so. "If the political situation and the economic situation were better, [Arima's] initiatives would be much more effective," says Keiichi Kodaira, director-general of the National Astronomical Observatory in Tokyo. For political appointees, "it is an extremely difficult time."

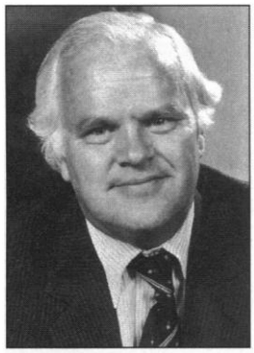
–DENNIS NORMILE

ENERGY

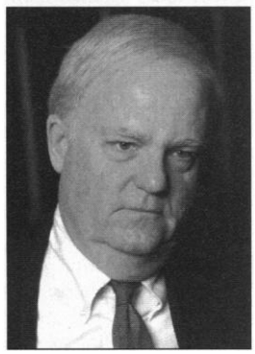
Fusion Facility Faces Fall Deadline

A battle of wills between two powerful members of the U.S. Congress and the Department of Energy (DOE) is jeopardizing efforts to salvage a multibillion-dollar international fusion project. The two congressmen told DOE not to sign an agreement late last month to continue work on the effort, known as the International Thermonuclear Experimental Reactor (ITER) project. If the United States doesn't sign the agreement by fall, the result would be "irreparable damage" to the project with "serious consequences" to fusion programs around the world, warns Shigeru Aoe, director-general of Japan's Atomic Energy Bureau.

The dispute comes at a critical time for ITER. The four partners in the project—Japan, the United States, the European Union, and Russia—have been working on a design for a massive, $10 billion machine that would be a prototype for commercial fusion power plants. But that design has come under fire in the past 18 months for technical and financial reasons, prompting researchers to explore a simpler and cheaper version—dubbed ITER Lite—that would cost roughly half as much (*Science*, 30 January, p. 649). Project supporters hope to win a green light from politicians in 2000 to build the scaled-down device.



ISAS



SAM KITTNER

No go. McDade *(above)* and Sensenbrenner *(below)* oppose further ITER work.

Whether the United States will continue to participate in reshaping the project depends on whether DOE can persuade Representative John McDade (R–PA), who chairs the House panel that funds DOE, and Representative James Sensenbrenner (R–WI), who heads the Science Committee, to lift a hold they have placed on extending the ITER agreement, which expired in July. Both lawmakers are loath to spend more money on the project until a thorough review of the U.S. fusion effort is complete (*Science*, 3 July, p. 26), and they directed DOE officials not to sign an extension of the ITER agreement when the partners met 21 to 23 July in Vienna. McDade's panel has also declined to appropriate the $12 million DOE has requested to continue work on ITER in 1999. Senior DOE officials and White House staff have been unable to meet directly with McDade on the matter, and their entreaties to his staff have failed. ITER supporters hope that Sensenbrenner will be persuaded to support the project during a mid-August visit to Japan.

Aoe told DOE Undersecretary Ernest Moniz in a 14 July letter that all parties must sign the agreement in order for work on ITER to continue. The U.S. decision, he wrote in the strongly worded missive, would determine the project's fate and "the future fusion programs" of all four partners. Hidetoshi Nakamura, director of the Science and Technology Agency's Office of Fusion Energy, explains that Japan's ability to work on ITER is based on a four-party international agreement. Without an agreement, "efforts [in Japan] would have to be suspended," he says. That would mean disbanding the teams of scientists and engineers working on the project. But Hiroshi Kishimoto, executive director of the Japan Atomic Energy Research Institute, which heads Japan's ITER design efforts, emphasizes that if the United States drops out entirely, "The other three parties—Japan, Europe, and Russia—will consider other possibilities to continue the joint work." Europe also is willing to proceed without the United States, say fusion officials, but Japan's participation is key, since it wants to host the facility and is willing to pay the largest share of the project's cost.

