SLAC BEAM LINE

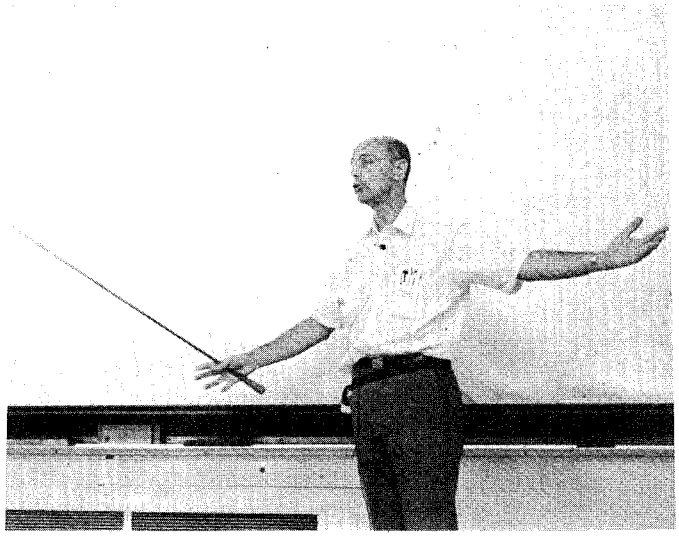
All that glisters may not be gold, but at least it contains free electrons *-J.D. Bernal*

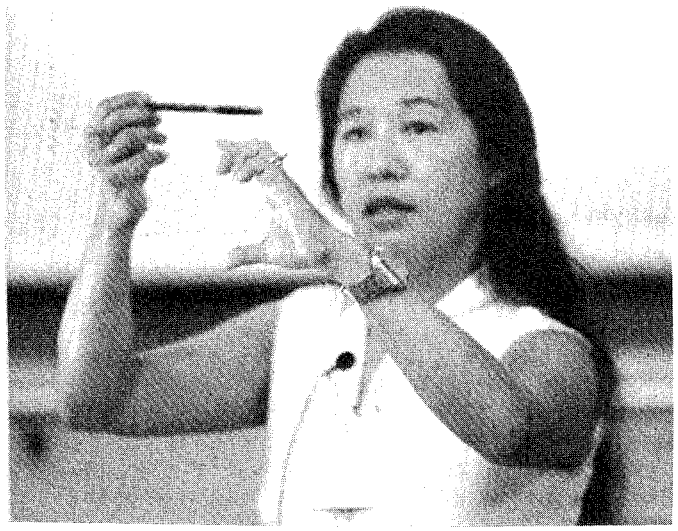
Volume 13, Number 10 *October 1982*

SECOND SUMMER SCHOOL ON HIGH ENERGY PARTICLE ACCELERATORS
AUGUST 2-13, 1982

TENTH SLAC SUMMER INSTITUTE ON PARTICLE PHYSICS
AUGUST 16-17, 1982

These two conferences, together with the Anniversary Celebration, made this SLAC's busiest August. At right Raphael Littauer of Cornell makes a point about instrumentation. Haim Harari, below, makes two points about quarks and leptons, and Juliet Lee-Franzini of Stony Brook talks about upsilon physics.
(photos by Joe Faust)





TENTH ANNUAL SLAC SUMMER INSTITUTE

SLAC hosted 376 physicists during the two-week Summer Institute on Particle Physics this August. This year marked the tenth anniversary of the Institute, and attracted participants from fourteen countries in Europe, Asia, Latin America, and virtually every state of the USA. The Institute consisted of two sessions: a seven-day school of a general pedagogic nature followed by a three-day topical conference. The short courses had as their theme Physics at Very High Energies, while the topical conference brought results from current experiments.

Both theorists and experimentalists focused on what should be learned from the future machines. R. Cahn (LBL) presented a brilliant summary of old and new physics at hadron colliders, and J. Dorfan (SLAC) explored the experimental consequences of the standard model and of the supersymmetric theories presented in the learned lectures of L. Susskind (Stanford). B. Wiik (DESY) drew from both theory and accelerator science in presenting the motivation and challenges of electron-proton colliders. In the same vein R. Stiening (SLAC) talked about the e^+e^- colliders and R. Diebold (Argonne) presented plans for a hadron collider with 20 TeV beams. The semilogarithmic Livingston plot which shows the evolution of accelerator energies with time was presented many times in these talks, but with a new twist: some speakers indicated their retirement year on the plot, reflecting the desire for a speedy construction of new facilities. The standing problems in weak interactions, such as lepton scattering, proton decay, and neutrino oscillations were reviewed in the courses by M. Strovink (Berkeley) and H.H. Williams (Pennsylvania).

