much brighter than our parent star. But observers outside the beam would see no pulse. Presumably, thinks Horowitz, an alien civilization seeking contact would direct such a pulsed beam at one promising star system after another. The beam could be made wide enough to cover a diameter of many Earth orbits.

"If we find nanosecond pulses, we can't lose," says Horowitz. "If it's not from an alien civilization, at least we will have discovered an astrophysical phenomenon that no one anticipated. Not a bad consolation prize."

Bertram Schwarzschild

Atlas shrugged off at Nevada Test Site

After spending more than $100 million on Atlas, the US Department of Energy (DOE) pulled the plug on 1 June, sacrificing the barely used pulsed-power machine, which studied nonnuclear materials at high pressure, temperature, and magnetic field, in favor of subcritical experiments, which use plutonium but stay clear of nuclear-explosion-causing chain reactions.

Atlas, which symmetrically implodes cylindrical targets, was built at Los Alamos National Laboratory (LANL) in New Mexico and was used there in 2001–02 before being moved to the Nevada Test Site (NTS; see PHYSICS TODAY, July 2001, page 28). With delays—due in part to lab shutdowns in 2004 (see PHYSICS TODAY, November 2004, page 31)—it took until last summer to bring the machine back on line.

The expected lifetime of the machine is 1000 experiments, but it's been used for only a couple dozen, says LANL Atlas project director Robert Reinovsky. Since reopening at NTS, he adds, Atlas has focused on three series of experiments. They involve hydrodynamic mixing, material damage, and high-velocity friction between two surfaces sliding past each other. The results, Reinovsky says, "are provocative." The friction experiments, he adds, "can only be done at Atlas."

The machine is being mothballed because of a shrinking budget, says Mary Hockaday, LANL's acting program director for experimental physics. Atlas provides excellent data, but it's not the top priority, she says. "It becomes the first to go when you don't have money to get what you need." What's needed first for stockpile stewardship, DOE's program for maintaining nuclear weapons without testing, is plutonium data, Hockaday says. If Atlas becomes a priority again, she adds, it could be restarted.

Running Atlas costs around $7 million a year, plus $250 000 to $300 000 per experiment. Hockaday grants that the amount of money being transferred to subcritical experiments is small, but she says, "the biggest issue is that we can-

LANL—IM DIVISION

Unplugged: The Atlas pulsed-power machine, now located at the Nevada Test Site.

not afford to support Atlas the way it was planned because the overall stockpile stewardship program was not funded as planned."

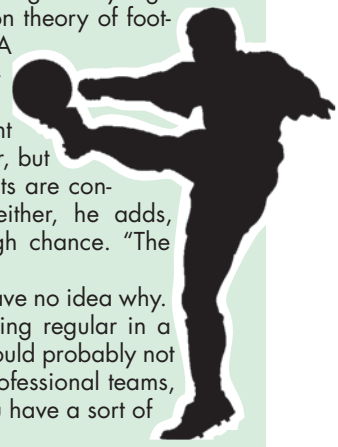
In addition to wasting taxpayers' money and aborting an experimental program, shutting Atlas damages US–Russian cooperation, says Irv Lindemuth, who, before he retired from LANL in 2003, was a project leader for pulsed-power science and helped handle collaborations with Russia's nuclear design labs. "We are looking at other venues for the collaboration to continue," says Hockaday. But Lindemuth says that "Atlas is one of the few US facilities of interest to the Russians that they can actually have access to. They are interested in NIF [the National Ignition Facility at Lawrence Livermore National Laboratory], but DOE is not likely to give them access." In the long term, he says, the question "is whether or not the US will provide the unclassified help Russia says it needs to maintain its nuclear stockpile in an era without testing." If not, he adds, "how can we expect Russia to provide help on nuclear issues of most importance to the US—control of Russia's nuclear materials?" **Toni Feder**

Soccer obeys Bessel-function statistics

The soccer World Cup gets under way in Germany on 9 June. For a month, 32 national teams will compete for the world title. Metin Tolan is betting on the home team.

