signal to background

Fermilab's Einstein scarecrow; a special cake for CERN's anniversary; two million CDs in your bedroom; observing seiches across the world; a mathematical riddle to illustrate fine-tuning; revival of theoretical ideas proposed in the 1920s; a book with tabloid-worthy details on a famous scientist.

Photo: Davide Castelvecchi/Fermilab

Smart scarecrow

"See, that's Albert Einstein!"

"Huh?" was the most common response from caramel-apple-wielding pre-school kids to their parents.

"Albert Einstein! He was a really famous scientist."

It was a classic pre-Halloween weekend in St. Charles, an old Illinois town now engulfed by Chicago's metropolis. At the local scarecrow competition, Fermilab's entry induced more reverence than most. "Einstein" was sitting on a chair, complete with his fleece, slippers, uncombed hair, and deep science questions hovering over his head.

A team from Fermilab's Lederman Science Education Center made the scarecrow, filling old clothes with dry prairie grass from Fermilab's prairie reconstruction project. During a Friday afternoon rain, a tarp helped Professor Einstein stay dry. On Saturday and Sunday, he enjoyed some

sunshine as thousands of festival-goers streamed past his chair, with kids taking a really close look at his face.

For the scarecrow, the Fermilab team had a budget of $200 at their disposal. The final cost: $11.50.

Davide Castelvecchi

Virtual cake

Celebrating anniversaries of global organizations presents unique challenges and asks for creative solutions. To congratulate the European laboratory CERN on its 50th anniversary, US scientists created a special birthday cake. But CERN employees never got to eat a slice of cake. Instead they received the cake virtually, as an image—appropriate for the laboratory that invented the World Wide Web.

The highly decorated cake represented the many connections that the US particle physics community has with its European partners. Custom-made candles displayed logos of several US national laboratories as well as the National Science Foundation and the Department of Energy. "Candles of Honor" carried the images of Raymond Orbach, Director of the DOE's Office of Science; Michael Turner, Assistant Director for Mathematical and Physical Sciences, NSF; and Robin Staffin, Associate Director of the Office of High Energy Physics at DOE—and they all were afire.

The United States is contributing a total of $531 million towards the Large Hadron Collider and its detectors, which are currently under construction. From building superconducting magnets to producing components for the ATLAS and CMS experiments, many US national laboratories and universities are playing key roles in the LHC project.

Fifty years from now scientists may know a way of transmitting a real cake in a matter of seconds. Then CERN employees can have their cake—and eat it too.

Kurt Riesselmann

Photo: Reidar Hahn/Fermilab, Candles: Kyle Romberg

Data by the boxload

How many CDs are in the box? "100," a child guessed. "1000," said another. The answer was 2000, the equivalent of just 0.1 percent of the database capabilities at SLAC. "Imagine 2 million CDs in your bedroom."

Several US Department of Energy laboratories, including SLAC and Fermilab, gave 600 Chicago-area 11-13 year-olds a glimpse of the science of the future on October 14, 2004. The *What's Next: Future Science for Future Scientists* fair at Navy Pier featured exhibits intended to interest and amaze. Sponsored by the Department of Energy, and featuring DOE laboratories and industry partners, the program strives to retain students' interest in the sciences beyond the junior high school years.

SLAC contributed "High Speed Data Transfer Will Revolutionize Your Lives," an exhibit about the large and fast database it has developed. Along with impressing the students with a large box of CDs and an illustration showing a CD stack spanning the length of the Golden Gate Bridge, the exhibit included a large plasma screen with superimposed popular movies in high quality. In comparison to how long it takes for one streaming video to download over a DSL line, SLAC's speed of data transfer would allow 100 DVDs to be transferred in high quality simultaneously.

Other exhibits had the students isolating their own DNA and preserving it in a necklace (from Lawrence Livermore Laboratory) and burning, literally, CDs in a microwave oven (from the Underwriters Laboratory).

Raven Hanna

Seiching

Maori lore says that the rising and falling of the water level in Lake Wakatipu every 51 minutes is due to the breathing of the giant sleeping beneath.

I learned this many years ago from a caption on a photograph in an Auckland art gallery, while between sessions of a conference. The caption explained that the scientific phenomenon is that of seiching (pronounced "sayshing"), a type of standing wave. It is most often seen in a cup of coffee when you walk with it, or at times in a bathtub when you rise quickly, and is recognizable by the nearly flat surface of the liquid as it sloshes back and forth. While in the art gallery, I remembered the first time I had seen the word was in an old International Physics Olympiad problem asking us to model the seiche in Lake Geneva.

I recalled that gallery visit while contemplating the round fountain at Fermilab's Feynman Computing Center. As the fountain's single vertical jet oscillates between a torrent and a dribble, the water in the center of the pond rises and falls in synch—a peculiar motion that is hypnotic to watch in its rare simplicity. But then I remembered one other circular seiche I had witnessed. It was driven by us, a group of young kids, jumping up and down in the center of a shallow circular swimming pool until the water would splash over the entire circumference at once.

My recall sloshed back and forth in time, renewing my lifelong fascination with seiches.

David Harris

Photo: Peter Ginter

Fine-tune this

Quick, what's 987654321 divided by 123456789?

The answer is close to 8, but not exactly 8. Why does the result differ by about a tenth of a million, yielding 8.0000000729...?

During a recent talk at Fermilab, Greg Landsberg of Brown University promised a bottle of wine to anyone who could explain this riddle by the end of the talk. The riddle, mind you, was not to find the result (Landsberg gave that away), but to explain why it is so weird—or not.

