Lightning strikes, Tevatron blinks; rainy-day roof rehab; congratulations arrive right on time; taking care of business, lyrically; menagerie of 'critters' as safety monitors; big jump needed to be top-cited; letters.

Photo: Tim Koeth, Rutgers University

Lightning strikes, Tevatron blinks

The highest-energy particle accelerator in the world, Fermilab's Tevatron, boasts four miles of particle-accelerating circumference. But during thunderstorms it can become a bull's-eye for stray lightning bolts that demonstrate the intimidating power of nature. "The Tevatron is a magnificent and wonderful thing," says Tevatron operations specialist Todd Johnson, "but it's also very fragile."

The energy contained in a large thunderstorm often surpasses that of an atomic bomb. When clouds build up extra electrons, they need to get rid of the charge somehow. A thunderous blast of lightning often results, and the energy in a single lightning bolt is often 100,000 electron volts with a current of about 1000 amperes. Disruption of accelerator operations doesn't require a direct hit. "When lightning strikes, large currents flow through the ground," Johnson says.

Power sources and communications networks can be disrupted, especially those featuring long, unshielded cables. Those disruptions can terminate the beam and delay experiments. Resuming operations can take several hours, depending on how long it takes to track down problems and make repairs.

Thunderstorms also affect the Tevatron in other annoying ways. When lightning strikes, fire alarms in any of the dozens of Tevatron buildings can trip. "I once spent an entire night shift doing nothing but driving to buildings where alarms were set off," Johnson says. Overall, he sees the complex Tevatron as a surprisingly robust system—but still susceptible to the power of nature. "When we see a thunderstorm approaching," Johnson adds, "we cross our fingers."

Dave Mosher

Rainy-day rehab

From the day it was completed in the early days of Fermilab, the design of the Meson Lab roof has been an aesthetic success and a structural nightmare. It leaks. Always has.

The water-welcoming weakness lies in the signature of the design, the corrugated steel arches: the ridges run perpendicular to the flow of water from a rainfall. "They do not encourage water to move from the roof," says Fermilab's Elaine McCluskey, project engineer for the upcoming roof repairs. The roof has many steel-to-steel connection points, which provide inlet opportunities for water. Without a water-tight coating, the roof has been leaking since it was built.

Repairs began in early October to make the roof watertight. The renovation will include power-washing, filling in cavities with a mastic-type material and applying two coats of a spray-on rubber coating. The coating

Photo: Fermilab

material, used in many industrial roofing applications, will dry as a sheet. "The material's manufacturer said the Meson Lab roof was one of its most unique uses," McCluskey says.

The trademark Fermilab colors, bright blue and orange, will also be restored, honoring the original vision of founding director Robert Wilson and designer Angela Gonzales. The duo attended to virtually every detail of the site's appearance. At the Meson Lab, they called for the use of corrugated steel culverts, laid side by side, to create giant scallops, with an orange inner surface and a blue outer surface to give added texture. McCluskey says, "The architectural legacy of Dr. Wilson is something we try to preserve as we remodel buildings and look to future facilities."

The renovated Meson Lab will house R&D projects for the proposed International Linear Collider. The west side of the building will belong to the development of detector components; the east side, to the testing of superconducting radiofrequency cavities for particle acceleration. Repairs to the roof are expected to be completed in two months–if the weather cooperates.

D.A. Venton

It absolutely had to arrive on time

The inaugural beam for the CERN Neutrinos to Gran Sasso (CNGS) project took just 2.5 milliseconds to fly 732 km through the earth from Geneva, Switzerland, to its destination at the Gran Sasso underground laboratory near Rome on Monday, September 11, 2006. But in preparation for the dedication ceremonies at Istituto Nazionale di Fisica Nucleare that day, a congratulatory gift had to make its own quick transit by air across ten times that distance (more than 7100 km), from Fermilab to Gran Sasso.

The gift was a framed poster, featuring a picture of Fermilab's Wilson Hall at sunset, mounted next to an image of the minehead for the Soudan Underground Laboratory in northern Minnesota—representing the beam origin and detector hall for Fermilab's NuMI/MINOS beamline and experiment, covering a similar distance through the earth as the CNGS beam. Fermilab director Pier Oddone had written his congratulations and best wishes (in Italian) across the center, before the framed greeting flew overnight from Chicago to Rome. "We had it all packed up and found out they needed it for some kind of presentation the next day," says Fermilab shipping manager Claudie King. "We put it on the next flight." The greeting arrived on time and was presented to Eugenio Coccia, director of the Laboratori Nazionali del Gran Sasso (photo).

