"the global effort will go on, though with some holes," says Barish. The reduction of US funding has been a particular setback to US development and industrialization programs for making the superconducting RF cavities that are a key ILC component.

Another major international undertaking imperiled by a US change of heart is the $1.5 billion Alpha Magnetic Spectrometer, a massive high-energy physics instrument designed to be bolted onto the ISS. Built over 14 years with contributions from 16 nations, the now nearly completed AMS was scheduled for delivery via space shuttle until NASA removed it from the shuttle manifest in 2006 (see PHYSICS TODAY, May 2007, page 30). In the wake of the *Columbia* crash and the decision to retire the shuttle fleet in 2010, NASA determined that all remaining shuttle flights would be needed just to finish building the ISS.

Samuel Ting, the MIT physicist who has headed the AMS collaboration, says the US, which contributed just 5% of the AMS cost, "has a moral obligation to [its] partners" to deliver the instrument. Now, with US–Russia relations deteriorating after Russia's August incursion into Georgia, NASA administrator Michael Griffin has ordered an internal review into the possibility of extending shuttle operations. In an 18 August internal e-mail first reported in the *Orlando Sentinel*, Griffin predicted that the next president will extend the shuttle's life as the "only politically tenable course" to eliminate what he has called "unseemly" US dependence on Russia for access to the ISS after 2010.

What next?

Marburger and other US science policy watchers tend to blame the political system, and the annual appropriations process in particular, for US ambivalence toward big international projects. DESY's Wagner doesn't buy that excuse. "Germany, and all civilized nations," allocate funding on either an annual or biannual cycle, he points out. Although funding cuts may at times have to be made in Germany, they occur only after the parliamentary committees with oversight have consulted and negotiated with the affected agencies. Like other non-US scientists, Wagner worries that the US remains "too self-centered" at a time when international collaborations are becoming increasingly important for big science. Those projects, he says, "are like a symphony. You can't remove the violins and expect the music to sound right."

Barish cautions against "throwing rocks at Congress" and the legislative process. The short-term nature of the US funding process does offer the advantage of allowing lawmakers to respond nimbly to new developments. He suggests that the Office of Science and Technology Policy, which Marburger heads, might develop some guidelines that would convey to Congress the importance of big collaborations to the continuing health of the US scientific community. Stanford University physicist Arthur Bienenstock, a former associate director of the OSTP, says the new president's science adviser "will have to put in some time with Congress" to explore solutions.

For his part, Marburger believes that particle physics stands out as the field "most vulnerable to US commitments" in coming decades. The field, he says, "has clearly crossed a border into an unknowable future. It remains a glorious, intellectually profound, highly international enterprise in which the US, the world's leading sponsor of science, has the ability and, I believe, the obligation to provide stability as [the field] finds its way."

David Kramer

India revives neutrino research

Some 45 years after the discovery in India of atmospheric neutrinos, a new lab and detector could put the country back on the international neutrino research scene.

An underground lab planned for India aims to, among other things, nail the neutrino mass hierarchy and increase the number of high-energy experimenters in the country.

The India-based Neutrino Observatory—so named because the 20 physicists at seven Indian institutions who spearheaded INO hope it will eventually become an international project—has in the past year received initial approval and promises of funding from the Indian government. Final approval is expected in the next few months, says project spokesman Naba Mondal of the Tata Institute of Fundamental Research in Mumbai. The project now has some 100 individual members from 25 institutes, with the University of Hawaii the only one outside of India so far. "It is the first time such a large collaboration from various institutions in India have come together to build an experiment that will be located and function in the country," Mondal says. It's also the largest and, at $220 million—including 10 years of operations—costliest basic scientific project ever undertaken in India.

The observatory would be dug into the Nilgiri mountains in the state of Tamil Nadu. The site is near a hydroelectric power plant, so roads and other infrastructure already exist. Some 1300 meters of granite would shield the experiments from cosmic rays.

Local environmentalists have opposed the INO site because of a nearby wildlife sanctuary. The observatory would be outside of the protected region, although during the construction phase trucks would drive through it. The project expects to get the green light for the site soon, Mondal says, and INO scientists are talking with ecologists about cooperating on such things as watch towers to monitor elephant movement and vehicle traffic. "Our plan is to develop INO as a model institution combining its scientific goals with preservation of the environment and ecology," he says.

No technological showstoppers

"From time zero, it takes approximately five years to build the tunnel and cavern," says Mondal. The first of three 16-kiloton modules for an iron calorimeter detector (ICAL) will be ready around the same time, he adds, and the full detector will be completed about two years later.

