"High risk, high payoff"

"If we observe neutrinoless double beta decay, then we know neutrinos are Majorana particles and that lepton number is violated. Those are discoveries," says Wilkerson of the Majorana experiment. "Then you extract the mass of the neutrino." Violation of lepton number, adds Jesse Wodin, a postdoc at Stanford who works on EXO-200, "would point to very exciting physics. There are arguments for why lepton-number nonconservation leads to bariogenesis, explaining why matter, not antimatter, dominates our universe. It's a very high-risk, high-payoff field. It's a hard problem that needs to be attacked from many avenues. It's a very exciting time for neutrino physics."

The next generation of experiments aims for a 10-fold or greater increase in sensitivity to neutrino mass, down to 50–100 meV. Another bunch of smaller, more specialized, or less developed experiments are also in the works. For example, scientists in Japan are considering retooling the KamLAND neutrino detector by dissolving Xe into a subset of the facility's 1000 tons of scintillator to look for double beta decay. "If we don't see a signal, we can only set limits," says Schönert. "Then the quest will be to design an experiment that scrutinizes the 1-meV mass range"—one of the scenarios predicted by neutrino oscillation experiments. That would require operating background-free with 10 to 100 tons of isotope for several years, he adds. "It is yet science fiction."

In any case, says Wodin, extracting the mass involves a "smudge. Predicted events depend on nuclear matrix elements, and there are multiple ways to do the calculations. No one knows the right way to do it yet. I suspect when we get a real signal, there will be a flurry of theoretical work."

Toni Feder

US seeks science ties to salve relations with Muslim world

Agencies move tentatively to implement Obama's plan, but Iran isn't invited to the table, and funding is scarce.

In the coming weeks, three renowned US scientists will fan out across the Muslim world bearing an invitation from the White House to engage in scientific cooperation. In November, Secretary of State Hillary Clinton announced in Morocco that former National Academy of Sciences (NAS) president Bruce Alberts, former National Institutes of Health director Elias Zerhouni, and Nobel laureate and UCLA chemistry professor Ahmed Zewail have agreed to serve as "science envoys" and visit a number of Muslim-majority countries in North Africa, South and Southeast Asia, and the Middle East. The emissaries will gather input on areas of potential collaboration from government officials and leaders of the nations' scientific communities.

They are one element of a science and technology (S&T) outreach plan President Obama announced in a June speech at the University of Cairo, when he proposed a "new beginning" in US relations with Muslim-majority nations. Other steps include an increase in the number of environment, science, technology, and health (EST&H) officers stationed at US embassies in those countries and the creation of several "centers of excellence" in the Middle East, Southeast Asia, and Africa.

Also in response to the Cairo speech, the US Overseas Private Investment Corp announced plans in October to establish one or more private equity funds for investing in science, technology, education, and other areas in Muslim nations. OPIC has invited proposals from private equity fund managers to operate the funds, which are to invest in knowledge-based businesses in the countries. Administration officials say the response to OPIC's solicitation has been overwhelming, and several funds will be created, each with an investment from OPIC of $50 million to $100 million, to be matched by funds from private investors.

Details to come

The Cairo initiative is clearly still in its early stages. No decision has been made on how many of the 57 nations with majority Muslim populations will be invited to participate, nor have significant resources been identified to support the initiative. "Eventually, we would like to see programs of this type extended to the whole world," says Steve Fetter, assistant director at large at the White House Office of Science and Technology Policy. "These are global challenges, and there is great enthusiasm here in strengthening US partnerships worldwide," echoes Jason

Nuclear waste dump doubles as low-radiation site for science

Scientific experiments that require a low-radiation environment may seem unlikely bedfellows with long-lived transuranic waste from nuclear weapons, but in the US Department of Energy's Waste Isolation Pilot Plant near Carlsbad, New Mexico, the relationship appears to be mutually beneficial. Some 655 meters down in a salt formation, the background radiation level is much lower than at the surface, and the DOE can point to the sensitive experiments WIPP hosts as evidence that the controversial waste repository poses no hazard to the public.