The congressional ban on extending the agreement is already hampering U.S. efforts to convince the other project partners to consider alternatives to ITER Lite as a hedge against a failure of the scaled-down design to win political backing, says Anne Davies, U.S. fusion program chief. She says that because of time, money, and resource constraints, the partners rejected a U.S. proposal that the ITER team work simultaneously on the design of smaller and cheaper machines that could be parceled out to various countries. But the partners agreed to cooperate with a U.S. effort to examine such options. "We want our partners to join

ScienceScope

X-RAY MISSION SNAGGED

The launch of an $86 million Japanese satellite designed to answer questions about the universe's development could be postponed due to problems plaguing NASA's contribution to the payload.

In early 2000, Japan's Institute of Space and Astronautical Sciences (ISAS) intends to orbit a satellite carrying a half-dozen x-ray telescopes aboard a $50 million ISAS M-5 rocket. NASA is equipping the satellite with an array of delicate sensors to provide high-resolution data on the energy outputs of the telescopes' targets. But "this is a troublesome program—and not a week seems to go by without a problem popping up," says NASA space science chief Wes Huntress. The technical glitches could push back the M-5's launch, he told an agency advisory panel 29 July.

Hajime Inoue, an ISAS project scientist, says NASA's snags have him "a little worried." But he admits ISAS is running into its own problems building the satellite. Inoue says ISAS hopes to make up time by testing and calibrating the telescopes more rapidly than planned and by working weekends. "It's still too early to talk of delaying the launch," he says.

WAR DECLARED ON ALIENS

Exotic invaders, beware. The White House plans to establish a high-level council next month to coordinate the efforts of more than 30 federal agencies coping with the pernicious effects of non-native plants and animals.

The action stems from a letter sent to Vice President Al Gore last year by more than 500 scientists decrying the government's piecemeal approach to exotic species (*Science*, 14 February 1997, p. 915). These species can destroy native habitats, outcompete crops for soil and water, and clog waterways.

President Bill Clinton will soon issue an executive order that creates a federal council to spell out each agency's responsibilities and tactics. "That makes good management sense," says Elizabeth Chornesky, director of stewardship for The Nature Conservancy. The council will also estimate how much money is needed to control the invaders.

us in doing so, and they may in some limited way," Davies said.

Congress recessed last week until September without an agreement between the House and Senate on a final 1999 DOE spending bill. That will provide DOE officials with additional time to make the case for ITER to lawmakers. The project's fate may be riding on their powers of persuasion.

–ANDREW LAWLER

With reporting by Dennis Normile in Tokyo.

SUPERCOMPUTING

Computer Experts Urge New Federal Initiative

Last week, 200 experts from academia, industry, and government gathered in Washington, D.C., to help put together a potential major research initiative: an effort spread among several government agencies to build the next generation of U.S. supercomputers. The National Workshop on Advanced Scientific Computation—hastily convened by the Department of Energy (DOE) and the National Science Foundation (NSF), which are now preparing their fiscal year 2000 budget requests—reached broad agreement that the government should invest about $1 billion over the next 4 years to develop a national network of supercomputers for civilian use, together with supporting technology and cutting-edge software.

> **"The science is ready for this kind of activity. The scientists ... know what to do; they just need the technology."**
>
> **—James Baker**

The ultimate goal would be to construct two 40-teraflop machines by 2003, each of which would be 200 times more powerful than the best supercomputers in universities today. (A teraflop is 1 trillion operations per second.) To allow scientists across the country access to the new machines, workshop participants also agreed to urge the government to bankroll a network of scientific and support centers. The workshop's organizers—who include DOE Undersecretary Ernest Moniz and Larry Smarr, director of the Illinois-based National Center for Supercomputing Applications—have put together a 10-page draft proposal that they will pass along to DOE this week for consideration in its budget preparations.

