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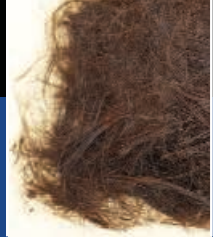

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PHYSICS

Energy Department Pulls Plug on Overbudget Fusion Experiment

Fusion may someday yield cheap power, but a troubled experimental reactor has proved too pricey for the U.S. Department of Energy (DOE). This week, DOE terminated the National Compact Stellarator Experiment (NCSX) at the Princeton Plasma Physics Laboratory (PPPL) in New Jersey. The not-yet-completed reactor would have been one of four large "magnetic confinement" reactors in the United States.

Donald Rej, a plasma physicist at PPPL and NCSX project manager since February, says he was disappointed to hear the news. "My colleagues have put a good fraction of their careers into this," Rej says. "It's a technological tour de force."

Like a supernova, the stellarator's budget had exploded. In 2001, it was proposed as a $58 million project to be completed in 5 years. It won approval in 2005 with a "baseline" budget of $102 million and a completion date of 2009. But in April, a DOE review showed that the cost had ballooned to $170 million and the machine could not be completed until 2013 at the earliest. The review suggested that even those estimates might not hold. "We were unable at this point to rebaseline, to formally say that we knew what it would take to finish," says Raymond Fonck, associate director for fusion energy sciences in DOE's Office of Science.

Surreally hard. The reactor's coils look like something Salvador Dalí might have sculpted. Joining them proved hugely difficult and expensive.

Had it been completed, the NCSX might have served as the prototype for the next great fusion experiment to come after ITER, the $12 billion machine that will be built in Cadarache, France. In a magnetic confinement reactor, scientists heat an ionized gas, or plasma, of light nuclei to 100 million degrees while trapping and squeezing it with magnetic fields. ITER and the three remaining machines in the United States are tokamaks, reactors built around a tubelike magnetic coil curled into a doughnut shape, or torus. The coil produces magnetic fields that go straight around in the horizontal torus. But to confine the plasma, the field must be modified so that it spirals around the doughnut like the stripes on a candy cane. To make that happen, the plasma must flow around the tokamak to produce an electrical current. The flow is generated by applying pulses of magnetic field or by other, more complicated means.

A stellarator, by contrast, uses bizarrely shaped coils to generate a spiraling field from scratch. Those coils are immensely complicated. NCSX researchers were able to fabricate them, but they needed more time and money to assemble the parts into a whole machine. The problems were far trickier than sticking tab A into slot B and required overcoming engineering challenges such as how to weld the massive asymmetrical pieces without deforming them, Rej says.

The cancellation of the NCSX strikes a body blow to the United States's domestic fusion program, says Stewart Prager, a plasma physicist at the University of Wisconsin, Madison, and chair of DOE's Fusion Energy Sciences Advisory Committee. "The loss of important scientific knowledge is very large," Prager says. "NCSX would have tested a fascinating physics concept and advanced understanding of a very promising fusion configuration."

The cut intensifies the uncertainty already facing plasma physicists. Over the past decade, DOE's budget for fusion research has stagnated at $300 million, and since the United States rejoined the ITER collaboration in 2003, researchers have fretted that money for smaller experiments at home might be siphoned off to pay for the nation's commitment overseas. (This year, however, the U.S. Congress zeroed out a scheduled $149 million contribution to ITER and bumped up the budget for running domestic facilities to $93.5 million, $6 million more than DOE had requested.)

Fonck says he would prefer to keep the $19.6 million requested for NCSX next year within the domestic fusion program. That money could be used simply to run the other U.S. fusion experiments longer. For example, PPPL's tokamak, the National Spherical Torus Experiment (NSTX), ran for only 13 of a possible 25 weeks in 2007 and will

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run for 15 weeks this year. "The plan for next year is down to 9 weeks," says A. J. Stewart Smith, dean of research at Princeton University, which runs PPPL. "This was necessary to accommodate NCSX."

It's too early to know whether the cancellation of NCSX will lead to layoffs at PPPL, Fonck says. The lab has a staff of 420 and a budget of $77 million this year.

