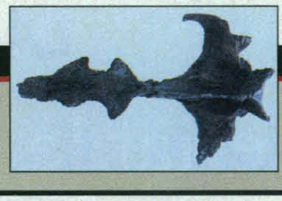


that if gravity lived in more than three dimensions, it could be very strong at short distances but would peter out into its normal, weak self at distances greater than the size of those extra dimensions. And, Arkani-Hamed points out, "gravity has only been accurately measured down to a millimeter or so." Researchers are now planning at least two tabletop experiments to see whether gravity's strength grows at smaller distances, down to a micrometer.

> **If the theory is correct, "it would rock the foundation of physics."**
>
> —Brian Greene

Reaction to this theory is mixed: "It's a long shot," says John Schwarz, a string theorist at Caltech. He and others suspect that an extra, "large" dimension for gravity might be inconsistent with various astrophysical measurements. The supernova explosion of 1987, for instance, should have produced gravitons that would have carried energy into the extra, "large" dimensions and cooled the star quickly. But neutrinos from the explosion came in at approximately the expected numbers and over the right time period for a star cooling in three dimensions.

Arkani-Hamed and colleagues say their theory survives this challenge if there are more than two of these "large" dimensions, or if there are two that are smaller than about 10 micrometers. The theory has survived other assaults as well. "At first I thought 'This is crap, I'm going to rule it out,' " says Stanford University physicist Scott Thomas, "but it turns out it's completely consistent with experimental data." Tom Banks, a theorist at Rutgers University in New Brunswick, New Jersey, however, says that the theory still needs to be checked against certain precision measurements made at accelerators.

A third group is also independently exploring the consequences of an additional "large" dimension, this time in a string theory picture where all particles and forces can experience it. Keith Dienes, Emilian Dudas, and Tony Gherghetta at CERN have found that allowing the electromagnetic, weak, and strong forces to leak into an extra dimension on a scale of 10^{-19} centimeters makes the three unify at a very low energy. The extra dimension is small enough that it might have escaped notice thus far. "Everyone thought [the extra dimension] would destroy the unification" and the theory, Dienes says, but add it "and bingo, the [three forces] unify almost immediately."

Combined with the work by Arkani-Hamed and colleagues, showing how gravity can be made to get strong at low energies, that opens the tantalizing possibility that unification, and hence a theory of everything, might be revealed at energies that would be probed by the LHC, Dienes says. If that's true, he adds, the LHC will show that the strength of the forces are hurrying to meet at an energy far lower than anyone had expected.

A negative verdict on this and other schemes to add new dimensions to the real world might come earlier. "It could be that next week someone will come up with a very simple argument why none of this can be true," Dienes says. "But we've been at this since the end of March, and nobody has knocked us out." Others point out that the theory might work on paper but still not be the one that runs the universe. Still, comments Juan Maldacena, a theorist at Harvard University, "in this field, any idea that is not obviously false is interesting."

–DAVID KESTENBAUM

SCIENCE APPOINTMENTS

Physicist Named Japan's Education Minister

For the first time in recent memory, Japan has a Minister of Education, Science, Sports, and Culture with hands-on experience as a researcher and educator. On 30 July, physicist Akito Arima, former president of the University of Tokyo, took the post as head of the Ministry of Education (Monbusho) in the Cabinet formed by the new prime minister, Keizo Obuchi. Monbusho oversees all the national universities as well as several dozen national research institutes.

Arima, 67, had been president of the Institute of Physical and Chemical Research (RIKEN), outside Tokyo, since retiring from the University of Tokyo in 1993. He resigned from RIKEN earlier this year and on 12 July was elected to the upper house of Japan's Diet.

The science community is elated to have a friend in such a high place. "When he was president of the University of Tokyo, he put extraordinary effort into improving the research environment," says Yoji Totsuka, director of the university's Institute for Cosmic Ray Research. "We're hoping he can do even more in a higher position." Hirotaka Sugawara, director-general of the High-Energy Accelerator Research Organization (KEK) in Tsukuba, seconds the approval. Arima, whose specialty was nuclear physics, can be counted on "to emphasize that basic research is also important" at a time when pressure is increasing for research to be economically strategic, says Sugawara.

Arima, however, will have much more on his mind than research. The $60 billion ministry has responsibilities ranging from developing kindergarten curricula to training Olympic athletes to preserving Buddhist statues. The ministry is also at the center of a number of political storms, such as a long-running and bitter controversy over how World War II is covered in secondary school textbooks. It is also set to be merged with the Science and Technology Agency as part of an effort to make the bureaucracy leaner and more cost-efficient.

Arima could not be reached for comment. But at a joint news conference with other Cabinet members, he said he recognizes the importance of all aspects of the ministry's agenda. He puts education at the top of his list, beginning with reforms to primary and secondary school that were outlined earlier this year by a committee he chaired. "This is an extremely important issue for the public," he said.

There are, however, questions as to just how much Arima will be able to accomplish, particularly as his tenure may be limited. Pundits are predicting that the political weakness of Obuchi and his Liberal Democratic Party, which lost seats in the most recent election, will mean the new Cabinet may only hold power for a year or

EIJI MIYAZAWA/BLACK STAR

In the hot seat. Akito Arima will head Monbusho at a difficult time.

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."

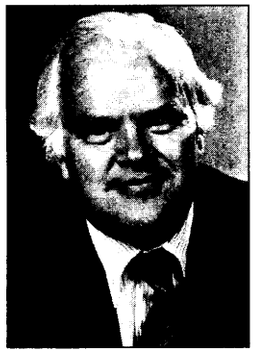
–DENNIS NORMILE

ENERGY

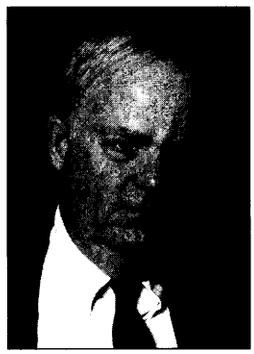
Fusion Facility Faces Fall Deadline

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.