Like Fermilab's beamline, CNGS will help physicists understand the role that the puzzling neutrinos played in the early universe. "Of all the known particles, neutrinos are the most mysterious," says Oddone. "In the years ahead, neutrino experiments at Gran Sasso and around the world will discover the fascinating secrets of neutrinos and how they shaped the universe we live in."

Siri Steiner

Photo: Laboratori Nazionali del Gran Sasso

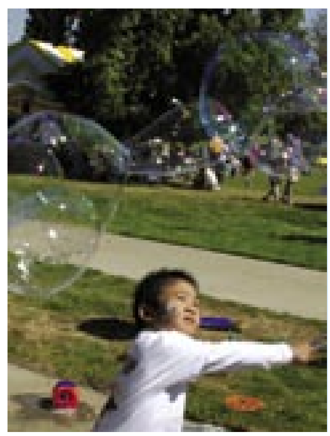
Takin' care of (SLAC) business

When 20-year-old Ryan Auer set out to find his very first job, he didn't expect to wind up at the Stanford Linear Accelerator Center, let alone on stage in front of over 1000 people at the lab's annual Family Day. A college sophomore, Auer worked this summer with the campus Heating, Ventilating, and Air-Conditioning engineers. The job inspired him to change his major from civil to mechanical engineering. As a parting tribute before heading back to school, he wrote and performed these SLAC-happy lyrics to the Bachman-Turner Overdrive tune *Takin' Care of Business.*

Rachel Courtland

Watch a performance of the song in the online edition of symmetry at www.symmetrymagazine.org.

Photos: Diana Rogers, SLAC



Takin' Care of Business

by Ryan Auer

We made our debut,
Back in 1962;
It's all controlled at MCC.
Faster than the speed of light,
SLAC hosted the first website,
And you can take a tour here for free.

The Archimedes text,
What will they uncover next?
Come and view the linac from afar.
The wires intertwine,
Up and down the beamline,
We've got an experiment called BaBar.

And we'll be...
Takin' care of business, here at SLAC,
Takin' care of business, no turnin' back,
Takin' care of business, everyday,
Takin' care of business, and everything's okay.

Three Nobel Prizes,
And buildings of great sizes,
We get our funding from the DOE.
Particle acceleration,
And our own fire station,
We've got the great Dr. Panofsky.

Several injectors,
And we've got 30 sectors.
We're just right off the interstate.
PEP & SPEAR,
You can find it all right here,
Just come on in through Alpine Gate.

And we'll be...
Takin' care of business, here at SLAC,
Takin' care of business, no turnin' back,
Takin' care of business, everyday,
Takin' care of business, and everything's okay.

Visit SSRL,
Or come stay at our hotel,
Come to watch the gamma rays burst.
If the tunnels are too small,
Just come to Collider Hall,
But please make sure that safety comes first.

Now before you embark,
Don't forget about the quark,
Discovered in End Station A.
I hope you liked my song,
Now I must be movin' on,
Enjoy the rest of Family Day.

And we'll be...
Takin' care of business, here at SLAC,
Takin' care of business, no turnin' back,
Takin' care of business, everyday,
Takin' care of business, and everything's okay.

Photo: Butch Hartman, Fermilab

Safety critters monitor lab site

The instrumentation team of Fermilab's Environment, Safety & Health Section is the caretaker of a unique menagerie: albatrosses, chipmunks, hippos, pterodactyls, scarecrows, and an aardvark to name a few. These critters are radiation detection instruments, designed and built in-house. "Everyone here knows what they are, but no one else in the world would," says Butch Hartman, team co-leader.

The level of radiation at Fermilab is stringently monitored, and radiation at Fermilab consistently falls below radiation standards set by the US Department of Energy. Throughout the site, radiation levels are maintained at the normal, background levels found in the natural environment; higher levels are found only inside accelerator enclosures and at a few posted, fenced-off locations. Workers who enter experimental areas that might be exposed to measurable levels of radiation wear detection badges. The majority of radiation exposure occurs when accelerator components need repair; the maintenance inside accelerator enclosures, of course, is always done after the beam is turned off. For an extra level of safety, Fermilab policy mandates that workers in radiological areas may only be exposed to levels that are less than one-third of the annual limit allowed by the DOE for radiological workers.