GABRIELLA SCIOLLA, MIT

For science, says Norbert Rempe, WIPP's liaison for researchers, "the big advantage we have is the nature of the host rock. Radiologically, it is extremely quiet. Salt has practically no thorium or uranium, and the level of potassium is minute." WIPP is host to the Enriched Xenon Observatory–200, a prototype double beta decay detector (see the story on page 20); clean-room and other R&D facilities used since the early 1990s by Los Alamos National Laboratory scientists; an experiment that is gearing up to hunt for dark matter; and biology studies that aim to test the hypothesis that cells are affected by ionizing radiation in proportion to dose, with no lower threshold. Most of the experiments are located about a kilometer from the stored nuclear waste. DOE estimates it has put around $500 000 toward science in WIPP since 2002, including creating experimental galleries such as the one shown at right, which is now home to EXO-200; the individual experiments bring their own funding.

DOE

A team of scientists from Boston-area universities is setting up a dark-matter time projection chamber in WIPP. The idea is to look at the recoil tracks of fluorine nuclei knocked out of the experiment's carbon tetrafluoride gas molecules by collisions with dark-matter particles. "What's really different about this experiment," says MIT's Peter Fisher, "is that it does not just measure dark matter that bumps into a nucleus and leaves some energy but also measures the direction the dark matter comes from." Because of Earth's rotation and its motion through the galaxy, the direction of incidence of dark matter should shift about 96° in 12 hours, he says. "If we measure the wind from this prediction, it would be decisive proof we had observed dark matter." The detector's four view ports (getting a tweak here by MIT postdoc James Battat) will be instrumented with CCD cameras, which will image a two-dimensional projection of recoil tracks, and photomultiplier tubes will go in the center to measure the tracks' third dimension. The experiment is intended as a proof of principle; the team hopes to later expand the target volume from 18 liters to 1000 liters.

Geoffrey Smith, a microbiologist at New Mexico State University, Las Cruces, heads up studies on the effects of radiation on cells. Cell growth is being compared under three different radiation exposures—a reduced level underground at WIPP, a surface level, and a slightly elevated level. "These are not levels we know as harmful," Smith says. "The point is to get data to test the linear no-threshold hypothesis." For two types of bacteria, Smith and his group track cell growth, protein production, and absorbance of the cell culture media. For the underground tests, Smith says, "the cells experience unnaturally low radiation levels because they are grown in a chamber made from 7-inch-thick, pre–World War II steel, which does not have radiation fallout from atomic bombs." From the first round of experiments last summer, he says, "it looks like cells may not be doing as well underground, but it's not statistically different from aboveground." He plans another round of experiments this summer. Smith is also involved in other research in WIPP that doesn't require low radiation levels, namely, the search for 250-million-year-old bacteria in saturated-brine inclusions.

Toni Feder

Rao, senior policy analyst at the OSTP. The form, location, and topics to be addressed by the centers of excellence haven't been defined. "We're wide open on what it might be," says Fetter, noting that input gained from the envoys will help to shape the process. But the centers' focus is likely to be on issues relevant to the regions, such as food, agriculture, and water, he adds. An OSTP spokesman says that centers could consist of brick-and-mortar as well as virtual facilities. As for resources, OSTP staffers say to watch for Obama's fiscal year 2011 budget request, due to be made public next month.

Rao says that Zewail will visit his native Egypt, and possibly Jordan and Lebanon as well, early this month. Alberts will go to Indonesia in the latter part of January. Now editor-in-chief of *Science* magazine, he spent a good part of his 12 years as NAS president working with national academies in developing nations. He says that he has offered to visit Pakistan in the coming months. "Funding will be a problem, but I've been told it's a presidential priority," Alberts says. Zerhouni will travel to his native Algeria in February, Rao says, and adds that other details of the Johns Hopkins Medical School professor's trip haven't been firmed up. Additional envoys are expected to be named, though Rao and other officials offered no details.

Iran a big exception

The US's scientific outreach to the Muslim world won't be touching Iran, which is arguably the Muslim state with the most advanced S&T (see PHYSICS TODAY,

May 2009, page 28). Washington and Tehran have had no diplomatic relations for 30 years, and there appears to be no end in sight to the stalemate over the nuclear issue. Improving S&T cooperation with Iran is particularly problematic, says Richard Nephew, the Middle East team chief in the State Department's Bureau of International Security and Nonproliferation, in that "science is at the heart of the issue" of the nuclear stalemate. Trying to disentangle nuclear science and technology from broader cooperation in S&T would be "a public relations nightmare," he notes.

