and off. For spallation, moreover, negative ions—hydrogen atoms with an extra electron—generally make the best projectiles, while tritium production requires protons. That means, according to Appleton, that retrofitting the APT for spallation would mean adding another ion source and a second storage ring for the negative hydrogen ions. By Appleton's calculations, the retrofitting could tack $520 million to $780 million onto the APT's cost, making it only slightly cheaper than building two separate machines. Richter, in his letter, gave a more sanguine cost estimate: "a few hundred million dollars."

Even if Richter's estimate is nearer the mark, however, many scientists think combined military and civilian use of the tritium accelerator is inherently impractical. "When you try to do dual use in any facility, it simply doesn't work," says Appleton. Walter Kohn, a physicist at the University of California, Santa Barbara, who chaired the committee that endorsed the ANS in January 1993, agrees. The Los Alamos Neutron Scattering Center (LANSCE), which combines basic research with nuclear weapons work, offers a good example, he says. "LANSCE had ... many serious problems, design conflicts, scheduling conflicts," says Kohn. "Its performance had fallen short of the original specifications, in good part because of this multiple use."

Dual-use advocates counter that the Department of Defense has built huge margins of error into its tritium-need projections, in case arms control accords go awry or a new arms race begins. Chances are good, they say, that the accelerator will sit idle for long stretches of time, and the conflicts that worry Kohn wouldn't come up. Says Richter, "I see no reason why [APT] could not operate at almost any duty cycle one wants, from 6 hours a day for physics and 18 hours a day for [tritium] production, to the other extreme of one quarter of the year for physics and three quarters of the year for production."

The debate over dual use will be moot, of course, if two powerful backers of the South Carolina reactor have their way in Congress: Senator Strom Thurmond (R–SC), chair of the Senate Armed Services Committee, and Representative Floyd Spence (R–SC), chair of the House National Security Committee. Also posing a threat to the accelerator is the possibility of making tritium in a commercial reactor, which O'Leary will recommend exploring. That strategy would cost less than half as much as building either an accelerator or a new reactor, according to an unpublished analysis by the Washington consulting firm Putnam, Hayes and Bartlett.

But a knowledgeable Senate staff member, speaking on condition of anonymity, said the DOE's two-pronged strategy could work in favor of Los Alamos and the neutron-scattering community. Given DOE's severe budget constraints, he thinks the department will ultimately go ahead with the cheapest option—purchasing or leasing an existing reactor. The full-scale accelerator would fall to the budget knife. But by then, enough of a prototype accelerator would have been completed at Los Alamos for it to be converted into a new neutron source. "Then we would have a world-class spallation source at Los Alamos," concludes the staffer. Oak Ridge officials would be miffed, but physicists, at least, would have fewer mixed feelings.

–Jonathan Weisman

Jonathan Weisman is a science and defense writer at The Oakland Tribune.

SPACE PHYSICS

Shuttle Mission to Seek Antimatter

A Chinese-built magnet may fly aboard the space shuttle in 1998 in an attempt to give scientists an unobstructed view of antimatter and other exotic particles winging their way through the cosmos. But the project—the brainchild of Nobel laureate Samuel Ting—is a bit of a political hot potato, coming during a period of growing tension between the United States and China.

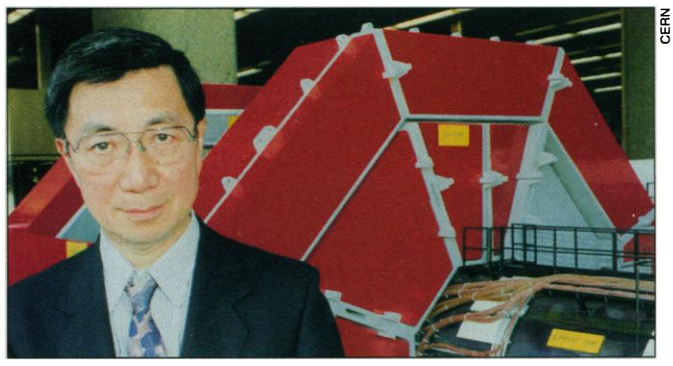
Ting described the experiment last week to a standing-room-only crowd of physicists at an international meeting in Shantou, China (see box on p. 916). The Massachusetts Institute of Technology physicist said that if the 6-ton Alpha Magnetic Spectrometer (AMS) performs successfully on the shuttle, it could be placed aboard the space station in 2001. Under a plan Ting has been pushing in Washington for the past 18 months, the National Aeronautics and Space Administration (NASA) would provide a ride into space, while the Department of Energy (DOE) would finance the $3 million instrument.

The idea has won enthusiastic support within both agencies. DOE officials say they want to provide an exciting new program for high-energy physicists in a time of tight money. And NASA Administrator Daniel Goldin is eager to prove that world-class science can be conducted on the shuttle and on the space station, according to agency managers. "There's no question Goldin wants to do this," says one. "Having an experiment by a Nobel laureate on the shuttle and station gives us prestige."

The project's Chinese connection has made some NASA managers nervous, however. Although Chinese officials have indicated their interest in participating in the space station, the White House last year warned the agency to steer clear of initiating joint projects with China given the political animosity between the two countries. As a result, NASA is quick to point out that Ting's experiment should not be seen as a joint effort between the two countries. "This is not a NASA project," says one NASA official. "And we've made it clear to DOE that we don't want any Chinese present at the [shuttle] launch." Adds another NASA official: "We're just the truck drivers."

Although Ting says that NASA signed off on the project in April, spokespeople for both agencies insist that a final decision has not been made. According to other sources, NASA and DOE expect to complete work this fall on a memorandum of understanding.

