signal to background

A brainy playground springs up at Fermilab; Picasso's paint proves common; a hipster detector searches for the crystalline "plink" of dark matter; SLAC's softball team applies science to sport; a physicist fights for academic freedom.

Illustration: Sandbox Studio, Chicago

Precocious protons

Ask a bunch of 10-year-olds this question: Would you rather hear about the journey of a proton through Fermilab's accelerators, or would you rather be a proton and take that journey yourself?

And now, go visit an ear doctor, since the deafening sound of kids shouting out the second option has no doubt caused some damage. It's no secret that hands-on education experiences are more fun for kids—it feels like recess, and yet learning is happening.

That's the guiding principle behind the Physics Playground, now under construction at Fermilab's Lederman Science Center. The first attraction to be built is a running track that allows children to pretend to be protons, antiprotons or muons, as they run along trails in the shape of the lab's iconic accelerator complex.

The track mirrors the route a particle takes as it travels through the linac, Fermilab's initial accelerator, then around the booster and the main injector, where the particle ramps up to nearly the speed of light. The path then leads to a replica of the Tevatron ring, where kids can pretend to be protons or antiprotons, running around the track in opposite directions depending on their choice.

The Proton Run is the brainchild of a veteran educator who knows the value of mixing fun with learning: Marge Bardeen, head of Fermilab's Office of Education.

To construct the run, Bardeen partnered with Susan Dahl, who coordinates the Teacher Resource Center at the Lederman Center. Dahl obtained funding for the Proton Run in an unusual way: She secured a gambling tax grant from Kane County, Illinois, that covered about half the cost.

She and other members of the non-profit organization Fermilab Friends for Science Education will now help arrange funds to build the rest of the playground, which may also include an energy-wave simulator and a swing set that mimics the behavior of neutrinos.

The Proton Run will open to the public this spring.

Andre Salles

The secret of Picasso's paint

Although he was one of the few artists who attained wealth from his trade, Pablo Picasso used inexpensive, common house paint for some of his works. Perhaps more surprising is that, decades after he painted his greatest masterpieces, a facility with fundamental physics roots identified that paint by using a powerful instrument to peer, for the first time, at individual pigment particles comprising some of Picasso's paintings.

Judging from letters Picasso wrote to his dealer and photographs of his studios, art historians had previously concluded that Picasso preferred to use an ordinary house paint manufactured by the famous French company Ripolin. Yet these letters and photographs offer only visual identification, which can leave room for error, says Art Institute of Chicago conservation scientist Francesca Casadio, who was part of a project the institute led to study Picasso's paints.

Volker Rose, a physicist at Argonne National Laboratory, happened to hear about Casadio's work and proposed that Argonne's synchrotron light source, the Advanced Photon Source, could offer a closer look, thereby settling any skepticism.

Synchrotrons were just getting their start in the mid-1940s, around the same time that Picasso produced some of his most famous works. With their intense beams of X-rays, synchrotrons are capable of viewing the nanoscale structure of just about any material—from advanced electronics to viruses.

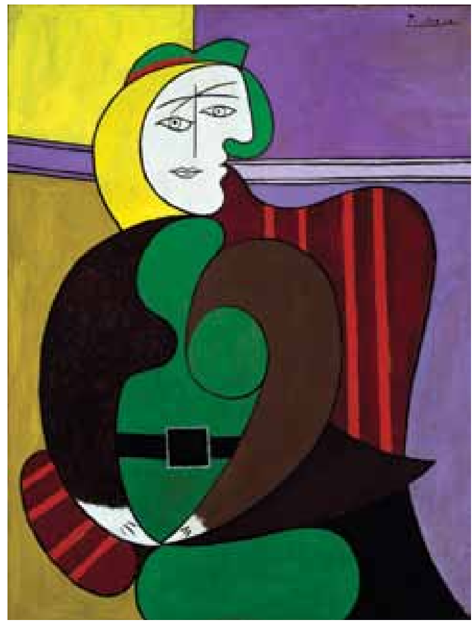
Casadio leapt at the chance, and soon four samples, each no bigger than the point of a pin, were carefully removed from the edges of paintings or where slight damage was present. Rose and his colleagues trained Argonne's synchrotron X-ray beam on these minuscule samples and found that the concentration and ratio of impurities, including iron and lead, within the paint chips proved identical to mid-20th century Ripolin paint samples. The group had a match.

More surprising to Casadio was the low level of impurities within the pigments, which meant that Ripolin was manufacturing high-quality house paint during that time. In fact, the quality was akin to fine artists' paints.

Picasso was one of the first artists to use common house paint in his paintings. He likely preferred it, Casadio says, because it has a glossy finish and takes days rather than months to dry.