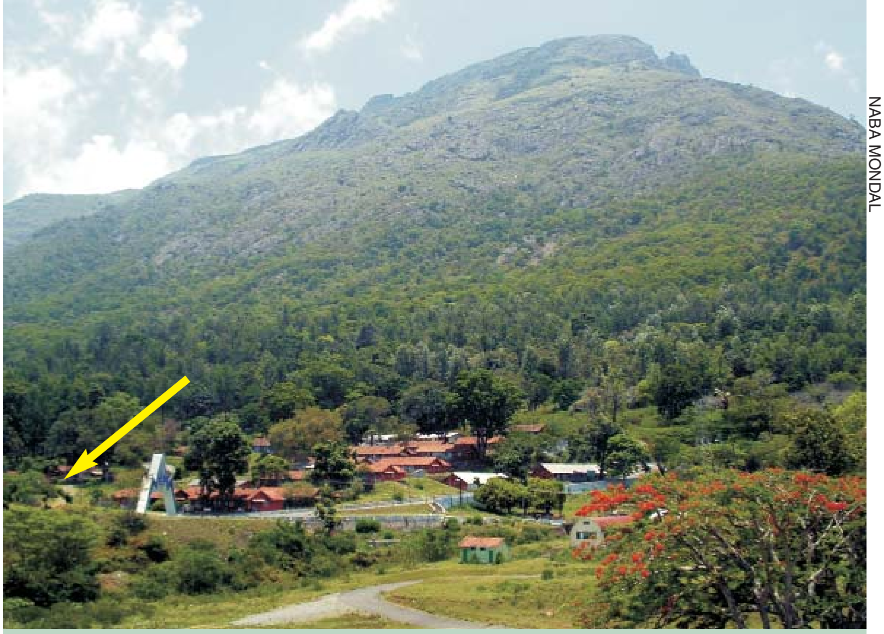
The detector will consist of alternating horizontal layers of iron and resistive plate chambers. Incident neutrinos that interact with the iron will produce muons (in the case of muon neutrinos), which will be detected by the RPCs. (Although ICAL—like other experiments—will also detect electron and tau neutrinos, their signatures are messier.) An applied magnetic field will send resultant negatively charged muons and positively charged antimuons (from antineutrinos) along trajectories with opposite curvature. "Because of this ability to distinguish the positively and negatively charged muons," says Mondal, "this detector can in principle determine the ordering of neutrino masses"—one of the fundamental open questions in neutrino physics.

To start with, INO will be used to look for atmospheric neutrinos. "This will work out of the box," says the

University of Hawaii's John Learned, who served as an international reviewer of INO. "I don't think there are any technological stoppers, it's just a matter of doing it."

"They will push the parameter space in a number of directions," adds Fermilab's Alan Bross. "It's a massive detector, and the spectrum they can see is different than with a Cherenkov detector, so it's complementary to Super-Kamiokande [in Japan]." Specifically, in addition to being able to tell apart neutrinos and antineutrinos, INO will be sensitive to higher-energy neutrinos than is Super-Kamiokande.

In a second phase, says Mondal, "we want to use ICAL as a far detector for high-intensity neutrino beams created in some other part of the world." Adds Bross, "INO is just about the right distance from CERN [on the French–Swiss border] and Rutherford lab [in the UK] to serve as a long-baseline detector. At 7500 km the effect due to matter would cancel out, so it gets rid of some ambiguities and allows you to be sensitive to other parameters of the neutrino matrix." But to serve as the long-baseline detector from a neutrino factory, Mondal notes, "We need the involvement of the neutrino community globally for such future steps." Another experiment under discussion for INO is a double beta-decay detector.



NABA MONDAL

The India-based Neutrino Observatory is set to be dug into this mountain (above) in Tamil Nadu (the arrow indicates the entrance). Technicians prepare resistive plate chambers (below) for a prototype magnetized iron calorimeter detector.

M. V. N. MURTHY

Brain gain

In addition to its experiments, the INO team is trying to build a pool of young scientists to take advantage of the facility. In August the team launched a new graduate program that focuses on neutrino physics. "We have five students this year who are taking courses in the Tata Institute," Mondal says. "We wanted 10. They'll get more courses in particle physics and experimental techniques than other [physics] students." Notes Learned, "India has turned out lots of great theorists. Their experimenters have gone to CERN, Fermilab, et cetera. We have drained their brains pretty heavily." The graduate program will move to its own center in Mysore once INO goes on line.

Alluding to the 1960s discovery of atmospheric neutrinos in southern India's Kolar Gold Fields—around the same time as an experiment in South Africa spotted them—Learned adds, "I'm very enthusiastic about Indian cosmic-ray experts getting back on the map."

Toni Feder

One man, one hundred meetings, and a physics subfield

"Joel is remarkable." "Everybody feels like he is their brother or father." "He has a magnetic personality." Comments like those come from everyone who knows Joel Lebowitz. And everyone knows him, or at least everyone remotely involved in statistical mechanics does. As Michael Fisher, a theorist at the University of Maryland, College Park, puts it, "Anyone who knows Joel, and sees him in action, loves him as a person."

The action that most people have seen is the statistical mechanics meeting that Lebowitz has orchestrated twice a year since 1959. The 100th meeting—but not the last—will take place in December at Rutgers University, where Lebowitz is on the physics and mathematics faculties. "It's truly astonishing to think that one person has organized 100 meetings," says Haverford College experimentalist Jerry Gollub. "It's an amazing service to science."

"The Yeshiva–Rutgers meetings"—the informal name for the meetings based on where Lebowitz has held them—"have played a huge role in the statistical mechanics community. The field was the Cinderella of physics, and Joel has become a focal point for the field," says Fisher. "The exact solution of the mean spherical model was announced there. The solution of the Percus–Yevick equation for hard spheres was announced there. In 1971 all the renormalization group ideas—