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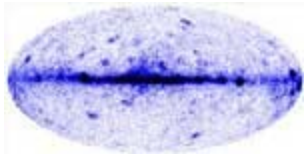
In a Virtual Sky, Astronomers Find Dark Matter

By Davide Castelvecchi



Making sense of the data coming from the Large Area Telescope (LAT), one of two main instruments of the GLAST mission, will take highly trained eyes and sophisticated software. Once the NASA probe is in orbit in 2007, astronomers will be able to hit the ground running thanks to three rounds of a simulation drill called Data Challenges, or DC. After six months of preparation, the first round started last December and ended successfully with a SLAC workshop in February.

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New SLAC Public Lecture Series Energizes its Audience

By Kate Metropolis

"After the electrons and positrons in our linear accelerator have gone just ten or fifteen yards, they are already traveling at 99.999999999 percent of the speed of light. It's hard to make them go any faster, but along the remainder of our two-mile-long accelerator we pump them full of energy."

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How Many Physicists Does it Take to Write a Paper?

By Kate Metropolis

SMAISMRMILMEPOETALEUMIBVNENUGTTAVIRAS must rank as one of history's shortest scientific publications. In 1610, it caused a sensation among the prominent scientists of Europe. It came, after all, just months after the same author had announced that four satellites were orbiting Jupiter.

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Harris to Spearhead SLAC-Fermilab Magazine

By Davide Castelvecchi

David Harris has just moved to SLAC to be the editor of a new magazine dedicated to highlighting an exciting new age of fundamental research.

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Community Day in April

By Emily Ball

Don't miss the third Stanford Community Day to be held Sunday, April 4. Bring your family and friends to enjoy an all-day open house on the Stanford Campus featuring music, arts, athletic events, science exhibits, a childrens' community carnival and a health fair.

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Thesis

By Beck Reitmeyer and Sharon West

SLAC-related theses are available on the Web. Is your thesis there?

The Technical Publications department keeps track of theses based on work done at SLAC as SLAC Reports.

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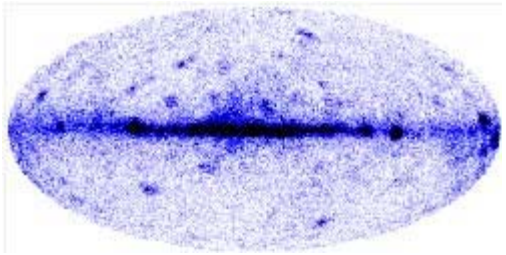
"We took a major step forward in preparing for the launch of GLAST," said Stanford's Peter Michelson, Principal Investigator of the SLAC-based LAT project. Steve Ritz of NASA's Goddard Space Flight Center led the overall DC effort. Ritz is both Project and Instrument Scientist for the GLAST mission.



An image from Data Challenge 1. This is a simulation of what the sky would look like if our eyes could see gamma rays. The darker, horizontal band is the Milky Way. Most of the visible point-like sources are fast-rotating pulsars (within the galaxy) or accreting black holes at the center of other galaxies. *Image by Julie McEnery (NASA/GSFC)*

An international team coordinated by Richard Dubois (SLD), a particle physicist on SLAC's LAT team, wrote the simulation software, which ran on SLAC's computing system. The software churned out data that was meant to look like it came from the LAT detector.

Meanwhile, LAT astronomer Seth Digel (GLAST) coordinated the data analysis team. American, French and Italian physicists wrote the software tools astronomers will need to analyze the data, whether it is simulated or real.

"This level of end-to-end simulation is almost unprecedented for a space astrophysics mission," said Michelson. On December 8, both the data and the analysis tools were presented to the GLAST community at a meeting on the Stanford campus.

The first DC round simulated most known sources of cosmic gamma rays, the highly energetic radiation GLAST is meant to observe. Each round of the drill will include more and more sources of gamma rays, requiring the equivalent of several days of SLAC's full computing power.

Because LAT's images will have tens of times the definition of those from previous gamma ray telescopes, astronomers will have to be prepared to witness entirely new phenomena. In this round of simulations, Ritz told the 'test-takers' to watch out for some surprises, and they readily realized that his model produced clues of dark matter at the center of our galaxy.

