signal to background

SLAC's Einsteins meet the local community; a scientist's mother fosters the deciphering of an Archimedes manuscript; connections between physics and dance; the hottest science papers; Fermilab's robots, built on the cheap, are on patrol; review of a book on the fundamental role of symmetries; letters.

Photo: Linda A Cicero, Stanford News Service

Photo: Diana Rogers, SLAC

Einsteins at Stanford Community Day

When was the last time you met three Einsteins? Masa Hokari and his son Harumi (top photo) had this opportunity during Stanford University's Community Day, held in April. They were two of the thousands of visitors who explored exhibits and participated in special activities offered by Stanford's departments and programs.

Stanford Linear Accelerator Center displayed its *Quantum Universe* exhibit, providing a glimpse of the 21st century particle physics revolution. Many modern-day Einsteins—male and female graduate students and physicists outfitted in lab coats, white wigs, mustaches, and ties—were on hand answering questions and conducting fun experiments with soda cans, bowling balls and spinning wheels to demonstrate phenomena such as atmospheric pressure and the gyroscopic effect. A continuous stream of people watched the particle tracks created by cosmic rays in a cloud chamber. The all-time crowd-pleasing favorite, of course, was the chocolate-chip ice cream produced with liquid nitrogen at a temperature of minus 320 degrees Fahrenheit.

Nina Adelman Stolar, SLAC

Photo: Rochester Institute of Technology and Johns Hopkins University

Archimedes at SLAC

As mothers around the world inevitably do, Ingrid Bergmann gave her son, Uwe, a pile of news clippings when he visited home. Although Uwe's trip to Germany was actually for a conference on photosynthesis, it also gave him a chance to see his family.

In Mrs. Bergmann's pile was the October 2003 issue of *GEO* magazine's German edition. The article that caught Uwe's attention described technological efforts to completely read the Archimedes palimpsest, a parchment containing treatises by Archimedes copied down by a 10th century scribe. The text was scraped off two centuries later and the parchment reused as a prayer book. From the article, Bergmann learned that the ink of the original text contained iron pigment, prompting his own Eureka moment.

"I read that and I immediately thought we should be able to read the parchment with x-rays," Bergmann said. "That's what we do at SSRL [Stanford Synchrotron Radiation Laboratory]: we measure iron in proteins—extremely small concentrations of iron."

Bergmann contacted the archivists at The Walters Art Museum in Baltimore, where the parchment is being studied (on loan from a private collector who paid $2 million for it in 1998). With their agreement, the manuscript traveled to SSRL in May to be illuminated by x-ray light that causes the remnants of iron-laced ink to fluoresce. A detector catches the fluorescence and renders the 2000-year-old thoughts of the mathematical genius readable.

For a short time, three pages of an irreplaceable, one-millennium-old goat-skin parchment could be read by modern technology's most discerning light.

Heather Rock Woods

Dance, physics and energy

Robert Wilson, the first director of Fermilab, was both scientist and artist. There are many anecdotes about his interest in and promotion of art at Fermilab. Over many years I have observed that physical scientists often have a deep interest in the arts. On a recent trip to Flagstaff, Arizona, I encountered the reverse.

While attending the 75th birthday celebration of noted anthropologist Joann Keali'inohomoku, I was surprised to see a bubble chamber picture on the cover of a book in her library. The title was *Studying Dance Cultures around the World.*

Upon inquiry, I learned the author, Pegge Vissicaro, was attending the party and I introduced myself. She was delighted to meet someone from Fermilab. She had obtained the picture through the Fermilab Public Affairs office.

In her book, Vissicaro devotes part of a chapter to the relationship of physics and dance. She explains this relationship is both physical and metaphorical. Dance on the physical level is using the physics of energy and mechanics to produce movement. On the metaphorical level, dance connects people of different cultures in the way that elementary particles connect us in the physical universe. She states, "The behavior of elemental particles demonstrates that energy is the fundamental link between all things, all people, and all places."

The bubble chamber picture vividly illustrates this. In our imaginations, we can easily picture the tracks as whirling dancers.