Landsberg tried to make a point about physics. There are numbers in nature that just happen to be "fine-tuned." For instance, when viewed from earth, the sun and the moon appear to be roughly the same size. This effect, which can easily be explained, is a "freak accident." But other balancing acts that look miraculous—like Landsberg's riddle—can instead be explained by deeper-running principles.

In physics, Landsberg said, there are cases of fine-tuning that are still mysterious. For example, three of the four basic forces of nature have comparable strength, when contrasted to the much weaker force of gravity. Nobody knows if there's any special reason behind that, or if it's pure chance.

Landsberg's numeric example, it turns out, is part of a general fact about the way we represent numbers in a particular base, *n*. Dividing the two numbers with digits running from *n*-1 to 1 and that reversed, the answer approaches *n*-2 as *n* increases. For the decimal representation

used in Landsberg's example, *n* equals 10.

Fermilab director Mike Witherell solved Landsberg's mathematical quiz in time to claim the prize: a bottle of Sakonnet red from the state of Rhode Island, home of Brown University.

Davide Castelvecchi

Trends in extra dimensions

Sometimes old papers can be highly influential, decades after their publication. Theodor Kaluza and Oskar Klein, working independently, sought to unify Einstein's gravity with Maxwell's electromagnetism through the introduction of a fifth dimension. These ideas were published in two papers in the 1920s.

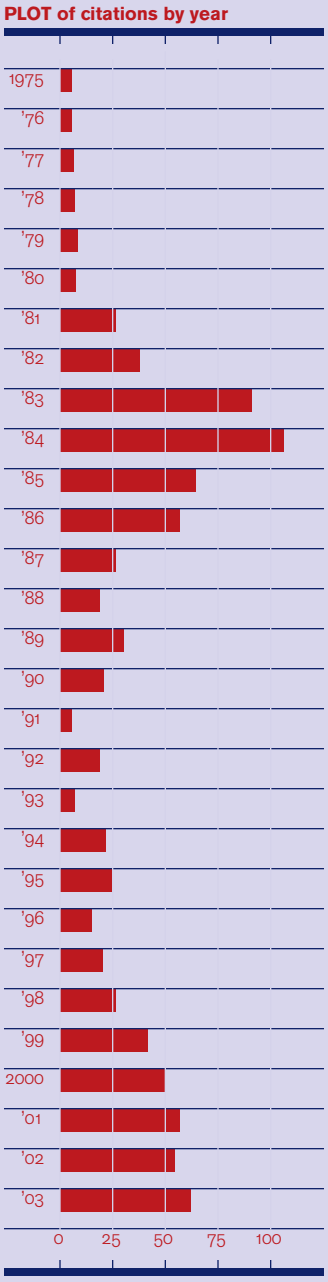
Though an idea that impressed Einstein, the initial interest in this topic faded with the rise of quantum mechanics. Using the SPIRES databases, we counted the number of citations of Klein's work in each of the years since 1975, to see how this 80-year-old idea has been influencing modern high-energy physics (Kaluza's paper is in a more obscure journal and is, unfortunately, less well-cited in SPIRES).

By the late 1970s interest in extra dimensions was growing, with a number of influential papers referring to the work of Kaluza and Klein (KK). After the mid-'80s heyday, interest in KK theory appeared to have gone into remission only to experience a resurgence in the late '90s. This was spurred by suggestions in 1998 that the KK extra dimensions might be large enough to be detectable at present or planned colliders and experimentalists at CERN and Fermilab are actively looking for them. This connection even resulted in a few citations from experimental collaborations, for a paper that was previously the domain of theorists.

The history of this one idea reveals much about the trends and ideas of the last 25 years of high-energy physics.

Heath O'Connell, Fermilab

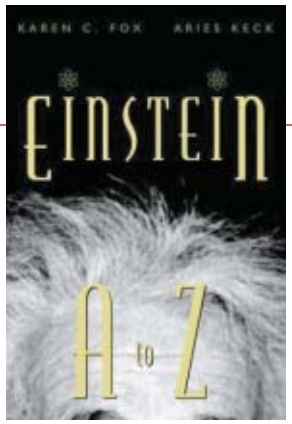
Below: Citations of O. Klein, "Quantum theory and five-dimensional theory of relativity", *Z. Phys.* **37**:895-906 (1926). Source: SPIRES



Reviewed by Heather Rock Woods

Einstein A to Z

Karen C. Fox and Aries Keck
Wiley, Hoboken, New Jersey, 2004



Everybody knows $E=mc^2$ and the hair, but did you know Einstein had an extramarital affair with his cousin then married her at the urging of his mother?

Einstein A to Z is a handbook on the celebrity scientist, offering short alphabetical entries on everything from his convoluted relationships to his superb science.

Despite some of the tabloid-worthy details, the book is not sensational. The entries are bright, down to earth, informative and easy to dip into randomly or otherwise. The passages on general and special relativity give clear background and context on how Einstein came up with the theories, what they mean, and how they were received and proven—all as valuable for non-physicist aficionados as knowing his Nobel Prize was for the photoelectric effect, and that he did not want a gravesite for fear it would become a tourist attraction.

The authors draw heavily on the numerous Einstein biographies, leaving you to wonder why the world needs yet another such tome. But the public and even scientists can't seem to get enough of the man who died half a century ago and is still the poster boy for brilliance—and on the advertising poster for the 2005 World Year of Physics.