"The chemical characterization of paints at the nanoscale opens the path to a better understanding of their fabrication, possible provenance and chemical reactivity," she says. To know this, she continues, "is to know more about the artist, the time and place he painted and how best to preserve the work."

Jessica Orwig



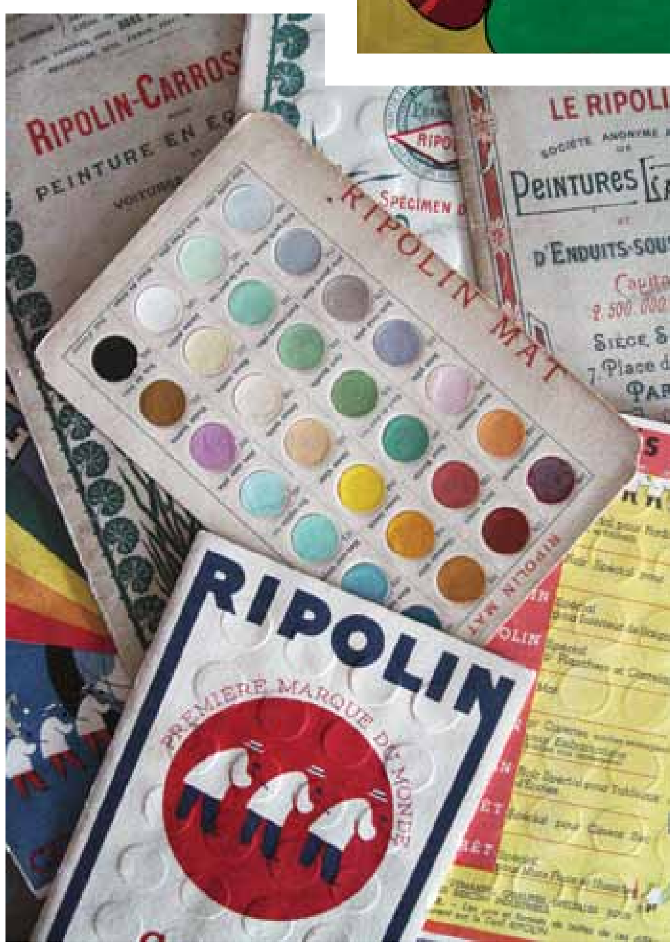
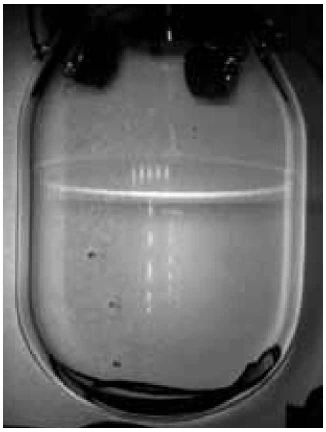
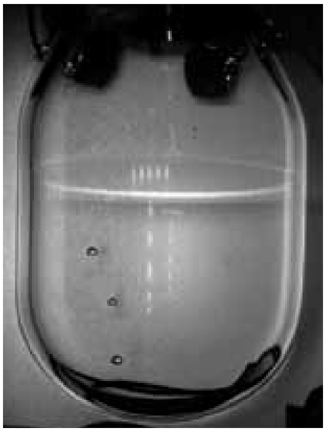
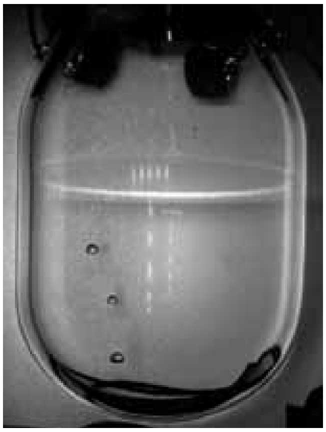


Photo and painting courtesy of Conservation Department, The Art Institute of Chicago

Photos: COUPP

Tiny bubbles

In the hunt for dark matter, the stealthy stuff that makes up about a quarter of the universe but neither emits nor absorbs light, observational techniques span from strange to stranger.

The Chicagoland Observatory for Underground Particle Physics may top the list.

The COUPP experiment is the hipster of the dark-matter crowd. Its detector is a bubble chamber, a retro bit of 1952 technology originally used to discover interactions through the weak force. Its inner vessel is a clear, quartz tank that looks a bit like a champagne flute without a stem.

The champagne in this case is a clear, heavy liquid heated and pressurized to the edge of evaporation, "waiting for any excuse to boil," says University of Chicago physicist Juan Collar, head of the Fermilab-based experiment. When a foreign particle bumps into an atom of the liquid, the champagne bubbles.