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Dark matter has not yet been directly observed in reality, though physicists say it has to be six times more abundant than ordinary matter in order to explain the shape of some galaxies. The nature of dark matter is one of the mysteries that GLAST may help to solve.

The DC exercise has been an opportunity for particle physicists, astrophysicists, astronomers and software experts to learn about each other's science ends and means. "The fun part was putting the team together to pull this off," Dubois said.

Gamma rays are some of the most energetic radiation found in nature, billions of times more energetic than visible light. They are emitted by the nuclear reactions that happen in such dramatic cosmic phenomena as black holes and supernovae, the exploding stars that can temporarily outshine entire galaxies. To observe the gamma-ray sky, astronomers need high-altitude balloons or orbiting satellites. Luckily for us, the earth's atmosphere is an effective shield against the highly destructive radiation in space.

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Neil Calder (COM) was the speaker at the first public lecture in the series. (Photo by Joni White)

Images of coffee cups fill the auditorium screen.

"More and more energy."

Drawings of coffee pots fill the screen.

"They are really very, very, very buzzed."

The audience of non-physicists laughs with relief: this public lecture isn't going to hurt, after all. It's going to be comprehensible. It's going to be fun.

There was a full house in Panofsky Auditorium on the evening of February 24, when Neil Calder (COM) launched the SLAC public lecture series with a talk entitled, "What Goes on Inside the World's Longest Building?"

Seventy-five minutes later, the audience had been greeted, on film, by people from around the world drawn to SLAC because of what the world's longest building makes possible. They had learned that SLAC is managed by Stanford for the DOE's Office of Science. They had watched a movie in which a Snickers bar collides with an anti-Snickers bar to create M&Ms and anti-M&Ms, gummy bears and anti-gummy bears, to illustrate that PEP-II produces new particles.

They had heard that BABAR is helping to resolve the mystery of why there is vastly more matter than anti-matter in the Universe, when equal amounts of both were likely present in the beginning. They had seen the crispness of images made at SPEAR of osteoporitic bone as well as an illustration of the GLAST gamma-ray detector.

After the talk, the lobby was packed with people asking questions. They were fielded by an impressive team of strategically placed physicists, mostly graduate students: Christopher Barnes (ARDB), Adam Edwards, Christian Flacco, Steve Sekula, Eileen Sneeden and Michael Wilson (all of BABAR).

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The series was conceived by physicists—users of SLAC's many resources—who want to inform the public about the value of SLAC in a jargon-free, entertaining way. Emily Ball (COM), the event's publicist, called the event an excellent success. "We created the opportunity for our community to better understand what we do here."

In twos and threes, 325 neighbors of SLAC slowly filtered out into the night very, very buzzed.

For more information on future lectures, visit: http://www2.slac.stanford.edu/lectures/

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David Harris has just moved to SLAC to be the editor of a new magazine dedicated to highlighting an exciting new age of fundamental research. He was formerly Head of Media Relations at the American Physical Society (APS).

David Harris (COM) hails from Australia. (Photo by Nicolle Rager)

The new publication—which does not yet officially have a name—will be a joint venture between SLAC and Fermilab, our sister DOE facility near Chicago.

"Particle physics is entering a new area, where traditional accelerator physics is joining with cosmological physics, and that is changing the whole field," Harris says. Harris wants the new magazine to emphasize that cross-fertilization and also to explore the connections to other areas of science and global culture.

The magazine will be a way for SLAC and Fermilab scientists to reach out to the public and to policy makers, and facilitate communication in both directions. "We also want to use the magazine as a way for policy leaders to communicate with the physics community," Harris says.

In an age when addressing fundamental questions will require large facilities such as the International Linear Collider, organizational and financial cooperation among countries will be key. "We really want to take a global perspective, because particle physics is increasingly an international venture," Harris says.

Harris is a theoretical physicist. He has done research in Bose—Einstein condensation and quantum information theory—and has extensive experience communicating science through several kinds of media. After earning a physics degree and a graduate degree in scientific communication from the Australian National University in Canberra, Harris went on to graduate studies in theoretical physics at the University of Queensland in Brisbane. At the same time, he started a career as a freelance writer and as a radio broadcaster for the Australian Broadcasting Corporation, where he led a weekly science program. He also worked for Radio Australia, an international radio station, and wrote and co-produced a 65-episode TV series on science for children.