As part of Fermilab's careful monitoring program, the radiation detection "critters" keep a watch on radiation levels throughout the lab's accelerator complex and beyond. The origin of the instrument names is often part of lab lore.

In one legend, an employee working in frustration on a radiation instrument in the late 1960s dubbed his instrument the "albatross," alluding to the poem *The Rime of the Ancient Mariner* and the sailor who wears an albatross around his neck as a burden. The "scarecrow," an instrument mounted on a tripod (left), would—if it detected unacceptable levels of radiation in an area—warn people to stay out of the area, like crows warned to stay out of a cornfield. A piece of hardware called the "aardvark" collects little, termite-like bits of radiation data and has a long, protruding trunk-line. The "chipmunk" makes a chirping sound, and "hippos" are rotund and gray.

The stories behind some of the names have been lost. The "pterodactyls"? "I really don't know how they were named," says John Larson, team co-leader. "But it's a conversation starter; it's not boring. You get tired of hearing acronyms all the time."

D. A. Venton

Letters

More travel stories

Reading the September issue of *symmetry*, I was reminded of when Larry Rosenson of MIT told me the story some years ago of being stuck on a long flight next to talkative woman. She insisted on telling him how great her son was. "He did this, he did that…." Larry tried everything he could think of to stop her chatter. Finally, he took out a book titled something like "Elementary Particle Physics." The woman saw the title and said, "Oh, I see you are studying elementary particle physics. My son studied advanced particle physics."

Harvey L. Lynch, Stanford Linear Accelerator Center

Make your own data card

Thanks for the pictures of the pocket particle card [September issue]. I can't wait to laminate the two halves together. Yes, you will be able to tell its a reproduction, but it still looks too cool!

John Sandow, Harper College, Illinois

Letters can be submitted via letters@symmetrymagazine.org

Big jump needed to be top-cited

In the realm of the top-cited papers in particle physics, life is indeed lonely at the top. Since 1951, only 45 particle physics research papers have climbed to the level of 2000 or more citations; and of those 45, only three—for a ratio of one in 15—have reached the pinnacle of 4000 or more citations.

In fact, that last part of the climb is the hardest of all. The second-hardest step is getting the first 50 citations. The SPIRES database lists some 235,000 papers that have received fewer than 50 citations; only 16,643 crossed the threshold of 50, a ratio of one in 14. The ascent from 50 to 2000 was a relatively easy climb, with the ratio ranging from 1 in 1.8 (50+ to 100+) to 1 in 4.7 (250+ to 500+).

The three most highly-cited papers are Steven Weinberg's 1967 "Model of Leptons" (*Phys. Rev. Lett.* 19 1264 (1967), 4602 citations); Makoto Kobayashi and Toshihide Maskawa's 1973 "CP-Violation in the Renormalizable Theory of Weak Interaction" (*Prog. Theor. Phys.*, Vol. 49 No. 2 (1973), 2792 citations); and Juan Maldacena's "Large N Limit of Superconformal Field Theories and Supergravity" (*Adv. Theor. Math. Phys.* 2 231-252 (1998), 4064 citations), which received all of its citations in less than 8 years.

Peak publication periods for papers in the 2000+ range are 1998–99, with 12; and 1973–74, with seven. In 1998–99, the 12 papers span a wide range of interests, from theoretical papers on strings and extra dimensions (small and large), to experimental papers on cosmology and neutrino oscillations. The 1973–74 period featured all seven top-cited papers on theory papers of the electroweak and strong interactions, which laid the groundwork for the Standard Model.

Heath O'Connell, Fermilab

Top-cited papers in HEP

Number of Citations	Number of papers	Ratio
4000+	3	1 out of 15
2000+	45	1 out of 3.4
1000+	151	1 out of 4
500+	612	1 out of 3.3
250+	2,035	1 out of 4.7
100+	9,494	1 out of 1.8
50+	16,643	1 out of 14
up to 50	235,000	

Papers with 2000+ citations

Source: SPIRES database