If the project is approved, the spectrometer would allow scientists to search for additional proof of the existence of antimatter, says Luciano Maiani, president of Rome's National Institute of Nuclear Physics, who is familiar with the project. By orbiting the instrument 300 kilometers above Earth, Ting said, the shuttle would take AMS beyond the planet's magnetic field; that would allow researchers to spot particles like antiprotons much more readily than from the ground or atmosphere. Experiments with balloons, at heights of up to 40 kilometers, have recorded about 10 antiproton events, but Ting says he expects to observe 200 such events on the 10-day space shuttle mission.



CERN

Attractive idea. MIT's Samuel Ting hopes the space shuttle will carry his Chinese-built magnet for the detection of antimatter.

At the heart of the spectrometer would be a magnet shaped like a 1-meter-square

Physics Meeting Unites the Two Chinas—Briefly

SHANTOU, CHINA—Scientific fellowship rose above national differences here last week, when an unprecedented gathering of more than 400 ethnic Chinese scientists from 14 countries—including Taiwan—went off without a hitch. Nominally billed as a physics conference, the event, held from 5 to 9 August on the campus of Shantou University, was in fact much more: part reunion, part public relations exercise, and part political theater.

In English, the organizers called the meeting "The First International Conference on Frontiers of Physics." But exciting new scientific findings were scarce, participants agreed. "I learned something new about what mainland scientists are doing, but there has been nothing earth-shaking presented here," said Yuan T. Lee, president of the Academia Sinica in Taipei. The Chinese title, "The First International Ethnic Chinese Physics Conference," turned out to be a more apt description for the event, which was attended by four Chinese nobelists* and two dozen scientists from Taiwan.

Nobel guest. C. N. Yang, co-winner of the 1957 physics prize, at the Shantou meeting.

Participants said the meeting provided a rare opportunity for scientists with much in common but many political and logistical obstacles dividing them to share results in fields ranging from particle theory to condensed matter and new materials. Organizers also hope that contacts made in Shantou will lead to future collaborative work. Y. C. Liu of Taiwan's Synchrotron Radiation Research Center, for example, introduced his facility's third-generation synchrotron and outlined procedures by which mainland scientists can apply to use it when it comes on line next year.

Indeed, in spite of the difficulty of getting passports and hard currency, some mainland scientists are already in the habit of collaborating with their compatriots elsewhere. "Since 1977, the Chinese government has sent about 10 of their very best experimentalists to come work with me," notes Samuel Ting, who teaches at the Massachusetts Institute of Technology and conducts research at CERN, the European particle physics laboratory. But for scientists on opposite sides of the bitter rivalry between the mainland and Taiwan, collaboration remains difficult, and organizers had to tiptoe around national sensitivities to arrange the Shantou meeting.

Participants' name tags, for example, gave only their names and not their institutional affiliations. Confusing on one level, this was prudent on another. Each side has an Academia Sinica; each has a technology school called Tsinghua University; each has a Physical Society; and neither side recognizes the institutions of the other. And because some of these rival institutions collaborated in arranging the conference, the program was a masterpiece of diplomatic nicety, acknowledging both "The Chinese Physical Society, Beijing, China" and "The Physical Society Located in Taipei, China."

But in a week when relations between the mainland and Taiwan reached a new low after Beijing conducted provocative missile tests in late July and announced plans for a second round of tests, some attendees saw the fact that the conference came off at all as a good omen for future interactions. "So far scientists have been able to stay above any political problems. And I think everyone agrees that exchanging research results is a lot better than exchanging missiles," said W. Y. Hwang, a professor of physics at National Taiwan University. C. N. Yang of the State University of New York, Stony Brook, told *Science* that he was especially encouraged by the presence of Lee, from Taipei's Academia Sinica: "The fact that he did come, together with a large group of people from Taiwan, indicates that strained relations are not viewed by Taiwanese authorities as something that should impede exchange."

Still, one mainland conference participant who asked not to be named said he doubted that substantial mainland-Taiwanese collaboration will be easy to arrange. "There are a lot of difficulties and political problems," he complained, "and those are the sort of problems that physicists cannot always solve."

–T. P.

* Yuan T. Lee, Academia Sinica Taipei (chemistry, 1986); Samuel Ting, Massachusetts Institute of Technology (physics, 1976); T. D. Lee, Columbia University, and C. N. Yang, State University of New York, Stony Brook (co-winners, physics, 1957).

cube made from rare earth elements mined in China. Ting declined to discuss the technical details of the project and the exact composition of the proposed magnet with *Science*, but scientists familiar with the project say the device would be just as strong and much simpler to use than a superconducting magnet, which requires complex circuitry and a power source. "It's not really very sophisticated," says one. At the same time, its simplicity allows it to be built more cheaply and rapidly than most space-based instruments.

The goal would be to measure the electrical charges of cosmic particles by monitoring their tracks as they pass through a hollow core in the magnet's center. "The secret is to collect enough particles to find antinuclei," says another scientist who has seen Ting's proposal. Because accelerators on Earth and natural processes in the universe are able to produce tiny quantities of hydrogen antimatter, he said the instrument's search will focus on the heavier antihelium.

Although optical telescopes cannot spot antimatter sources, scientists have determined that there are no such sources within 30 million light-years of Earth. Maiani says Ting's project could pinpoint antimatter sources 100 times as distant. And another physicist says the mission could reveal the existence of entire antigalaxies.

If it succeeds, the project will be a testament to Ting's tenacity in a time of fiscal austerity, according to Administration sources. "Ting is a masterful politician," says one about Ting's campaign to win approval for his experiment. "He successfully played one agency off against the other, and he's been pitching this all over town." In fact, he's been pitching it even farther afield: In March Ting spoke with leaders of the Russian Academy of Sciences about placing the magnet aboard the space station Mir if he doesn't get the go-ahead from Washington.

–Andrew Lawler and Ted Plafker

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