Walking a mile for a piece of the LSST; brewing Atom Smasher beer; building a detector one Lego at a time; playing a particle card game; recycling BaBar; correction.

Photos: Mark Thiessen, National Geographic

Science worth trudging for

Would you walk 10,000 steps for a piece of glass the size of a deck of cards?

What if that piece of glass were part of an astrophysics experiment to warn people about potentially deadly asteroids zooming toward Earth and make a 3D map of the universe? And wait, there's more! What if the glass came from part of the world's largest combined primary and tertiary telescope mirror?

Steve Souza thought the "small vicarious thrill of being connected to a great enterprise by the thinnest possible of threads" was more than worth the exercise.

In a break from the tradition of limiting keepsakes to VIPs, Souza and nine others beat out eight dozen energetic competitors to win a chunk of glass produced for the mirror of the Large Synoptic Survey Telescope.

These particular chunks of ultrapure borosilicate glass had failed an exacting inspection process at the University of Arizona. So they became contest prizes at a recent American Astronomical Society meeting: attendees who walked 10,000 steps had their names entered in a drawing to win their own piece of astrophysical history.

The 51,900 pounds of glass that did pass inspection were dumped into a mirror mold (photo) and heated to 2125 degrees Fahrenheit. A 39-foot-diameter rotating furnace used centrifugal force and a 100-day slow-cooling process to create the curved mirrors from molten glass. Grinding and polishing will smooth the mirrors down to 35,900 pounds and make them optimal for catching dim light from distant galaxies to study dark matter and dark energy, as well as catch quickly changing objects such as exploding stars. LSST is the follow-up experiment to the Dark Energy Survey, which will start taking data in 2012.

LSST's complicated fabrication and polishing methods captivated Sarah Yost, who works with optical images and has visited large telescopes. Like Souza, she successfully competed for a piece of glass: "I thought it would be really neat to have something that is part of those processes."

Tona Kunz

A smashin' good taste

What beverage could capture the essence of a high-energy subatomic particle collision? It would require specific elements: rareness, a blend of flavors, a twist on technology.

Not a problem for Two Brothers Brewery, whose newest creation pays homage to the microbrewery's neighbor, Fermilab, the nation's dedicated high-energy physics laboratory.

"We also try to do things outside of the box, so we wanted to give a tip of our hat to Fermilab with this beer," said Jason Ebel, co-founder of the family-owned company in Warrenville, Illinois. "Fermilab is doing some really high-tech science over there involving smashing atoms, breaking them apart and creating antimatter and all that kind of stuff."

Just as physicists are always eager to discover new things, Atom Smasher beer breaks the mold for brewing, Ebel says.

The beer spends its days aging in a solid oak foudre, or cask, a common practice for wine fermentation but extremely rare for beer, which usually ages in stainless steel tanks. The result is a hefty, full-bodied lager with a clean, crisp finish.

The label's depiction of atoms smashed to smithereens with a hammer draws on the common nickname for particle colliders.

Why not just call it particle accelerator beer? Because, well, that just doesn't sound very cool, says Ebel. So they took the liberty of calling it Atom Smasher. Cooler indeed.

Christine Herman

Photos courtesy of Two Brothers Brewery

Lego Belle II

Particle detectors help physicists study the fundamental building blocks of matter. Now building blocks can help people study detectors.

In Japan, Yuji Katagiri has built a Lego scale model of the inner workings of the Belle II detector, including glowing particle collision tracks.

Belle II is an experiment currently under construction at Japan's high energy accelerator research laboratory KEK. The scientists who are collaborating on the experiment and KEK's public relations office contacted Katagiri, head of the University of Tokyo's Lego club, with a request to build the model as a public outreach tool.

"I tried to make this model as real as possible so that scientists who are actually involved in the Belle II project would be satisfied by my work," Katagiri says. "I was a bit anxious because I did not specialize in physics study, but it was really fun making it."

It took 10,000 common Lego blocks and a month and a half to build the model. Katagiri, whose first love is chemistry, has also built Lego representations of carbon nanotube molecules and graphene.

"I think Lego is a great tool for science communication, since it works not only for kids but for people not really interested in science," Katagiri says. "Some of my Lego friends got interested in science through my other work when I presented it at a school festival."

KEK will eventually display the Lego Belle II model at the laboratory.

Cynthia Horwitz

10,000 Lego blocks were used to make a replica of the Belle II detector. Legos called Electric Light Unit Power Functions and clear blue blocks simulate collisions inside the detector.

Photos courtesy of KEK

Photo: Brookhaven

A deck of particles

Want to play with subatomic particles? You could go to work at Brookhaven National Laboratory's Relativistic Heavy Ion Collider, RHIC—or you could play a new card game.

Two Hungarian students, Csaba Török and Judit Csörgõ, and Judit's dad, RHIC/PHENIX collaborator Tamás Csörgõ, invented the Quark Matter Card Game as an entertaining way to learn about subatomic particles and their interactions. The teens were inspired by physics presentations in the science club at their secondary school, where Tamás Csörgõ frequently gave science talks.

The game, now available in Hungarian and English, "provides a great opportunity for all people—not just physicists—to get acquainted with some of the elementary particles and concepts of the Standard Model," Török says.