Harris took his position at the APS in 2002, when he was only 28. He is enthralled to be at SLAC and to be in charge of the new effort. "It's not every day that you have a chance to communicate science in a new form

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and to a really diverse audience," he says. "This was too good an opportunity to pass up."

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Writing a Physics Paper—an Interview with Robert N. Cahn

By Kate Metropolis

Robert N. Cahn (LBNL) is the current chair of the BABAR Publications Board. Known for the clarity of his prose as well as the clarity of his calculations, Cahn is co-author, with Gerson Goldhaber, of The Experimental Foundations of Particle Physics (Cambridge University Press, 1989). He has been a member of the Theory Group of LBNL since 1979. Cahn took time recently to answer some questions about publishing papers in BABAR.

Q: What makes a good experimental physics paper?

(Photo courtesy of SLAC)

A: Of course, a good experimental paper must have an important result. It needs to explain the significance of that result for our understanding of fundamental physical laws. It needs to explain how the experiment was actually conducted. It should explain how the data were analyzed and should identify the critical aspects of the experiment. What was special about the data or the analysis? What was novel here?

A good paper provides enough information for the reader to assess the experiment. Unfortunately, this makes it very hard to write a good experimental paper for Physical Review Letters. In the few pages that are allowed, it is nearly impossible to explain thoroughly analyses as complicated as those that are typical in high energy physics these days.

The discussion of systematic errors plays an especially important role, for it is here that the authors need to demonstrate their competence in identifying possible problems and quantifying them. When so many analyses are based on similar datasets and similar analysis techniques, the quality of the systematic error discussion provides guidance to the quality of the work.

Of course, a good experimental paper is written clearly. It is particularly hard to avoid the jargon that pervades a 600-person collaboration. It becomes the lingua franca and you forget that it is incomprehensible to the rest of the world. We need that jargon and the acronyms to communicate efficiently, but it is hard to shed them when it is time to write.

A good paper should show some craftsmanship. The quality of the presentation inevitably affects the readers' judgment of the result. If the paper is sloppily written, you worry that the analysis was sloppy as well. Good writing is simple and to the point. I am happy to report that you can find Strunk and White [authors of the

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definitive writing guide, The Elements of Style] in the *BABAR* graduate student room at LBNL. Actually, it belongs to a Russian whose knowledge of English grammar is far too good to be that of an American, Canadian or Brit.

Figures and tables are critical parts of a paper. They express results that cannot be conveyed in words. Designing an effective figure is not easy. You need to worry about proportions, about the scales for the axes, about labels. You need to distinguish real data from Monte Carlo, signal from background. It is important that the reader quickly grasp the meaning of the figure. Tables are not so subtle, but it is still important to make them attractive and consistent. Have you used the correct number of significant figures? Are the units correct?

Q: How does *BABAR* ensure that its papers are good?

A: *BABAR* works very hard to make sure its papers are correct and well presented. These efforts are demanding enough to generate some controversy. Are we putting too much effort into our internal review process? Do we worry too much about questions of style and grammar?

Papers are written by small groups of authors or, occasionally, a single author. The authors function within Analysis Working Groups (AWG). The AWGs provide the first critical audience for a new analysis. When the analysis is far enough along and well enough documented, the Physics Analysis Coordinator signals to the Chair of the Pub Board that a Review Committee is required. The three-person review committee ideally includes one member of the Publications Board, one person from the AWG (though not an author) and one other, an outsider.

When the review committee believes the analysis is complete, it informs the Pub Board Chair, who announces the start of a collaboration-wide review. During this time, every member of the collaboration is invited to critique the paper, which by now is a full draft of a journal. To make sure the review is thorough, a number of institutions (now typically 12 of them!) are asked to review the draft paper formally, posting their critique on-line using hypernews.

After the collaboration-wide review, the authors respond to the critiques, posting responses again on hypernews. When the review committee believes that the authors have responded adequately and made the corresponding changes in the draft, they notify the Pub Board Chair. At this point, the Pub Board Chair announces that the draft is in Final Notice and that, if no problems are identified within a week, the draft will be submitted to a journal.