The eighteen lecturers contributing to the Topical Conference presented the experimental results from work at all the accelerator centers. Results from the CERN $\bar{p}p$ collider attracted intense attention, both for their physics content and as examples of new large spectrometer systems. The modern stress in lepton production and lepton beams was reflected in the results from neutrino experiments and from the CESR, PEP, and PETRA colliding beam machines.

The final session, stimulated by the recent possible discovery of a magnetic monopole by B. Cabrera at Stanford, disgressed from the central topic of the meetings with lectures by F. Wilczek (Santa Barbara) on properties of monopoles and by Cabrera on the experimental aspects of his search. The conference concluded with a fascinating expose by G. Steigman (Bartol Research Institute) linking particle physics with cosmology.

--Giora J. Tarnopolsky

ACCELERATOR SUMMER SCHOOL

Approximately 150 physicists and engineers from the United States, Canada, Europe, and Asia spent two weeks at SLAC this August in the second Summer School on High Energy Particle Accelerators. Twelve morning lectures covered the principles of linacs and synchrotrons; lattice and magnet design; beam instrumentation; new methods of acceleration and accelerator technology; the beam-beam interaction and coherent beam phenomena; and computer techniques in accelerator design. The 7 afternoon seminars applied these tools and principles to current and planned machines, including hadron and lepton colliders, both circular and linear.

W.K.H. Panofsky presented his perspectives on accelerators at the opening of the conference. He concluded that the candidates for the coming generation of very large $\bar{p}p$ circular colliders and the very large RF-supplied linear colliders look both practical and extremely promising. The generation of machines after that looks very difficult, however, and the talents of the accelerator physicists are needed more than ever to enrich the technology and keep the enterprise going.

Robert R. Wilson, Director Emeritus of Fermilab, spoke about the thinking for a 20 TeV proton synchrotron. One scheme would use 'superferric' magnets with superconducting coils within an iron yoke. Whatever the design, the numbers would require mass production techniques in which magnets were extruded like toothpaste. One must not fear large distances; the machine radius would be 25 m (for miles, not meters). Wilson also noted that within the lifetimes of the students in this school there will be a 100 TeV machine.

Martin Veltman, a theorist at Michigan, reviewed the theoretical landscape for points of interest to builders. There is an 'energy curtain' which has been raised in the past years to reveal the first two families of quarks and leptons and almost all of a third; The top quark and the W-Z family are presumably just a little farther up. As for the postulated 'desert' in which little happens after these bosons until extraordinarily high energies, Veltman noted that this may be just another name for the lack of knowledge and imagination. We must explore the particle spectrum between 100 GeV and 1 TeV, and we need e^+e^- machines of 1 TeV and $\bar{p}p$ machines of 10 TeV to do it.

Greg Loew was the director of this school which was sponsored jointly by the US Department of Energy, the National Science Foundation, and SLAC.

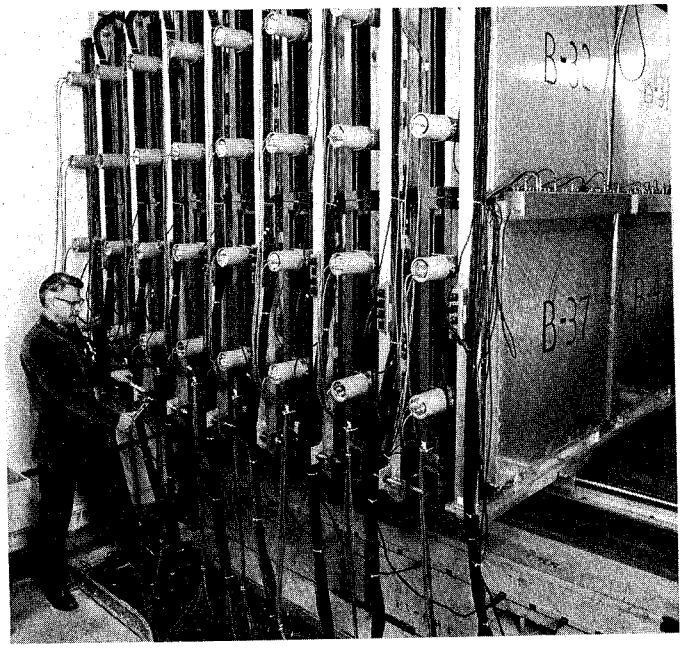


Photo by Joe Faust

Finn Halbo, Beam Engineer on Experiment E-137, is shown fiddling with the supports of the detector array.

THE AXION EXPERIMENT

Nestled in a cut in the hillside north of PEP Region 2 are two venerable power supply shelters that now house Experiment E-137, the Search for the Exotic Axion.