John Urish, Fermilab

Detail, cover of Studying Dance Cultures around the World *by Pegge Vissicaro*

Hot extra dimensions

The most-cited paper in theoretical particle physics in 2004 was "A large mass hierarchy from a small extra dimension" by Lisa Randall and Raman Sundrum, published in *Physical Review Letters* in 1999. It was also the fourth most-cited of all high-energy physics papers in 2004, including those on experiments, and it has been in the top ten each year since publication. A facsimile of Randall's working notes related to the paper appears in this month's "logbook" (inside back cover).

The Randall/Sundrum paper has already reached number 19 on the all-time citation list. Randall and Sundrum have written four papers together (another is at number 22 on the all-time list), and only one person has written a paper with both of them: Nima Arkani-Hamed, an extra dimensions expert. His 1998 paper with Savas Dimopoulos and Gia Dvali comes in at number 18 on the all-time list.

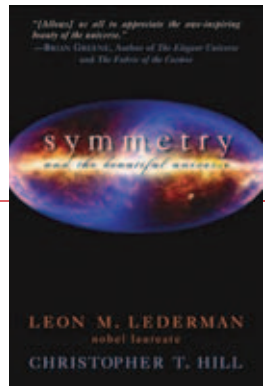
Moving up the list one more place to number 17 is the 1981 inflation paper by Alan Guth (featured in *symmetry,* Dec 2004/Jan 2005). Guth also happens to be the only person to have published with both Randall and this month's "60 seconds" contributor, Sean Carroll (back cover). Guth and Randall published two papers together, one on neutrinos, the other on inflation, while Guth and Carroll wrote their two joint papers on the difficulties of building time machines.

Heath O'Connell, Fermilab

Reviewed by David Harris

Symmetry and the Beautiful Universe

Leon M. Lederman and Christopher T. Hill
Prometheus Books, Amherst, New York, 2005



Perhaps the key lesson we learned from Einstein is the significance of physical symmetries in the laws of nature. For example, the special theory of relativity is, in a nutshell, nothing more than a description of the symmetries of space-time. In modern particle physics, symmetries have such a fundamental role that particular theories are often referred to by the names of the symmetry structures lying at their cores, such as the seemingly obscure SU*(5)* and SO*(10)* symmetries.

Amid the cutting edge symmetries of current, narrow fields of research, it is easy to forget that much of physics can be understood in terms of symmetries, and even elementary physics gains new interpretations when cast in the light of symmetries. The purpose of Lederman and Hill's book is not to push the readers of popular science books to more modern ideas but to revisit all that has gone before, giving it a new life through the perspective of symmetry principles. Importantly, the book does a good job of introducing Emmy Noether's seminal contributions in connecting physical laws with symmetries.

The writing is clear and fresh, often presenting new stories and analogies rather than the tired rehashed tales common in popular science writing. Upon reading the book, it is easy to wonder why freshman physics classes aren't based more on this approach, given that Lederman and Hill are able to convey some of the most important conceptual ideas in physics without needing difficult mathematics. Indeed, mathematics (in the sense of equations and symbols) is almost entirely lacking from the book.

This book does not teach the non-specialist about more new physics. Instead, it teaches a way to think about physics that is neglected in most physics courses and popular books.

Starship it's not

"It's funny to see how people react to it. Non-technical people steer wide and won't touch it, while engineers and designers, people you wouldn't think of as given to humor, will stand in front of it until it moves around or put a handkerchief on the wireless camera. Someone even put a 'kick me' sign on it."

This is how Ray Tomlin, an engineer at Fermilab, describes reactions to test runs of his latest creation and Fermilab's newest worker: MARV, or Mobile Arm Radiation-measuring Vehicle. While reactions to the 12-inch MARV I and its bigger sibling MARV II have been humorous, the MARVs have a serious job, boldly going where no one has gone before: into the accelerator tunnels while the accelerators are running. MARV is operated remotely through a wireless Internet connection set up inside the Booster tunnel, and can perform a multitude of tasks, which currently include live calibration of beam loss monitors and radiation detection. Other possible uses of MARV include fire suppression

and detection of arcs or water leaks without shutting down the beam.