In parallel with the final notice, two members of the Pub Board do a final reading of the draft. At a minimum, they catch remaining grammatical problems, typos, etc. They may find other problems, and occasionally there are real issues of physics that are identified at this stage. Once the Final Notice and final readings are done, the paper is submitted.

Q: What is your role?

A: I have primary responsibility for forming the review committees. I sit in on a large fraction of the practice

talks for conferences (which I haven't discussed here). I am involved in formulating policy on publications. I serve on a few review committees myself. I try to be one of the final readers on every journal paper.

I want *BABAR* papers to be something we can be proud of. This takes real work. At the same time, we need to keep some sense of balance. We need to get results out and we can't really take the time to make each of them a literary gem. What we can and should do is make sure they are clearly written. This is hard enough.

Q: How significant a metric is the number of papers produced by a collaboration? When does the difference in the number of papers produced by *BABAR* and Belle become significant?

A: The number of papers written by the two collaborations is an important measure for people who can't actually understand the papers themselves. It allows them to judge productivity. What the members of the collaborations know, and that other knowledgeable people in the field know, is that both of these collaborations are making real contributions that are significant. Both collaborations have done a great job measuring sin 2 beta with the J/psi Ks final state. We—especially Antimo Palano—did a great job in discovering the Ds(2317), and Belle did a great job in following up on that discovery.

The real competition is for great results in pi pi, in rho rho, in phi Ks, and in many other channels. This is what really counts, not the number of papers. Still, we want the agencies who support us to see that we are productive. Making sure we get our results into print also helps them understand we are doing a good job.

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Three months later, Galileo went public and decoded the anagram: Altissimum Planetan Tergeminum Observavi—I have observed the farthest planet [then thought to be Saturn] as a triple sun.

Yet, two years later, after turning his telescope on Saturn again, Galileo had doubts about his conclusion that Saturn was a triple star. "Looking at Saturn within these last few days, I found it alone, without its accustomed stars, perfectly round. ...How can this be? Are the two smaller stars consumed like spots on the sun? ...Or was the appearance a fraud and illusion? I cannot resolve so new, so strange, so unexpected a change. The shortness of time, the weakness of my intellect, the terror of being mistaken, have greatly confounded me."

Were Galileo to spring out of a wormhole from seventeenth century Tuscany into last week's meeting of the BABAR collaboration, he would have found that while the scale of endeavor has changed dramatically—600 physicists working together instead of one—the goals of publishing scientific results have remained essentially unchanged. You want to be first. And you want to be right.

As of February 17, 2004, BABAR physicists had completed 46 physics analyses since January 1, 2003, bringing the total for the lifetime of the collaboration so far to 80. "There are a lot more in the pipeline," Jeff Richman (BBR), Physics Analysis Coordinator, said confidently.

Belle, the rival collaboration at Japan's *B*-Factory, completed 29 analyses during the same period, for a lifetime total to date of 83.

How much should one make of those numbers? "What's important," said Pat Burchat (Stanford), "is not the

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number of papers, but what's being published." A Stanford Physics Professor, Burchat is both a past chair of the BABAR Publications Board and has served as BABAR Physics Analysis Coordinator. "What fraction of the data is actually being used? What's the quality of the analyses: Is it something novel, or just a repetition of what's already been done?"

About 150 BABAR physics analyses are underway at the moment. Before they are submitted to one of the peer-reviewed journals, often Physical Review Le.ers, they undergo what Burchat described as a high level of scrutiny. *(See Cahn interview for details, page 3.)*

The scrutinizers on the three-person committees that review every putative publication are there to ask critical questions and to give constructive feedback to the authors. "Some people are known for a high rate of suggestions," said Burchat, "but when we ask someone to serve on a review committee, we are looking for a high rate of useful suggestions."

The process is especially valuable for graduate student authors, Burchat pointed out, particularly those whose advisors aren't able to spend a lot of time at SLAC because of teaching responsibilities at their home institutions.

