

predicts a much more massive partner for every type of particle known today.

But the true cause of the discrepancy is far less exciting. Misled by an extra minus sign, theoretical physicists underestimated the predicted value of the muon's magnetism. To find that value, physicists must add up the results of a series of hugely complicated calculations, one for each combination of particles emitted and reabsorbed by the muon.

In 1995 two groups independently calculated the contribution for a combo known as "hadronic light-by-light scattering," but both got the sign of the answer wrong. If the negative results are made positive, the theoretical prediction for the muon's magnetism

national School for Advanced Studies in Trieste, Italy, and Joaquín Prades of the University of Granada in Spain performed the calculation in two different ways, and now they think they've found a different mistake in each approach. "We're still checking it, but it seems that we have an overall sign error, too," Bijmens says.

The winnowing of the discrepancy is disappointing, says Lee Roberts, an experimental physicist at Boston University and spokesperson for the Brookhaven team: "You always want to be the first to discover something new and exciting." However, the discovery of the mistake has an upside, Roberts says. The scrutiny that unearthed the mistake has also improved the various calcu-

$$a_{\mu}^{\text{LbyL},\pi^0} = -e^6 \int \frac{d^4 q_1}{(2\pi)^4} \int \frac{d^4 q_2}{(2\pi)^4} \frac{1}{q_1^2 q_2^2 (q_1 + q_2)^2 [(p + q_1)^2 - m^2][(p - q_2)^2 - m^2]} \\ \times \left[\frac{\mathcal{F}_{\pi^0 \gamma^* \gamma^*}(q_1^2, (q_1 + q_2)^2) \mathcal{F}_{\pi^0 \gamma^* \gamma^*}(q_2^2, 0)}{q_2^2 - M_{\pi}^2} T_1(q_1, q_2; p) \right. \\ \left. + \frac{\mathcal{F}_{\pi^0 \gamma^* \gamma^*}(q_1^2, q_2^2) \mathcal{F}_{\pi^0 \gamma^* \gamma^*}((q_1 + q_2)^2, 0)}{(q_1 + q_2)^2 - M_{\pi}^2} T_2(q_1, q_2; p) \right]$$

Are you positive? The sign of this elaborate expression originally led physicists astray.

goes up enough to shrink the discrepancy by nearly half. That leaves the difference only slightly bigger than the theoretical and experimental uncertainties, spoiling the case for new particles.

The sleuths who cracked the case were Marc Knecht and Andreas Nyffeler of the Center for Theoretical Physics in Marseille, France. The pair repeated the calculation after improving a key mathematical ingredient called a "form factor." "We thought perhaps with our better description we could get an improved value. But we didn't expect to get the opposite sign," Nyffeler says.

Knecht and Nyffeler's paper appeared on 6 November on the Los Alamos preprint server, leading the other two groups to double-check their work. Both found mistakes that affected the outcome.

In a paper posted on the Los Alamos server on 6 December, Masashi Hayakawa of the KEK laboratory in Tsukuba, Japan, and Toichiro Kinoshita of Cornell University in Ithaca, New York, report that in their 1995 calculation they had inadvertently introduced an extra minus sign when using a specialized computer program to help grind through the staggering quantities of algebra. "We misunderstood the program in a subtle way," Kinoshita says.

Meanwhile, Johan Bijmens of Lund University in Sweden says that in 1995 he and collaborators Elisabetta Pallante of the Inter-

lations in ways that put the theoretical prediction on firmer ground. "I view it as a positive step that we have a lot more confidence in the theory than before," Roberts says.

The Brookhaven experimenters hope to publish an even more precise measurement for the muon's magnetism in March based on four times as much data as they used in their original measurement. Those results should allow physicists once again to say whether the magnetism of the muon adds up to a tiny sign of something big.

—ADRIAN CHO

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GERMAN RESEARCH

Helmholtz Reforms Mollify Scientists

BERLIN—A controversial plan to inject more competition into Germany's largest research organization, the Helmholtz Association of National Research Centers, has been modified to ensure that basic research remains a priority. Physicist Walter Kröll, the newly elected president of the association, discussed details of the plan last week at a press conference following the first meeting of the reorganized Senate.

The reforms, to take effect in 2003, will replace a system of block grants for the 15

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No-Confidence Vote In a straw poll, some 150 genome scientists, physicians, and ethicists voted 3:1 in favor of ending the government-backed Human Genome Project when it finishes its work in 2003. The informal tally, taken last week at a meeting of human genome experts in Warrenton, Virginia, reflects concern among some scientists that proponents of the decade-long, \$300 million effort have oversold its immediate benefits to biomedicine. But Francis Collins, director of the National Human Genome Research Institute, which funded and coordinated much of the sequencing effort, warned voters that "ultimately, you aren't going to decide this."

