An industrial waterfall; education by placemats; producing a super-clean surface; horned owls at SLAC; garden club for particle physicists; Nobel banners back on display; US Congress meets Quantum Universe.

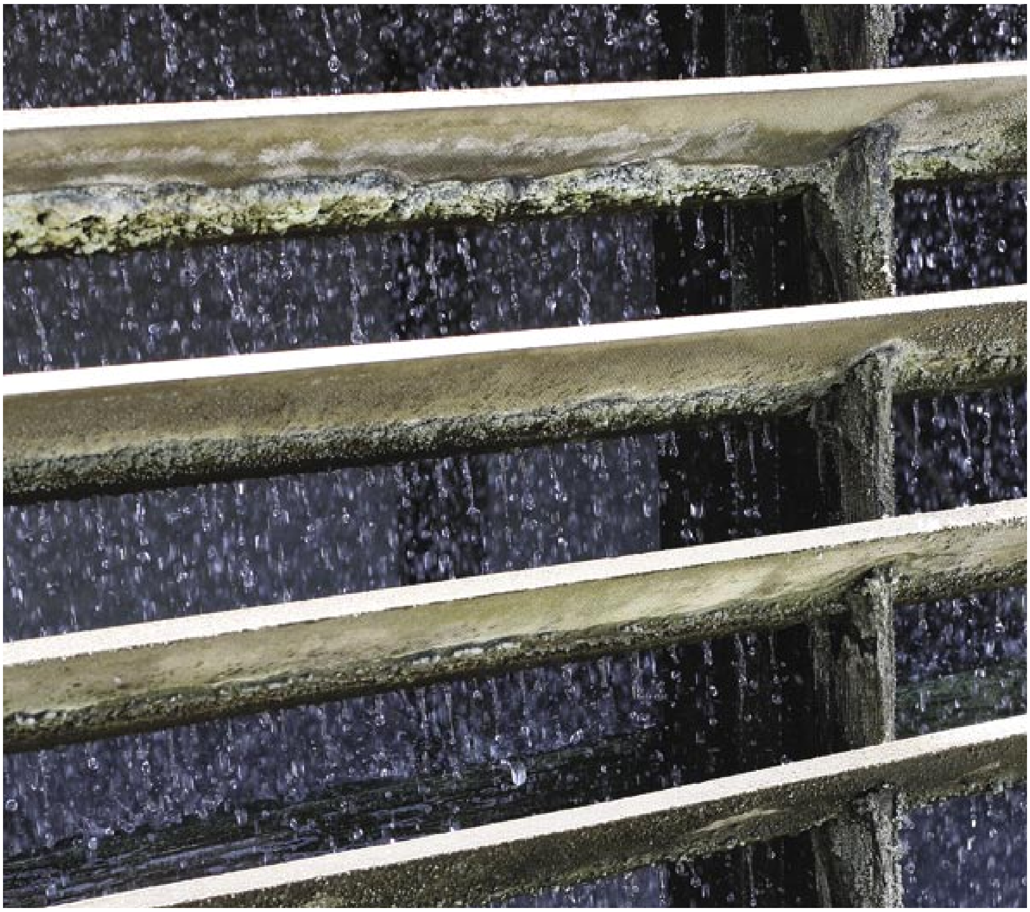


Photo: Diana Rogers, SLAC

SLAC's water cycle

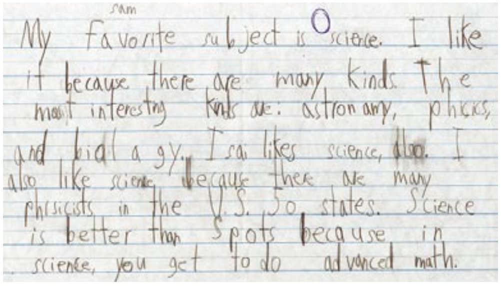
Along the Loop Road at Stanford Linear Accelerator Center, the roar of falling water and a refreshing mist filled the air after six solid weeks of California rain. But the water cascading down the inside of Campus Cooling Tower 101, and landing in a frothy pool, is hardly scenic. The corrugated metal building sprouts pipes of all sizes. The bottom section of the front façade is open except for mineral-encrusted slats, allowing Loop Road walkers to experience an industrial facsimile of the small falls that spring to life in the winter hills of California.