The size of the enterprise is reflected in the author list, which runs to several pages in Physical Review Letters. "BABAR has a system of distributed responsibility," said Burchat. "The people without whom we'd never even get the data—the run coordinators and the detector subsystem managers who are on call 24/7, the data processors—are fully entitled to be listed as authors, whether they've even had time read the paper."

There's even a protocol for when a person is added to or taken off the author list. Usually someone has to be on the experiment for at least a year before they're added, because that seems a reasonable length of time for them to have made a real contribution to the experiment. After someone leaves BABAR, they're usually entitled to stay on the author list for at least a year.

What happens, though, when a physicist is trying to get tenure and his or her name is buried in an author list several pages long? In experimental high energy physics, according to Burchat, it is not papers but letters of recommendation that allow others to evaluate an individual's contributions.

Although carefully checking BABAR results takes months, Galileo would probably not consider that a long time. His result that the Earth is not the immovable center of the Universe was, after all, not fully accepted for 360 years.

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The Green Meanie—Over 30 Years and Counting

By Davide Castelvecchi

Both Rich Torres (EFD) and the Green Meanie have been at SLAC since 1966, and neither one is ready to retire quite yet.

The front tires (8'2'' tall) and the rear tires (6'3'' tall), are taller than the average man. (Photo by Terry Tuck)

The mighty LeTourneau FL-40 Lift Truck is actually back to its original safety yellow now, though it had been green for some years, thus earning its nickname of 'Green Meanie'. It will be in perfect working condition again soon, after maintenance and some repair work is completed. Its 98-inch front wheels and 75-inch rear, steering wheels—all taller than an average person—are resting on their sides while mechanics work on replacing the four electric motors that power each wheel independently.

"This thing pretty much built most of the stuff here back in the old days," says Torres while standing by the gigantic machine in the Collider Experimental Hall. Torres still has a 1960's LeTourneau catalog, and points to a picture of the Green Meanie lifting concrete shielding blocks during construction of our linear accelerator. The Texas-based heavy-duty equipment maker built the Green Meanie to SLAC's specifications, adapting the design of the log-stackers commonly used in the timber industry.

The Green Meanie's forks can carry a load of 80,000 pounds (40 tons), and its front jib hook can lift up to 40,000 pounds (20 tons) at a time. And for all that, the cost to build it was a dollar a pound when it was purchased.

Torres and David Engesser (EFD) are the only staff members around who still know how to operate the 135,000 pound (67.5 ton) machine. Eventually all the riggers will be trained to operate the LeTourneau. "It's easier to operate than any other piece of equipment," Torres says.

The Green Meanie has an imposing presence. "We used to call it the giant praying mantis," says Torres. That's indeed what it looks like, articulated into an elongated rear section—carrying a 335 horsepower Diesel engine—and an upright front section, with the jib hanging from the top and the forks sticking out in the middle, like a mantis' mouth and arms. The engine acts as a generator, and all operations are electrically powered.

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SLAC also owns an over-sized forklift that can perform similar jobs, and the Green Meanie was once slated for retirement. But the Rigging department pointed out that it was worth keeping, because of its superior maneuverability. What does that feel like? Torres says, "It's a kick in the butt." Torres also points out that the cost of buying a new one now would be prohibitive.

Eventually, the pleas worked. "We're really grateful to EFD and the Research Division for recognizing it's value to SLAC," Torres says. "This thing is worth its weight in gold."

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Show Off Your SLAC Thesis

By Beck Reitmeyer and Sharon West

SLAC-related theses are available on the Web. Is your thesis there?

The Technical Publications department keeps track of theses based on work done at SLAC as SLAC Reports. As such, students benefit by having their thesis posted to the Web (therefore always available), reviewed for patent and included in SPIRES.

Moreover, we cover printing and distribution of the thesis to roughly 25 HEP libraries worldwide and provide students with up to ten bound copies for their own distribution.

Students aren't the only ones who benefit. The Lab and its collaborations benefit by having their work maintained in a comprehensive, publicly accessible list of intellectual work, while seamlessly complying with DOE requirements.