MOSE Advances Venice's lagoon may get its floodgates after all. Italian officials earlier this month approved a controversial plan to spend \$2.3 billion to build MOSE, a set of inflatable floodgates designed to protect the historic city from tidal flooding. In March, officials had requested revisions in the plan after researchers complained that the project hadn't accounted for the latest predictions for sea-level rise due to climate change (*Science*, 6 April, p. 28).

Critics still argue that MOSE, which will take at least 8 years to build, will be an environmental and economic disaster. Some experts say that reengineering the lagoon's outlets would do better—and save money. And the environmental group WWF-Italy calls MOSE a "presumptuous technological bet." A separate controversy over contracting is likely to delay construction—and prolong debate.



Lander Take Off? Look for the renowned Whitehead Institute in Cambridge, Massachusetts, and its genome center run by Eric Lander to go their separate ways in 2002. The center served as the flagship organization in the Human Genome Project with its more than 200 employees and a vast collection of sequencing machines. With the bulk of that project complete, new Whitehead director Susan Lindquist and Lander are contemplating making the center into its own institute, affiliated—like the Whitehead—with the Massachusetts Institute of Technology, according to sources familiar with the talks. Whitehead spokesperson Seema Kumar acknowledges that "informal discussions" are under way to examine "organizational models" to best make use of the center's genomic expertise.

nothing that can convince this government of the usefulness and the need to support the social sciences," says Renaud, a sociologist who was at the University of Montreal when he was recruited in 1997 to rescue a body embroiled in internal bickering (*Science*, 11 April 1997, p. 195). "The question for me is: Am I going to stay in Ottawa?"

—WAYNE KONDRO

Wayne Kondro writes from Ottawa.

CIRCADIAN RHYTHMS

A Time to Rest: Clock Signal Identified

Pet hamsters love to run on their wheels at night, the time when their wild cousins venture out of their burrows to scurry around in search of food. Wheel-running—or its natural equivalent—is just one of many activities and physiological states that follow a daily rhythm, cycling up and down about every 24 hours, under the control of an internal biological clock known as the circadian clock. Researchers have made tremendous progress recently in identifying the molecular gears and levers that run the clock, but they have remained in the dark about an equally important part of the clock: the signals it sends out to control circadian behaviors.

Now, on page 2511, a team of researchers led by Charles Weitz at Harvard Medical School in Boston reports that it has discovered the first known output signal from the mammalian clock, a molecule called transforming growth factor alpha (TGF- α), known for its role in cancer and embryonic development.

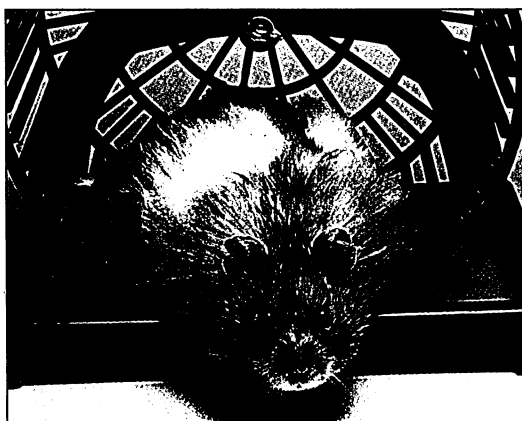
Clock researcher Michael Menaker of the University of Virginia in Charlottesville calls the work "a pioneering effort" that opens the way for clock researchers to begin to study the neural circuits by which the clock controls behavior and physiology. Joe Takahashi of Northwestern University in Evanston, Illinois, agrees: "One of our big gaps in understanding is how signals leave the [clock]." This paper, he says, begins to fill that gap.

Weitz's team based its quest for clock signals on work by several research teams showing that the brain's suprachiasmatic nucleus (SCN), home of the mammalian clock, secretes something that controls wheel-running. Weitz postdoc Achim Kramer searched for molecules secreted by SCN neurons, and Weitz scanned the literature for known SCN products. "About 20 secreted peptides have been documented from SCN," Weitz says, "and no one knows

what most of them do."