Players can play four games with the deck of cards. Icons represent particles and antiparticles, including neutrinos, electrons, positrons, muons, and quarks. In Quark Matter, a game that models RHIC physics, the cards are placed face up on a table and packed closely together to represent matter at the instant of collision—a quark-gluon plasma. The object for each player is to quickly extract particles in the order they would emerge from the collision: non-interacting neutrinos and antineutrinos first, followed by electron/positron and muon/antimuon pairs, then quarks and antiquarks as they hadronize, or freeze out, to form mesons, baryons, and antibaryons. Players must pick cards in an order that maintains a neutral color charge—a property of quarks and gluons that has nothing to do with color in the ordinary sense.

As players race to extract cards, the fluid particle system created by the collision expands just as it does in a real RHIC collision. Players score points for each correct particle pick. More sophisticated players can name the particles as they extract them. Additional games teach and reinforce deeper concepts, such as weak decays and conservation laws.

For more information, visit https://sites.google.com/site/particlescardgame/

Karen McNulty

Old detectors never die

Although BaBar completed its experimental run in 2008, it's not bound for the graveyard. Instead, the detector has become the particle physics version of an organ donor: Other laboratories are making use of its disassembled parts.

"There is a desire for these parts from a lot of places," says Bill Wisniewski of SLAC National Accelerator Laboratory, who is managing the decommissioning and dispersal project. "Some parts are in demand by multiple groups, so we'll have to decide how to distribute them."

Located at SLAC, the BaBar experiment had five layers of detectors for measuring and identifying particles created in electron-positron collisions.

It's the third layer, called DIRC, that had physicists salivating. DIRC stands for Detection of Internally Reflected Cherenkov light. It contained 144 quartz bars that formed a 12-sided shell around the beamline. When a charged pion or kaon from a particle collision hit the quartz, a flash of Cherenkov light would be picked up by an array of 11,000 photomultiplier tubes and used to identify the particle type.

"The DIRC detector was state of the art when it was built, and it's still state of the art now," Wisniewski says.

A truck moves a 15-ton superconducting magnetic coil from the BaBar detector to a storage area at SLAC. *Photo: Lori Ann White*

Three thousand of those photomultiplier tubes have already been shipped to the DOE's Jefferson Lab in Virginia, he said. The remaining 8000 tubes are available for re-use in experiments that have need of them.

The quartz bars, the mechanical structure that supported them, and the steel support structure for the entire detector are expected to go to the Super*B* project in Italy. In the meantime, the quartz bars await their destiny in a temperature-controlled storage area on the SLAC site.

Super*B* is also interested in re-using BaBar's 6500-crystal electromagnetic calorimeter, which measures the energy of particles, and a solenoid, whose magnetic field bends the tracks of charged particles to help determine their charge and momentum.

And so BaBar, which studied the building blocks of the universe, will live on in the next generation of discovery machines.

Lauren Rugani

The geekiest engagement ever

Dave Mosher wanted his wedding proposal to go off with a bang. A big bang.

So how would a self-described science geek do that?

By tricking his beloved into climbing into the guts of a house-sized machine that creates and studies a hot soup of energy like the one present just moments after the universe exploded into existence. What else?

"Make as many symbolic interpretations as you'd like—I chose the location for a lot of reasons!—but the truth is I wanted us to have a great story to tell," Mosher wrote on his blog. "A ridiculously nerdy, epic and smile-prompting story."

Mosher and his bride-to-be Kendra Snyder love a good science story. The pair met at a reunion for Fermi National Accelerator Laboratory writing interns. Both now have successful communication careers—Mosher as a productive freelance science journalist and Snyder as a writer until recently at Brookhaven National Laboratory, who now works at the American Museum of Natural History.

It was Snyder's Brookhaven job that made her easy to dupe.

Mosher arranged for Snyder's boss to pull her aside with news of an unusual discovery at the Relativistic Heavy Ion Collider, or RHIC. A rare crystalline deposit had been found in RHIC's beamline at the STAR detector and Snyder had to take a look immediately, her boss said. Forget going home on time at the end of a long week; she had to get to the detector pronto.

An intrigued Snyder hopped into her car and drove to the detector with no clue that the trip would end in one of her happiest days ever. Behind an enormous concrete radiation shield and inside the colossal detector, which had recently been opened up for its usual summer maintenance, lay the crystalline deposit. Mosher hid nearby. As Snyder ascended a stairway up to the center of the detector, the shape of a glittering diamond engagement ring became clear. Before she had a moment to think, Mosher snuck up behind Snyder, grabbed the ring and knelt down on one knee. For a few moments, she giggled in disbelief before following up with a heartfelt yes.

Mosher then further sealed the deal with a hand-made cake bearing the promise "Kendra ❤ Dave. Nerds 4 Life."

Tona Kunz

Photo courtesy of Dave Mosher

letters

A correction corrected

In a correction in the May 2011 issue, you say that the Large Synoptic Survey Telescope primary mirror blank shown on page 30 of the February 2011 issue will not be used for the tertiary mirror. But it will!

The LSST is being constructed using a unique "M1/M3 monolith": the optics were designed so their edges meet (with a 5 cm radial gap between them), and they are being ground out of one piece of glass.

The two different curvatures (and a black line separating them) can be clearly seen in the right-hand picture at http://www.lsst.org/News/enews/m1-m3-201104.html

For full, authoritative details, see:
http://www.lsstcorp.org/nsfmaterialsdec09/LSST%20Optical%20Design%20Summary.pdf

Richard Patten, Titusville, FL

The editors reply: Our faces are crimson. Many thanks for pointing this out.