You can search for a SLAC thesis by title or author name through SPIRES (http://www.slac.stanford.edu/library/catalog/theses.html), through the new search engine (select the SLAC Publications collection at http://www.slac.stanford.edu/search/index.html), or through the TechPubs FastFind if you already know the report number (http://www.slac.stanford.edu/pubs/fastfind.html). http://www.slac.stanford.edu/library/catalog/theses.html

For questions about publishing your thesis at SLAC, please contact Crystal Tilghman (Ext. 2677) or Sharon West (Ext. 2594).

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Everyone is Invited to Stanford Community Day in April

By Emily Ball

Don't miss the third Stanford Community Day to be held Sunday, April 4. Bring your family and friends to enjoy an all-day open house on the Stanford Campus featuring music, arts, athletic events, science exhibits, a childrens' community carnival and a health fair. Attend academic activities ranging from Discovering Dickens to Faculty Lectures.

For this and other pictures from last year's event, click on photo above
(Photo by Diana Rogers)

Everyone is welcome to a multifaith service in Memorial Church. The dramatic Founders' Day Procession ends at the Mausoleum, which will be open to the public. Visit the Cantor Center for Visual Arts, tour the historic Stanford Museum and view collections and special exhibitions including the extraordinary Rodin Sculpture Garden.

For program and parking information, visit: http://www.stanford.edu/dept/news/neighbors/communityday/

See a colorful photo gallery capturing last year's event at http://www-project.slac.stanford.edu/slacpix/Special%20Events/2003/040503_stan_day/040603a.html

Want to help develop science-related activities? See yourself as an Ambassador to the Community? To join the SLAC team contact Nina Adelman Stolar (Ext. 2282, nina@slac.stanford.edu) or see: http://www.slac.stanford.edu/grp/pao/ambassador.html

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MILESTONES

Dissertation Award

Rahatlou, Shahram (BABAR), 2004 Mitsuyoshi Tanaka Dissertation Award, "For his role in the development of the tools needed for the analysis of *B*-Factory data, including the tFIT program, a unique and comprehensive fitting framework for time-dependent analyses." (For complete details, see http://www.aps.org/praw/tanaka/04winner.cfm)

Service Awards

5 Years

do Couto E Silva, Eduardo (EK), 3/1

Haase, Andrew (KLY), 3/1

Husic, Ibrahim (SEM), 3/1

Jenkins, Diane (MFD), 3/1

Miller, Timothy (SCS), 3/1

10 Years

Kreitz, Doug (BLS), 3/7

Kreitz, Pat (TIS), 3/7

15 Years

Allen, Bruce (ESD), 3/6

Limones, Rebecca (ESD), 3/1

Reed, Robert (MD), 3/1

Rodriguez, Raymond (REG), 3/6

Usher, Tracy (EA), 3/1

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- Upcoming Events

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20 Years

Flynn, Vickee (EFD), 3/1

Steger, Michelle (SSRL), 3/5

30 Years

Luth, Vera (EC), 3/1

35 Years

King, Tony (MET), 3/12

Roos, Franklin (MFD), 3/3

Deceased

Chadwick, George (retired, formerly with SLD), on December 20, 2003

Kral, Lawrence (retired, formerly with TD), on February 22, 2004

To submit a Milestone, see:

http://www.slac.stanford.edu/pubs/tip/milestoneindex.html

See Awards and Honors at http://www.slac.stanford.edu/slac/award

The Stanford Linear Accelerator Center is managed by Stanford University for the US Department of Energy

Last update Tuesday March 02, 2004 by Emily Ball

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Volunteer!

Stanford Community Day

April 4

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First Annual CART Data Mining Conference

March 22-24

The Crowne Plaza Union Square, San Francisco

Featuring Keynote Speaker

Jerome Friedman,

Professor of Statistics, Stanford University and SLAC

Papers covering any application of CART, MARS, PRIM and TreeNet are encouraged, including innovative and unusual applications

For more information, see: http://www.cartdatamining.com

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Jason Larrabee Visit

Congressional Staffer Jason Larrabee from the House Appropriations Committee visited SLAC on February 18. Larrabee enjoyed touring the Lab and is shown (center, above) near the BABAR detector flanked (left to right) by Physics Analysis Coordinator Jeff Richmond (BBR) and Technical Coordinator Bill Wisniewski (EE).

(Photo by Diana Rogers)

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