Weitz's team took a selection of newly discovered and previously published SCN products and collaborated with Fred Davis's lab up the street at Northeastern University in Boston to test each candidate molecule's effects on wheel-running in hamsters. They infused each molecule continuously for 3 weeks into the brain near the SCN and monitored the animals' wheel behavior. Of 32 molecules they tested, TGF- α stood out: It completely stopped the animals from running in their wheels. Other experiments done with Tom Scammell across the street at Beth Israel Deaconess Medical Center showed that the hamsters weren't paralyzed or otherwise impaired. They just lost their nocturnal urge to run.

The researchers hypothesized that TGF- α may be produced by the clock during the day to inhibit running. If so, they reasoned, TGF- α production by the SCN should be high during the day and low at night—and that is exactly what they found. What's more, TGF- α would need to act on a nearby brain area called the subparaventricular zone



To run or not to run. Hamsters and other nocturnal rodents run at night when TGF- α levels are low.

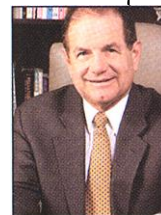
(SPZ), which controls daily running rhythms. And when they looked in the SPZ, they found that its cells contained the epidermal growth factor (EGF) receptor, which is also the receptor for TGF- α .

To confirm that TGF- α acts through the EGF receptor to block wheel-running, the researchers tested EGF, a molecule that works through the same receptor but is not made by the SCN. They found that it also suppressed wheel-running. What's more, Weitz's team found that mutant mice with impaired EGF receptors don't seem to register TGF- α 's signal; they run during the day more than normal mice do.

The mutant mice were oblivious to external signals as well. Normal mice stop running at night if the lights are turned on. This response, called "masking," seems to work like an emergency backup system to assure

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Orbach to DOE Theoretical physicist Ray Orbach, chancellor of the University of California (UC), Riverside, is slated to become the Department of Energy's next science chief. President George W. Bush on 11 December said he will nominate Orbach, 67, to head DOE's Office of Science, which oversees a \$3.2 billion research program. Orbach is a veteran academic and administrator who has led UC Irvine for nearly a decade. His appointment is getting good reviews. But one congressional aide warns that Orbach will have his hands full "promoting science in an agency that seems to be losing interest."



Super Concerned Japanese researchers hope to recreate the events that led to last month's accident that destroyed nearly 6800 of the 11,000-plus photomultiplier tubes (PMTs) at the Super-Kamiokande neutrino detector (*Science*, 23 November, p. 1630). Leading theories involve the effects of water pressure, the energy released by the collapse of the 60-cm-diameter vacuum tubes, and the impact of debris from the first broken tube. "We are going to try to reproduce the disaster," says Yoji Totsuka, a professor at the University of Tokyo's Institute for Cosmic Ray Research and head of the observatory, which in 1998 recorded the first convincing evidence that neutrinos have mass.

The first test will shatter one PMT at the tank's bottom and watch its impact on others nearby. A second experiment will test the ability of prototype plastic cocoons to protect the tubes from shock waves and debris. Totsuka hopes to complete the experiments in time to present the results to an investigative committee early next month.

EPA Seeks Advice The Environmental Protection Agency (EPA) has put on hold plans to use studies in which companies dose people with pesticides while the National Academy of Sciences studies the issue. A 1996 law that requires new safety limits for pesticides on produce prompted industry to expose paid volunteers to chemicals to determine the minimum level at which a toxicant causes effects. The Clinton-era EPA barred using the human data due to ethical concerns, but last month agency officials said they were reviewing some studies (*Science*, 14 December, p. 2285). Now EPA has shelved the studies until the academy weighs in on whether some human research is "unacceptable," and on how the agency should handle studies that don't follow federal ethics guidelines.

NOBEL STATEMENT

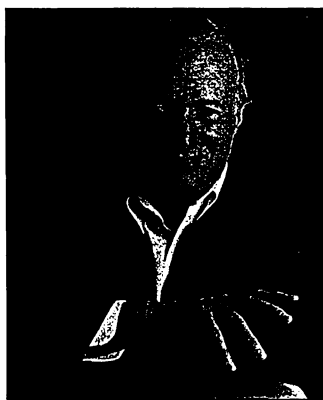
Laureates Plead for Laws, Not War

OTTAWA—A majority of the world's living Nobel laureates issued a statement last week urging industrial nations to work cooperatively to address conditions that they believe contribute to global terrorism and unrest in the developing world. The statement, signed by 108 laureates and released at the 100th anniversary of the prizes, identifies poverty, global warming, and the spread of arms as a combustible mix, and it points to several international agreements as examples of the kinds of measures that should be encouraged. Ironically, a few days after the statement was released, the Bush Administration announced that the United States is withdrawing from one of those agreements, the 1972 Anti-Ballistic Missile (ABM) Treaty.