There is considerable precedent, however, for scientific cooperation among nuclear rivals. Norman Neureiter, a former science adviser to the secretary of state, recalls that in 1972, when the US and Soviet Union had tens of thousands of nuclear missiles aimed at each other, the two nations signed an agreement to cooperate in science. At the same time, NASA and its Soviet counterpart began working together to enable the spacecraft of both nations to dock together. "You can imagine how that went over at the [Department of Defense]," Neureiter says. Among the first Chinese visitors to the US following President Richard Nixon's groundbreaking visit to Beijing in 1972 was a delegation of scientists, says Neureiter, who then worked on the staff of the White House science and technology office. "I can still remember meeting them in their Mao suits."

Glenn Schweitzer, who directs the Eurasian program at the National Academies, says that without exception, high-ranking Iranian officials admire US science and scientists. During two separate visits to Tehran by US scientific delegations, Schweitzer says, he got word that President Mahmoud Ahmadinejad wished to meet with the visitors. Worried about the message such a photo op would have sent back home, he demurred. Still, he says, visits by American scientists "are improving the image of the US among hundreds of thousands of Iranians." Indeed, a statue of Nobel laureate physicist Joseph Taylor, who visited Iran two years ago, was recently unveiled at the Pardis Technology Park outside Tehran. Three other US Nobel laureates have traveled to Iran in recent years, and their receptions were uniformly enthusiastic, Schweitzer adds.

But visits to Iran ended abruptly in December 2008, when Schweitzer was detained and interrogated in his Tehran hotel room for hours by men claiming to be government security agents. Letters from presidents of the National Academies demanding guarantees from Iran that such incidents won't recur have gone unanswered, Schweitzer says. Still, in the past six months, he's managed to arrange three workshops—in the US, Finland, and France—that were attended by Iranian scientists.

Alex Dehgan, an American Association for the Advancement of Science fellow who works on Middle East science issues at the State Department, believes that increasing exchanges between US and Iranian scientists would undermine the case that the regime has been trying to sell to its population—that demands by the US and other Western countries for Tehran to end its nuclear program are really an effort to hold back Iranian progress in S&T.

Science diplomacy

The State Department plans to add 8 to 10 newly trained EST&H officers to embassies in the affected regions, beginning this year. Currently, about 50 EST&H officers are stationed at US embassies worldwide. As their title implies, they are responsible for a broad range of issues, and many handle economic affairs as well. They are career foreign service officers, and most are nonscientists.

Nina Fedoroff, science adviser to the secretary of state, says that the Muslim nation initiative has its roots in a much broader plan to establish a "science diplomacy corps" for embassies to draw on as needed. In the plan, which she has been pushing, scientists from other federal agencies and State Department fellows from universities and industry would be recruited and detailed for up to three months as "embassy science and entrepreneurship fellows" in countries where their expertise is needed. The missing ingredient is funding, she says.

Many Muslim countries are among the 37 nations that have signed formal bilateral S&T agreements with the US. But only two of those pacts—those with nuclear-armed rivals India and Pakistan—come with dedicated funding. In November, Clinton announced a $45 million US grant to Pakistan's higher education authority to support the troubled country's S&T agreement. Proposals submitted to the US–Pakistan program are peer reviewed and ranked separately by both countries, with final selection made by a joint committee.

Fedoroff says she was "deeply impressed" with the quality of the science and the organization of the cofunded projects that were presented at a 2008 conference she hosted at the Islamabad Marriott. That was a few weeks before a truck bomb exploded outside the hotel, killing dozens of guests. With Pakistan's economy and security deteriorating, she fears that Pakistan won't be able to find funding for next year. On the positive side, a 2008 agreement between NSF, which can fund only US-based researchers, and the US Agency for International Development, which can support research in eligible developing countries, has opened up a potential new funding stream for the US side of projects supported by bilateral S&T agreements, including Pakistan's.

David Kramer

news notes

Simons says hire. "It was out of the blue, and a wonderful surprise," says Mark Srednicki, of the 6 November news that the University of California, Santa Barbara, physics department, which he chairs, would receive funding for two postdocs. The money comes from the Simons Foundation, which is paying out $19 million for 68 three-year postdoctoral positions in math, theoretical physics, and theoretical computer science.

The positions, open to candidates of any nationality, are with some 46