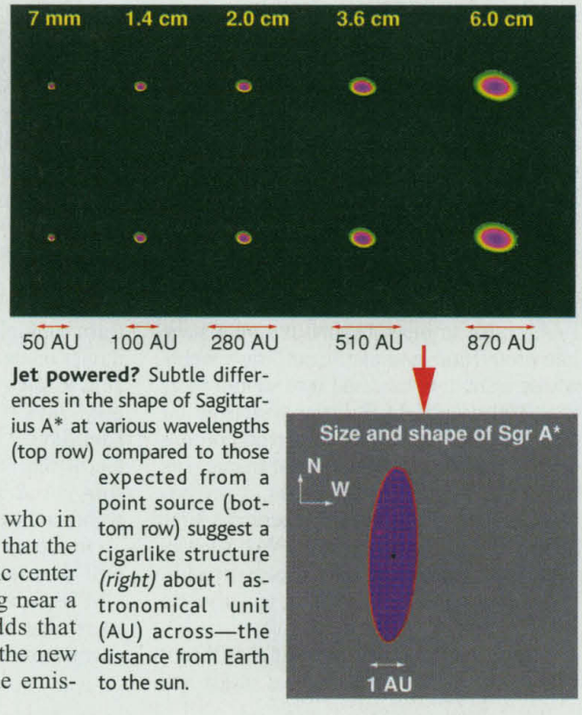
Probing the Milky Way's Black Heart

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*.



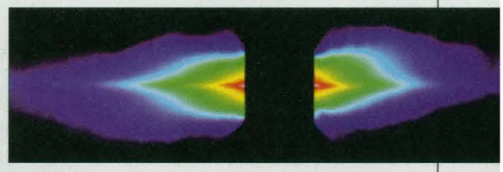
Jet powered? Subtle differences in the shape of Sagittarius A* at various wavelengths (top row) compared to those expected from a point source (bottom row) suggest a cigarlike structure *(right)* about 1 astronomical unit (AU) across—the distance from Earth to the sun.

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