

A researcher works on the inside of the doughnut-shaped tokamak at the Princeton Plasma Physics Laboratory.

## ENERGY RESEARCH

# U.S. fusion effort melts down

Scientific community battles with its federal office

By Adrian Cho

**D**ysfunctional, broken, in complete disarray: That's how numerous insiders describe the United States' research effort in fusion, which aims to generate energy using the same process that powers the sun. A rift has opened between officials in the Department of Energy's (DOE's) Fusion Energy Sciences (FES) program and the research community it supports. Many scientists say program officials operate opaquely, but the community itself has a reputation for being unmanageable.

The discord has muddled an effort to draw up a strategic plan for the program, due in Congress next month, and it could jeopardize the program's already strained \$505 million annual budget. "When you have to fight for every dollar, it makes it very difficult when you can't even produce a strategic plan," says a Democratic Senate staffer, who calls the planning effort "a failure."

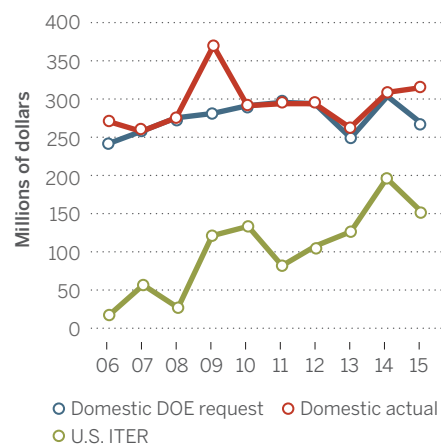
The fusion program has come under intense budget pressure as officials scrounge to pay for the U.S. share of ITER, the gargantuan international experiment to show that controlled fusion can produce more energy than it consumes. Now under construction in France, ITER cost the United States \$199 million in 2014, and DOE officials estimate that its total cost to the United States will be at least \$3.9 billion (*Science*, 18 April, p. 243). With ITER squeezing the rest of

the program, many researchers say that Edmund Synakowski, DOE's associate director for FES, and his staff exclude them from the decision-making process. "He's not a great believer in getting input from the community," says François Waelbroeck, a theorist at the University of Texas, Austin. Synakowski says he's "always a phone call away." But he emphasizes that his role is "to make the tough calls when they need to be made."

The disconnect in the fusion program contrasts with the approach taken in other

## As ITER spending grows ...

... spending on domestic research has stagnated, barely keeping up with inflation.



research programs run out of DOE's \$5.1 billion Office of Science, in which the associate directors strive to guide their communities to develop realistic plans for themselves. For example, a few years ago the U.S. high-energy physics community was perceived as fragmented. So, urged by leaders in DOE's office of high-energy physics, researchers held a 2-year-long series of meetings that informed the ad hoc Particle Physics Project Prioritization Panel (P5), which drew up a road map for the U.S. program (*Science*, 30 May, p. 955). Such a consensus plan "is a great example of what you want to see," says a Republican Senate staffer.

But Synakowski and FES officials aim to write the plan for their community. In January, after years of prodding, Congress demanded that FES draw up the strategic plan that is due next month. In April, DOE officials asked the Fusion Energy Sciences Advisory Committee (FESAC) to form an ad hoc panel to provide input—but not to actually develop the plan. That committee held two 3-day community meetings.

The panel's report, presented to FESAC on 10 October, looked forward 10 years under various tight budget levels. It called for immediately shutting down one of three large fusion devices, or tokamaks, in the United States—the Alcator C-Mod at the Massachusetts Institute of Technology (MIT) in Cambridge—reviving a 2012 DOE plan for shuttering the facility, which Congress reversed. One of two other facilities—the National Spherical Torus Experiment (NSTX) at the Princeton Plasma Physics Laboratory (PPPL) in New Jersey and the DIII-D tokamak at General Atomics in San Diego, California—might be shut down after 5 years. Such closures would enable researchers to start preliminary work on a bigger device, dubbed the Fusion Nuclear Science Facility (FNSF), which would develop the materials and components needed to extract energy from the plasma in a practical power plant.

Even before the report was out, researchers railed against it. The panel included no one from General Atomics, MIT, or PPPL, they noted. Synakowski says such exclusions were necessary to avoid conflicts of interest. Other conflicts of interest left only nine of FESAC's 20 members eligible to vote on the report. Only six voted to accept it.

Complicating matters, Synakowski soon put the kibosh on several of the report's recommendations. On 27 October, at a meeting of the American Physical Society in New Orleans, he told researchers that work toward

the multibillion-dollar FNSF was off the table and that in the next 10 years it would be premature to shut off NSTX or DIII-D. Still, he says the report and previous FESAC studies will inform the plan DOE will deliver to Congress next year.