Some physicists argue that, in spite of the cost overruns, DOE should have stuck with the NCSX. "Given the energy problem we have, it doesn't make any sense to shut down projects like this," says Miklos Porkolab of the Massachusetts Institute of Technology in Cambridge. He notes that China and South Korea, both members of ITER, completed their own large fusion experiments in 2006 and 2007, respectively. The United States hasn't completed a new machine since PPPL finished the NSTX in 1999. **–ADRIAN CHO**

PARKINSON'S DISEASE

Streamlined Clinical Trials, From a Home Computer

A Parkinson's research and treatment center and the genetic testing company 23andMe, both in California's Silicon Valley, are experimenting with an unusual new approach to clinical trials: have participants assess themselves from their home computers potentially using everything from videos of tremors to a mouse that senses motor abilities. If it works—still a big if—the strategy could greatly reduce the need for doctors' visits and make trial participation vastly cheaper and possible from anywhere in the world.

Researchers have long considered how the Web might enhance clinical trials, in particular its ability to aggregate data from the thousands of people needed for studies tracking genetic and environmental factors linked to common diseases. But the new alliance comes with many uncertainties. Will there be a bias in who completes the assessment? Can the approach capture subtle changes in disease symptoms? Will participants understand what they're signing up for, and how will the data they supply be used?

"Can you really do valid clinical research via the Web?" asks Katie Hood, chief executive officer of the Michael J. Fox Foundation for Parkinson's Research in New York City, which is funding the project with a $625,000, 2-year grant. "That's what this will show."

The Parkinson's Institute and Clinical Center in Sunnyvale, California, will recruit 150 people, half with Parkinson's disease and half without, who recently participated in a traditional study examining occupational risk factors behind Parkinson's; through that study, researchers will have amassed a wealth of data on them. 23andMe will help design or adapt computer technologies and questionnaires for the 150 participants to see whether they accurately capture their health and health history. If they do, the tools could be expanded to much larger populations and to other research groups. Volunteers will also submit saliva samples to 23andMe, and those samples, like all supplied to the company, will be sequenced for more than 580,000 single-base variations. Eventually, their genetic information will be matched with information they provide online and, say the study leaders, stored securely.

Getting creative. Could Michael J. Fox and others with Parkinson's assess symptoms themselves online?

"We want to build this engine basically to be able to power genomewide association studies," says Linda Avey, a co-founder of 23andMe. Such enormous studies compare the genomes of those with a particular disease to the genomes of those without. To accomplish this, 23andMe needs to collect large online cohorts of people with different ailments, including Parkinson's disease. Eventually, 23andMe might sell information on participants, with their consent, to pharmaceutical companies looking to recruit for clinical trials. Avey notes that the company is considering similar strategies in other diseases, although she declined to say which ones.

"We're all trying to come up with new clinical approaches that can help us get large cohorts," says Kenneth Marek, a neurologist at the Institute for Neurodegenerative Disorders in New Haven, Connecticut. Marek is experimenting with another in-home assessment for Parkinson's disease, independent of the 23andMe venture: a sniff test that includes 40 different odorants. One of the first symptoms of the disease is a diminished sense of smell. Marek and his colleagues have begun recruiting 10,000 people whose family members have Parkinson's to see whether the disease can be detected in its earliest stages.

One concern, says Marek, is that relying on volunteers to run through such tests out of sight of clinicians may lead to bias. People who struggle with the tasks could "get frustrated and may be less willing to complete this at home than they would be in a clinic," he says. "We have some sense that that might be happening," but more information is needed. A question for 23andMe is whether participants in a disease-focused study will be ready for all the other genetic information the company offers when it surveys their genomes. Will someone in a Parkinson's trial want to know whether they—and by extension, their family members—are at increased risk for heart attacks or prostate cancer? The project leader, Parkinson's Institute scientific director and CEO J. William Langston, expects that the institutional review board considering the ethics of the venture, which could start later this year, will scrutinize it closely.

As that process gets under way, Langston and 23andMe are bringing together technology companies to explore how far computers can be pushed to assess Parkinson's disease from a person's home. The Michael J. Fox Foundation, meanwhile, is gearing up to spend as much as $1 million more on other Web-based assessment tools: It put out a call for applications in March. **–JENNIFER COUZIN**

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