The message "is a call, not to arms, but to disarm the source of major tensions in the world," says the University of Toronto's John Polanyi, a 1986 chemistry laureate and the driv-

the world's dispossessed. ... If, then, we permit the devastating power of modern weaponry to spread through this combustible human landscape, we invite a conflagration that can engulf both rich and poor."

"Science alone, technology alone, is not sufficient to deal with these issues," says Massachusetts Institute of Technology chemist and 1995 Nobel recipient Mario Molina. "We need strong commitments and values from society that technology and science are put to good use." The statement mentions the Kyoto Convention on Climate Change, the Strategic Arms Reduction Treaties, the Comprehensive Test Ban Treaty, and the ABM Treaty as agreements fostering a similar spirit of community. U.S. withdrawal from the ABM Treaty is a "serious mistake," Polanyi says, adding that nations are "fooling themselves" if they think safety can be found behind the protective walls of new missile screens. Crawling into an armed hole offers only the pretence of safety, Polanyi argues.



Polanyi began talking to his Nobel colleagues last July about drafting the statement. About 30 laureates declined, he says, for reasons that vary from its omission of population control to a general distaste for political commentary. Many laureates who initially thought that the statement might be presumptuous or an oracle of the future changed their minds, he notes, after deciding that "the alternative, having a high level of education and some public prominence and not saying what you believe, is even worse."

The message shouldn't be labeled liberal or conservative, Molina says. "To me, it's rational. It's the only means to provide stability in the long run. It's also what we think is fair and justifiable from an ethical point of view."

Molina says there is no formal plan to achieve official recognition of the document among governments or international bodies. "But there might well be next steps that each of us take as individuals," he says. Adds Polanyi: "I don't think one can afford to discount the thinking of scientists in an age of science."

—WAYNE KONDRÓ

Wayne Kondro writes from Ottawa.

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Healthy Investment Spending more on health care in the developing world would save lives, reduce conflicts, and boost the economy, a panel of 18 economists, health experts, and scientists argues in a report presented this week to World Health Organization (WHO) director-general Gro Harlem Brundtland. Echoing views long espoused by its chair, Harvard economist Jeffrey Sachs, the panel says that middle-income countries should spend an additional 2% of their gross national product on health and rich nations should chip in an extra 0.1%. Most of the money—some \$66 billion by 2015—should go to getting drugs and vaccines to needy people, with \$3 billion set aside for basic research and a "global NIH" that would target common but poorly understood diseases. The panel estimates that the investment would be repaid sixfold in economic expansion.

Sachs hopes such numbers will start swaying national health spending decisions as early as 2002. In the meantime, he says, big pharma should make its drugs cheaper for poor countries.

PCAST Named The Bush Administration has unveiled its President's Council of Advisors on Science and Technology. The president introduced his 22 picks and said that they would begin work by producing reports on information technology infrastructure, increasing federal science spending in fields likely to produce economic benefits, improving energy efficiency, and combating terrorism. The panel (see sciencenow.sciencemag.org/feature/data/pcast.shtml) will be led by White House science adviser John Marburger and investor E. Floyd Kvamme.

The council's makeup—just one member is a working scientist, more than half come from industry, and many served Bush's father—suggests that "the Bush Administration is moving even further than Clinton" toward addressing industrial issues, says Harvard University science policy analyst David Hart. Marburger says that the dearth of scientific expertise is deliberate: "The goal is to get advice from leadership in higher education and industry and not necessarily at the scientific level."

One more high-profile executive may still join the panel. The White House initially said that America Online founder Steve Case was on the team, but a paperwork glitch prevented his formal appointment.

Contributors: Elizabeth Pennisi, Susan Biggin, Andrew Lawler, David Malakoff, Dennis Normile, Jocelyn Kaiser, Martin Enserink, Eliot Marshall



Bully pulpit. Some 108 living Nobel Prize-winners have signed on to John Polanyi's 100th anniversary statement.

ing force behind the letter. "It's also a call for replacement of war by law." If Alfred Nobel could give away an immense fortune to reward achievements in science, literature, and peace, Polanyi decided, the least his colleagues could do is think idealistically about how to improve the world.

The statement, signed by luminaries in science, medicine, literature, and world affairs (see www.sciencemag.org/feature/data/nobel.shl for full text and list of signatories), says: "The most profound danger to world peace in the coming years will stem not from the irrational acts of states or individuals but from the legitimate demands of

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