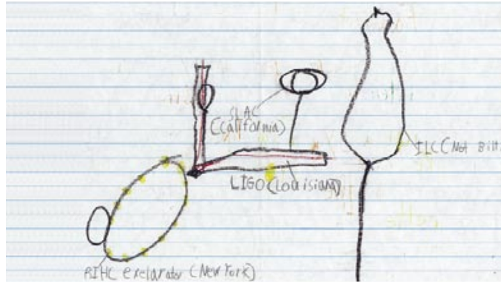
The perennial cooling tower is one of six at SLAC that cools vacuum systems, klystrons, magnets, and other parts that drive the accelerators. Cooling Tower 101 lowers the temperature of the chillers that cool computer components in the Computer Building.

Water flows through pipes next to hot equipment, soaking up the heat. The pipes run to nearby heat exchangers, transferring the heat to water in another set of pipes. The cooling water flows back to the cooling tower, like blood returns to the lungs for more oxygen. Spray nozzles release droplets of the cooling water—completely safe tap water—into the tower. As they fall through open air, the droplets release heat into the rush of air created by powerful fans on the cooling tower roof. On cool mornings, columns of steam rise from the cooling towers. Some loose water evaporates into mist.

To replenish one cooling tower, SLAC recycles half a million gallons of water a year. In winter, crews from Conventional & Experimental Facilities pump rainwater out of manholes with a truck called "The Dominator." After filtering the water, they top off Cooling Tower 1701, also known as "The Big One," near the downstream end of the linear accelerator. Just like its wild brethren, the Big One's waterfall carries real California rain.

Heather Rock Woods





Images courtesy David Ehrenstein

From placemat to prodigy

Over a half-eaten burrito or a bowl of spaghetti, Sam Ehrenstein ponders the unanswered questions of fundamental physics. Yet Sam is no experimental physicist or postdoc brooding over his data—not yet, anyway.

The seven-year-old son of *Physical Review Focus* Editor David Ehrenstein, Sam became interested in particle physics by reading science-themed placemats. "When he's particularly interested in a placemat, he often will use two—one for his plate, and one to read unobstructed," says David. "We have a lot of placemats."

Sam displayed his surprisingly complex knowledge to Mrs. Robertson, his first grade teacher, by writing a persuasive essay about his love of science. On the back, he drew pictures of the Stanford Linear Accelerator Center (SLAC), the Laser Interferometer Gravitational-Wave Observatory (LIGO), the Relativistic Heavy Ion Collider (RHIC), and the International Linear Collider (ILC).

In his first but probably not last interview, Sam admitted to mixing particle physics with astrophysics. "I know LIGO isn't a particle physics experiment," he said. "I guess I just got carried away."

Sam then went on to explain LIGO's purpose: to detect gravitational waves. "They're waves that usually come out of space. They come from a bunch of things in space like supernovae but now scientists are trying to see them coming from binary black holes. That's when two stars are constantly orbiting one another and when they die they become supernovae and then they become black holes and they get closer and closer and finally smash into one another and that releases gravitational waves," he said. "You wouldn't know if gravitational waves were coming without LIGO because when they hit something they make it longer and shorter but that's undetectable except when you have special equipment like LIGO does. It's fun to learn about and it can also be useful and stuff."

Sam says he'll probably be a pilot or an astronomer when he grows up.

Kelen Tuttle

A top gradient for cleanliness

After undergoing a buffered chemical polishing (BCP) treatment at Cornell University, the first US-processed and tested International Linear Collider superconducting cavity achieved a milestone accelerating gradient of 26 MV/m (megavolts per meter)—surpassing the first gradient goal (25 MV/m). The joint effort of the SMTF (Superconducting Module Test Facility) collaboration was a first test for the US facilities for ILC.