Some observers say fusion physicists are to blame for failing to make tough choices for themselves. In 2012, DOE asked a panel of researchers to decide which of the three big tokamaks to close if budgets required it. The panel refused to choose, acknowledges Robert Rosner, a theorist at the University of Chicago in Illinois who chaired it. However, that study was requested after DOE announced it intended to shutter the MIT facility. “Being told to take the closure of the MIT machine as a *fait accompli* completely rubbed people the wrong way,” he says.

Regardless of who is to blame, the dysfunction could cause “sponsor fatigue” in the higher levels of DOE and at the White House, says Raymond Fonck, a physicist at the University of Wisconsin, Madison. “In spite of our messianic vision of what we’re going to do for energy, there are other things on the federal docket,” he says. Recent budget numbers suggest fatigue has already set in. For fiscal year 2015, which began on 1 October, DOE requested \$266 million for domestic fusion work, \$39 million less than the previous year. But Congress reversed those cuts and boosted spending on the domestic program to \$318 million (see right).

Some observers say that the only way to save the domestic fusion program is to pull the United States out of ITER—as Senate budgetmakers have threatened to do. Others say fusion research is a bad fit for the Office of Science and should be moved into its own applied research program within DOE.

Barring such radical moves, FES officials and researchers must get beyond their current impasse. Some observers say that means Synakowski must go. “Until there’s a leadership change at FES, they can’t work together,” says the Democratic Senate aide. “They hate each other so much.” The Republican Senate aide is more optimistic: “I genuinely believe Ed is trying, so I would never say that he can’t resurrect himself.”

Synakowski and researchers agree on one thing: The current planning effort should be the first step. Researchers “desperately want” to expand it into a community-based effort like particle physicists’ P5 report, says Steven Zinkle, a physicist at the University of Tennessee, Knoxville, and a planning panel member. Synakowski says he’s setting up a series of workshops. Still, he sees their purpose as identifying scientific opportunities, not “making challenging choices.” Those divergent views sound like a recipe for further friction. ■

## RESEARCH FUNDING

# Science agencies make gains despite tight U.S. budget

## NASA, NSF among 2015 winners in difficult year

By Jeffrey Mervis and David Malakoff

In Congress, clout still counts. Once the political shenanigans ended and the dust settled, the \$1 trillion 2015 federal budget approved by Congress last week demonstrates that a few lawmakers can still make their voices heard. In a year in which Congress had no new money to play with, that fact was good news indeed for NASA and the National Science Foundation (NSF).

Those agencies received healthy raises thanks in large part to the work of retiring Representative Frank Wolf (R-VA) and Senator Barbara Mikulski (D-MD). The two se-

ingly well, although the largest, the National Institutes of Health, faces an essentially flat budget (see table, p. 1438).

One notable winner was NASA’s \$5.15 billion science office. Congress rejected the White House’s proposal for a \$179 million cut and instead awarded it a \$93 million raise, to \$5.24 billion. The biggest impacts of that \$272 million turnaround are an additional \$70 million to continue operations of SOFIA, an infrared telescope mounted on a Boeing 747 that NASA had proposed grounding, and \$100 million to accelerate planning for a multibillion-dollar mission to Jupiter’s Europa moon, which some researchers believe could harbor life



NASA got \$100 million to plan a mission to Europa that the agency is worried it can't afford.

nior appropriators, who chair the spending panels that oversee NASA and NSF in each body of Congress, have traditionally protected those agencies. (Mikulski also chairs the full Appropriations Committee in the Senate, a position she will relinquish in the new Congress.) And this year their views prevailed in protracted budget negotiations that narrowly averted both another government shutdown and an extension of a spending freeze in effect since the 2015 fiscal year began on 1 October.

Researchers had braced for the worst after a budget deal struck last year allowed for essentially no growth in the discretionary portion of the 2015 budget, which funds most science agencies. Against that backdrop, many research agencies did surpris-

in oceans beneath its icy shell.

Legislators also rejected a proposed \$25 million cut to the Hubble Space Telescope program and added back \$27 million to fund education and public outreach activities carried out by individual missions. Mars exploration also got a boost, as did planning for WFIRST, an infrared survey telescope.

Even so, some space science programs may feel a squeeze as NASA reshuffles money to accommodate Congress’s wishes. “There may not be any big losers, but some activities will take a hit,” notes Joel Parriott, head of public policy for the American Astronomical Society (AAS) in Washington, D.C. The agency may not be able to advance smaller Discovery-class space probes (which must cost less than \$425 million) and somewhat