If the proposal is approved, it would provide a civilian counterpart to the Accelerated Strategic Computing Initiative, a 2-year-old DOE project to develop a 100-teraflop machine in the next decade that would be used to model the behavior of nuclear weapons. Although some universities have constructed high-end computing systems, their machines cannot keep pace with the demands of scientists for faster number-crunching capabilities for tasks such as mapping climate change, simulating combustion systems, or studying a microbe's interaction with its environment. "This [supercomputer] initiative is the most cost-effective way of leveraging this new world of science and technology," says James Langer, a physicist at the University of California, Santa Barbara, and chair of the workshop.

DOE and NSF are not the only potential participants in the initiative. The National Institutes of Health, the National Oceanic and Atmospheric Administration, and NASA, among other agencies, are also interested in taking part and contributing funds, says Michael Knotek, program adviser for science and technology in Moniz's DOE office. "Everybody sees here a real opportunity," says Robert Eisenstein, assistant director of mathematics and the physical sciences at NSF.

"We've got to move fast to do it right," says Langer. But he and other participants acknowledge that the program's ambitious goals won't be easy to achieve. Even if the White House includes the initiative in its 2000 budget request and Congress endorses the plan, attracting the hundreds of experts needed to implement it from a relatively small pool of computer science graduates will pose a challenge. And "some of the development requires machines not available for 3 to 4 years," says Paul Messina, who directs the Center for Advanced Computing Research at the California Institute of Technology and helped organize the conference.

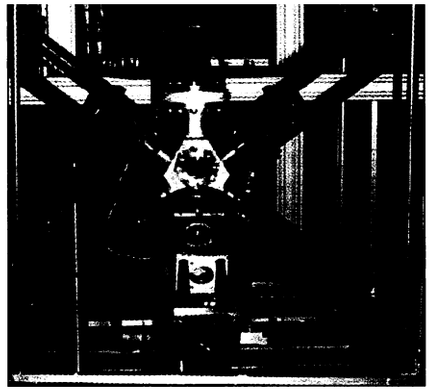
But scientists were heartened by the level of consensus achieved at the workshop among experts of varied backgrounds. "The science is ready for this kind of activity," says James Baker, administrator of NOAA. "The scientists are there; they know what to do; they just need the technology."

–JENNIFER COUZIN

PHYSICS

Gravity Measurements Ride the Atom Wave

Gravity may be the law of the land, but the force it applies varies slightly depending on the rocks beneath our feet. In the 3 August *Physical Review Letters*, researchers report that they have devised a sensitive new scheme for mapping these variations that relies on the quantum mechanical nature of atoms. The device could eventually be useful for searching out new oil and gas deposits, which reveal themselves in tiny gravity anomalies.



M. KASEVICH/YALE UNIV.

Interrogating atoms. Lasers firing into a vacuum chamber (center) manipulate atoms to create an atom interferometer.

Devised by Yale University physicist Mark Kasevich and his colleagues, the scheme builds on the bizarre dual nature of matter, which behaves—so says quantum mechanics—as solid particles at some times while resembling light waves at others. Since the late 1800s, instruments called interferometers have split light waves, allowed them to travel separately for a distance, and then recombined them. The result is a shadowy interference pattern, created because waves that converge in phase form light patches and those that cancel each other out form dark areas. In 1991, several research teams showed that "matter waves" of atoms can produce the same effect.

Typical atom interferometers work by dropping a collection of ultracold cesium atoms down a vacuum tube while hitting them with a series of laser pulses. The first of these pulses effectively places the atoms in two separate energy states at the same time, one moving faster than the other. These "atom waves"—two for each atom—split and move apart. Another pulse brings the two together again. In the meantime, however, the force of gravity has slightly different effects on the separated waves because they follow different trajectories. It alters the way they recombine, affecting the interference pattern, which a third laser pulse reads out.

One interferometer wouldn't be enough for measuring gravity in the field, says Kasevich. The problem is vibration, which can make gravity's tug appear weaker or stronger by moving the instrument closer to Earth's center or farther away. Using two instruments, one atop the other, gets around the problem. Both experience the same vibrations, but the difference in the two measurements—the gravitational gradient—stays constant. It varies only when