Tolan, an experimental physicist at the University of Dortmund, bases his prediction on an analysis, conducted with three colleagues, of some 34 300 past games—2000 professional games played in Italy, 5300 in England, and 27 000 in Germany. "We approximated a soccer team by a radioactive source. A soccer team emits goals according to Poisson statistics," he says.

Calculating the probability that a team will win or lose a game by a given number of goals leads to what Tolan calls the "Bessel-function theory of football"—as soccer is called in most places outside the US. A modified Bessel function results from summing over products of probabilities expressed as Poisson distributions.



Tolan's calculations assume that goals are independent of one another, which, he says, "is reasonable for soccer, but not, for example, for basketball, because there the points are connected." The calculations wouldn't work for tennis, either, he adds, because too many points are involved, and not enough chance. "The probability for surprise in tennis is not very high."

But for soccer the Bessel-function fits are good. "We have no idea why. I never would have guessed that you would find anything regular in a chaotic game like soccer," says Tolan. Bessel functions would probably not approximate minor league teams well, he adds. "The professional teams, while not of equal strength, have a certain level, and you have a sort of restricted system where not everything can happen."

For this year's World Cup, Tolan and his colleagues carried out 100 000 simulations based on past performance to get the probability of each team's winning the title. "Statistics cannot predict the results of a specific World Cup," says Tolan. "So this is where the fun begins." The simulations put Brazil's chance at 15% and Germany's at 10.5%, he says. But home teams tend to score an average of 0.6 to 1 additional goal per game. Incorporating that "home advantage," says Tolan, boosts Germany's chance of winning to 33%. **Toni Feder**

Report urges major effort to site collider in US

A National Research Council committee, charged with charting the course of US particle physics over the next 15 years, has released its report. Because particle physics is a costly business requiring broad support within the intellectual community—not to mention the government—several of the committee's 22 members, including its chair, economist Harold Shapiro, biologist Harold Varmus, and former Lockheed–Martin CEO Norman Augustine, were not physicists.

Entitled *Revealing the Hidden Nature of Space and Time*, the 125-page report (available from the National Academies Press at http://www.nap.edu/catalog/11641.html) contrasts the undeniable excitement and promise of particle physics at the start of the new century with the unmistakable downward trend of experimental facilities and programs in the US. The Superconducting Super Collider was cancelled in 1993 in mid-construction. With the Large Hadron Collider (LHC) about to start operation at CERN, Fermilab's Tevatron is unlikely to outlive the decade. Neither is the PEP-II asymmetric electron–positron collider at SLAC nor the Relativistic Heavy Ion Collider at Brookhaven National Laboratory.

Why should that matter? "Particle physics plays an essential role in the broader enterprise of the physical sciences," says the report. "It inspires US students, attracts talent from around the world, and drives intellectual and technological advances in other fields." As particle physics and its connection with cosmology enter "an era of unprecedented potential, the US should remain globally competitive . . . by playing a leading role in the worldwide effort to aggressively study terascale physics," that is, accelerator-based experiments at collision energies of order 10^{12} electron volts (1 TeV).

To that end, the report makes three principal recommendations to US funding agencies: They should undertake a "comprehensive program to [make the US] the world-leading center" for developing the science and technology of the International Linear Collider—a proposed TeV e^+e^- collider—and "do what is necessary to mount a compelling bid to build the proposed ILC on US soil." Furthermore, they should "fully exploit the opportunities afforded by the LHC" by adequately supporting US groups that will soon be taking data at the 14-TeV proton–proton collider. Finally, lest these programs at the terascale frontier cause neglect of very important particle physics at lower energies, the report urges the expansion of particle-astrophysics programs and the pursuit of "an internationally coordinated, staged program in neutrino physics."

The ILC is the highest-priority facility on the US particle-physics community's wish list. After the LHC has surveyed the first rough outline of the terra incognita beyond 1 TeV, an e^+e^- collider would carry out the precision measurements that are thought to be essential for extracting the full meaning of the LHC discoveries. The report does not quote an explicit cost for building the ILC. But with an estimated price tag on the order of $10 billion, the 30-km collider would obviously have to be thoroughly international from the start. Two years ago, a panel of the International Committee for Future Accelerators settled on superconducting RF acceleration technology for the ILC (see PHYSICS TODAY, October 2004, page 34).