While MARV may not be the Starship *Enterprise,* its nickel-cadmium battery can power the 8-pound chassis on eight servo-motors to achieve a distinctly non-relativistic top speed of two miles per hour for up to three hours. And the cost for MARV was not out of this world. Tomlin, along with help from Fermilab employees Greg Brown, John Larson, and Bob Florian, built MARV I for about $1400 and MARV II for about $5000 through a National Science Foundation grant. Original commercial estimates ran up to $250,000. Despite Ray's characterization of engineers, he has a sense of humor himself. While performing a test run, Ray walked in front of MARV with the block of wood that is MARV's stand. People in the halls stopped and asked him how he was driving it. "I've trained it to follow this block of wood," he said with a straight face. "I think we got a few people to bite."

Eric Bland

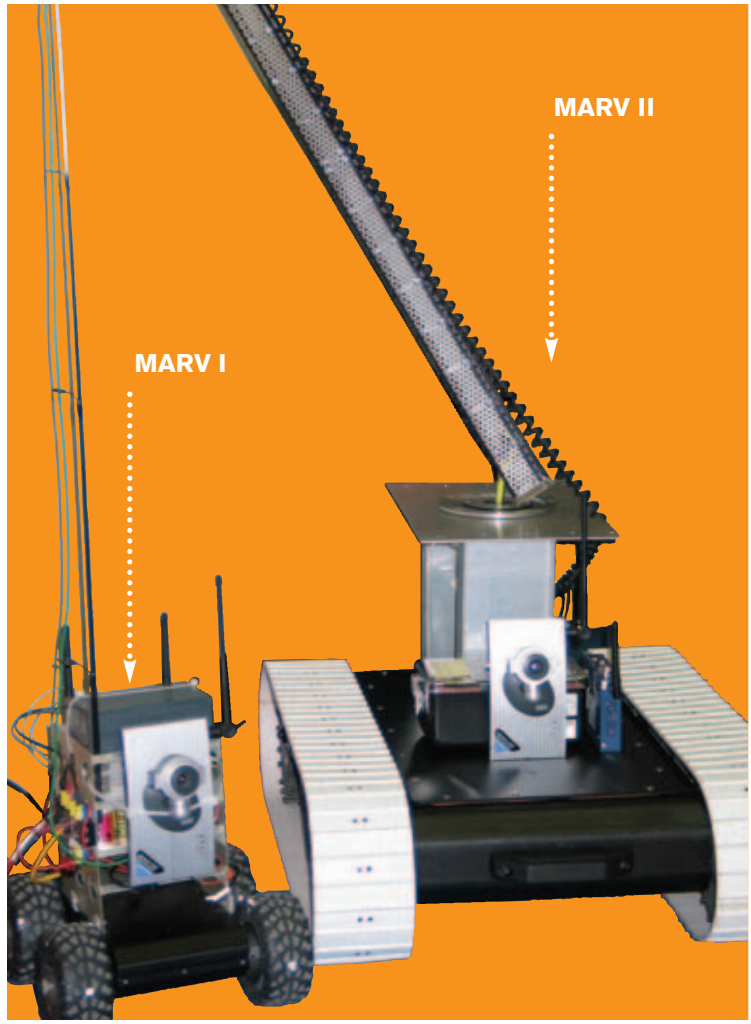


Photo: Eric Bland, Fermilab

Letters

Parental involvement

I confess to reading "Women's progress in face of challenges" in my husband's April 2005 copy of *symmetry.* Despite my educational background in business, I've always been interested in science. When our daughters' elementary school started after-school enrichment classes, I signed up to teach science. Eleven years later, I'm still there. We live in an affluent area where many, if not most, mothers have college degrees, but over the last decade, I've averaged about 2/3 boys, 1/3 girls in my kindergarten classes. I watched one girl in tears, asking her parents to let her quit gymnastics so she could take science.

Only twice have I had more girls than boys in a class, once when a Girl Scout leader offered to personally take her troop members home after class, and once when one girl convinced several friends to come because she didn't want to take it alone. Several times I've had one or two girls in a class of 15. Only the most outgoing, science-fascinated ten-year-olds can handle that. Until our culture, and our parents, encourage girls to develop an interest in science, they will be underrepresented from kindergarten on. Nature may be a part of it, but nurture plays a role, too. By the way, our older daughter is studying computer and software engineering, and our younger daughter is hoping to major in bio-mathematics.

Marlys Stapelbroek
North Tustin, California

Letters can be submitted via letters@symmetrymagazine.org