"This is a good [first] achievement," says Hasan Padamsee of Cornell University. "ILC cavities have not been tested in the US yet, and none of our facilities have been checked out to that extent. We decided to do a standard treatment that has been done for some years now, and we got the best result that you can hope to get at this stage."

Etching essentially cleans the cavity, with the BCP treatment removing a damaged layer typically 100 micrometers thick. Then, a high-pressure water rinsing scrubs the surface clean. Says Padamsee: "We showed no field emission, which means that our process is very clean."

Purchased from ACCEL Instruments in Germany, the cavity underwent mechanical measuring and testing at Fermilab before being sent to the SMTF collaboration partners Cornell and Jefferson Lab. The cavity will next be sent to JLab for electropolishing, and scientists eventually expect a gradient of 35 MV/m.

Elizabeth Clements

Photo: Hasan Padamsee, Cornell University

Photo: Diana Rogers, SLAC

Particle physics takes flight

Welcome to SLAC's End Station B, where work on the International Linear Collider (ILC) will help shape the future of particle physics—although some inhabitants don't seem to give a hoot. Until last month, End Station B was home to a family of horned owls, who claimed a piece of real estate on the building's ledge.

"Horned owls are common in the US," says SLAC's Michael Scharfenstein. "But it is unusual to find them nesting on End Station B."

The adult owls were seen in their new residence early in March. By the end of March, End Station B had exerted its irresistible romantic influence, and two adorable little baby owls had emerged. One of the babies ended up on the ground in early April. Rescued by Scharfenstein, the little ball of fluff went to live at a rescue center. A few days later, the remaining owls vacated their nest without giving notice.

Scharfenstein, an amateur ornithologist, witnessed the entire saga. "Owls are really shy," he says. "It was a unique opportunity to see them like this."

Moving into a new neighborhood carries its risks. The owls did not get along with a family of ravens nesting on the adjacent building, End Station A. "There was heavy sparring between the ravens and the owls," says Scharfenstein. "It was pretty amazing to watch."

Nobody saw the owls build their nest. A family of ravens—perhaps the ones on End Station A—may have been the nest's original owners. Could this explain the bad blood between the two avian families? The owls declined comment. Had a raven been asked if it would repeat the experience, one suspects it might have said, "Nevermore."

Chandra Shekhar

The particle garden

Mesons. Bosons. Pions. Muons. Asparagus. Yes, asparagus. Physicists have spare time, too, and a few of them spend it in Fermilab's Garden Club, with roots almost as old as the lab itself. It was 1969 when farm manager Bob Hines began allocating land to Fermilab users and employees for recreational gardening. Now the Garden Club boasts nearly 90 members, growing everything from sweet corn to strawberries. "As long as it's legal, people grow just about anything," says Computing Division's Eileen Berman, a club member for over 20 years.

Drive down the narrow gravel road through the trees at the northeast corner of the Fermilab Village, and you will find more than three acres of gardens, most surrounded by chain link fences or wire mesh to "keep out the critters." Half a dozen garden sheds of various colors and degrees of weathering speckle the property, and there is even an orchard. "It's a friendly atmosphere—international," says Jim Wendt, a linac technician who has been gardening with the club since 1970, two years before it moved to its present location and became an official club.

Plots are 40 feet by 20 feet and cost $5 per year, with funds going into maintenance of shared gardening equipment (such as lawnmowers and rototillers) and other repairs. "It's nice during the summertime to take a little break, get a little fresh air, get a little exercise, and then come back to work," Berman says.

Whether they are studying the cosmos or treating it for aphids, Fermilab's Garden Club members remind us that physics and nature are peas in a pod.