But it's stronger than a gentle fizz. "When these bubbles appear, it's a rather violent process," Collar says. "You can actually hear these things with your ears. The crack is very high-pitched. The inventor of the bubble chamber described it as a 'plink,' very crystalline."

In old-school bubble chamber experiments, the disturbance would trigger a still camera to take rapid photographs of the bubbles as they formed. In the upgraded, more-sensitive-than-ever COUPP experiment, motion sensors connected to video cameras set off the trigger.

The "plink" does not just alert the scientists that a particle has interacted in the detector; it also gives them information about what kind of particle it was. An interaction with an alpha particle, the most significant source of distracting background in the COUPP experiment, is four or five times louder than an interaction with a dark matter particle would be.

Hear it for yourself on *symmetry*'s website: symmetrymagazine.org/COUPP.
Kathryn Jepsen

A different spin

Sporting both physics and physique, SLAC National Accelerator Laboratory employees field a slow-pitch, co-ed softball team each year, the Spinors, in a Stanford University recreational league. Although their competitors are a mostly younger bunch of graduate students and staff, the SLAC team likes to think they have physics in their favor.

In physics, spinors are used to plot the spin properties of elementary particles. First described by French mathematician Élie Joseph Cartan in 1913, spinors have a range of applications in modern physics and mathematics. They also share a pronunciation with "spinners"—baseball slang that describes curveballs and sliders, which are pitches thrown with heavy spin on the ball.

The team's logo even features two softballs smashing together, with smaller spheres bursting out of the impact—paying homage to the lab's particle collider experiments.

Softball traditions run deep at SLAC; physics faculty and students engaged in annual softball championship games on the Stanford campus as far back as the 1950s, even before the 1962 groundbreaking for the lab's two-mile-long linear accelerator. Since then, an annual softball game remains an unbroken tradition.

Photo: Joe Faust, SLAC

Team manager Mike Woods, a 21-year Spinors veteran, says that since the Spinors first formed in 1991, the team has evolved to include a representative slice of SLAC's workforce: men and women, ranging in age from their 20s to their 80s, who trade hits and runs with teams that are often quite a bit younger.

Woods describes the Stanford recreational league as "very laissez faire, very social—we've never even had hired umpires." Based on work schedules and availability, it's common for a different set of players to show up to each game.

And although the Spinors haven't yet won the league championship, they'll be back again next year for another try.
Glenn Roberts Jr.

Fighting for academic freedom, one scholar at a time

A recent symposium honoring Herman Winick's illustrious career in synchrotron development boasted a stellar guest list. It included friends and colleagues from across SLAC National Accelerator Laboratory, where Winick has spent the lion's share of his 50-some-year career, and from across the world, because when Winick wasn't building experimental facilities at SLAC, he was busy convincing other scientists in other countries of the worth of synchrotrons—both as tools for discovery and as teaching tools that could help strengthen a local academic community.

But Winick learned decades ago that an academic community is only as strong as the freedom of its scholars. So in addition to advocating for synchrotrons, he advocates for his colleagues, both in science and beyond. A special guest at the symposium was Natalia Koulinka, a Belarusian journalist who faced danger in her home country due to her work. Hearing of Koulinka's plight through colleagues, Winick, working with the Scholars at Risk Network hosted by New York University, was instrumental in bringing her to safety in the United States.

Scholars at Risk is an international network of higher education institutions that promotes academic freedom and protects threatened scholars. Its work includes helping arrange temporary academic positions in safe locations.

"Through this program hundreds of careers, and undoubtedly some lives, have been saved," Winick says. "These are extraordinary people who have taken great risks to promote freedom and democracy in their home countries. Working with SAR enables universities such as Stanford to give them a safe place to continue their important work, while at the same time contributing to teaching and research at the host university."

Winick's own work with the network has resulted in five scholars finding sanctuary. He is now working with the Stanford Development Office to fund an endowment at the university to ensure that additional scholars can find sanctuary when necessary.

Still, it's Winick's personal touch that has had the biggest impact. Koulinka says she's grateful for the institutional and individual donations made on her behalf. "But my gratitude to Herman is very specific—he took personal care of me," she says. "He didn't have to, but he did." Now Koulinka is working with Belarusian colleagues to document the brief flowering of journalism in her country between its independence in 1991 and when the current regime took power in 1994. "Someday I'd like to go back and share all the knowledge I've gained here," she says.

Thanks to organizations like SAR and people like Winick, Koulinka may have that chance.
Lori Ann White

Photo: Fabricio Sousa, SLAC

FROM LEFT: Belarusian journalist Natalia Koulinka with three of the people who helped bring her to Stanford University and safety: Herman Winick, Nadejda Marques and Larry Diamond.