Jennifer Lauren Lee

Photo: Reidar Hahn, Fermilab

Photo: Lyn Hunter, LBNL

Nobel banners restored at Berkeley Lab

Street banners honoring nine of Berkeley Lab's Nobel Prize winners, originally installed along Telegraph Avenue in 2003, have been mounted on poles on Cyclotron Road leading to Berkeley Lab in honor of its 75th anniversary. Uncovered recently in storage, the deteriorating vinyl banners were restored by the Lab's Vic Haskett of the paint shop.

The original installation of 66 banners, sponsored by University of California, Berkeley, and Telegraph Avenue merchants, celebrated the Berkeley campus' 18 Nobel Laureates—13 for scientific achievement, four for economics, and one for literary success.

When John Hickey, design director for UC Berkeley's Public Affairs office, began work on the 2003 Telegraph Avenue project, he said he had no idea what kind of an endeavor it would be. "We had to work with some pretty old photos of Berkeley laureates," he said. "Some were postage stamp-sized images that had been dug up from old department files." A few, fortunately, were top quality, having been shot by Berkeley portrait photographer Paul Bishop; others had been shot more recently by his son, Paul Bishop, Jr.

Ernest O. Lawrence (1939) was the first of Berkeley's Nobel Laureates in Physics. Other Physics Laureates: Owen Chamberlain and Emilio G. Segre (1959); Luis Alvarez (1968); Donald A. Glaser (1960); Charles H. Townes (1964), and current Berkeley Lab Director Steven Chu (1997). Chemistry Laureates: Wendell M. Stanley and John H. Northrop (1946); William F. Giaque (1949); Glenn T. Seaborg and Edwin M. McMillan (1951); Melvin Calvin (1961), and Yuan T. Lee (1986). Economics Laureates: Gerard Debreu (1983); John C. Harsany (1994); Daniel L. McFadden (2000), and George Akerlof (2001). Literature Laureate: Czeslow Milosz (1980).

Berkeley Lab News

US Congress meets Quantum Universe

Have you ever tossed a ball at a wall, playing a game of one-man catch? As you tossed that ball again and again and again, have you ever thought about the chance that it could go right through the wall? According to quantum mechanics, this is a real possibility. "It's a small probability, but it is there," said renowned physicist and author Brian Greene, who addressed the Congressional Research and Development Caucus Advisory Committee in Washington, DC, on May 9.

After explaining the theory of relativity, quantum mechanics, and string theory all in the span of an hour, Greene also summed up the process that physicists use to answer some of the universe's deepest mysteries. "We slam stuff together and see what happens," he said. Referring to the construction of the Large Hadron Collider, Greene explained how scientists can look at the debris from the particle collisions to learn if such ideas as dark matter, supersymmetry, and extra dimensions are real. "This machine will test many things," he said. "If this experiment bears fruit, think about what that means. Every time we put our minds to it, we have been able to make progress. We have never hit a wall, and I believe that some day we will understand the fundamental forces of the universe."

Greene's talk, "Reaching for Einstein's Dream: The Quest for the Deepest Laws of the Universe," headlined an event hosted by Congresswoman Judy Biggert and Congressman Rush Holt, members of the Science Committee in the US House of Representatives, to launch the new High Energy Physics Advisory Panel publication *Discovering the Quantum Universe*, a companion volume to the *Quantum Universe*. Holt is one of two physicists in Congress; the other is Vernon Ehlers of Michigan.

The director of the Department of Energy's Office of Science, Raymond Orbach, presented the report, which explains the discovery opportunities at the Large Hadron Collider and the proposed International Linear Collider. "We are living in a world that we still don't really understand," Orbach said. "We don't know what happened at the beginning of the universe, and the ILC—referred to as Einstein's telescope—will allow us to go back in time and see what happened. This is a wonderful time for us to be alive. There are so many questions of wonder and beauty that exist, and we have a shot of answering them."

Elizabeth Clements

Photo: Tissara Photography

Quantum Universe Meets Hollywood: Actor Alan Alda (left), a science supporter and host of the PBS series *Scientific American Frontiers*, chats with Brian Greene (center) and Congresswoman Judy Biggert of Illinois (right) at the R&D Caucus.