The experiment is based on a beam-dump technique. High energy electrons from the Linac are piped into the beam dump at the end of the A-line behind End Station A. High energy photons produced here continue in the original direction and produce (maybe) axions which go in the same direction. The hill which backs up the dump is about 200 meters thick and absorbs everything produced except neutrinos and the proposed axions. The axions would decay in 200 meters following the hill into two photons which are then detected in a high resolution shower counter.

The collaboration running this search has only five members: Luke Mo and Al Abashian from Virginia Polytechnic Institute and State University; James D. Bjorken from Fermilab, and Stan Ecklund and Ralph Nelson from SLAC.

Bjorken, or BJ, is well-known at SLAC for his theoretical work in many areas. He is now demonstrating that, just as in Fermi's day, a theoretical physicist can do an experiment and enjoy it if he puts his mind to it.

The experiment was set up in the summer of 1981 by Finn Halbo and his cohorts in EFD. Excellent support was enthusiastically provided by Don Farwell and the HEEP crew, the riggers, and the carpenters. In January of '82 data taking began. In a dedicated run of two weeks an impressive 9.5 Coulombs of 20 GeV electrons delivered. About 5600 triggers were taken and the data analysis is about finished. There are no surprises yet and the group will run for another 20 Coulombs of beam this fall.

THE AXION THEORY

The sub-nuclear world seems to be well described these days by a theory called the Standard Model because it describes correctly a vast class of experiments performed at energies under 100 GeV. In this model matter is composed of six quarks, six leptons, eight gluons, one photon, and three intermediate vector bosons. The particles not yet found are the tau neutrino, the top quark, and the three bosons, commonly called W^+, W^- and Z^o.

The story does not stop here. Three other heavy particles called the Higgs bosons are required to put all the regular particles in their places. The bosons are believed to have masses of several hundred GeV, well beyond the reach of existing or planned machines.

Apart from the undiscovered particles most physicists seem happy about the present understanding. There is, however, one embarrassment: the theory predicts a very large CP-violation in strong interactions which has never been observed. (CP is a theorem in physics which compares the behavior of particles with opposite charge and opposite handedness--or anti-particles and mirror images). This problem has been cured by introducing another particle (theorists always do that), called the axion. This is supposed to be a neutral particle,weakly interacting with matter, and not very massive.

In 1981 a German group announced that it had found such a particle in a reactor experiment with a mass of 250 KeV and a lifetime of 8 milliseconds. Four subsequent experiments elsewhere have failed to confirm this result, however. The best one can do is to keep looking. Maybe there is a particle like the axion; maybe the truth is simply very different.

-Luke Mo

Summer Science Program–1982 Stanford Linear Accelerator Center

Each summer about 20 undergraduate science students are selected from schools around the country to take part in SLAC's Summer Science Program. For nine weeks the group shares in SLAC's research activity through short courses, lectures and association with various SLAC groups.

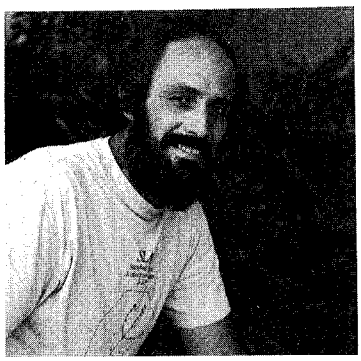
Dr. Ernest Coleman was the Director of SLAC's SSP in 1973 when the program consisted of twelve local students. By 1975, Vicente Llamas was brought on as Associate Director and recruiting efforts were greatly increased. The program grew to more than 20 students and Llamas was named Director when Dr. Coleman assumed leadership of Central Laboratory Research at ERDA. Coleman remains active in the SSP as Executive Director.

For the next three years the program grew to a maximum of 36 students representing schools from all over the country, with special emphasis on the smaller schools that traditionally were unable to offer much research experience for their students. The program has now settled down to about twenty students each summer, not counting returning SSP students who are hired directly for the summer.

Top row: Yukkei Hui, Dr. Vicente Llamas (Director), Steve Weiss, Paul Corredoura, Lisa McCain, Don McSwain, Cathy Tomlin, Eric Yuen. Middle row: Elizabeth McCormack, Vassilios-Nikos Nicopoulos, Karen Magee, Mark Santistevan, Christine Lin, Daniel Teyibo, Adrian Padilla. Bottom row: Kelly Foley, John Gabb, Leela Rangan, Joanne del Corral, Christina Back, Dr. Ernest Coleman (Executive Director), Toku Takuyasu.

Currently, there is one Ph.D. in Nuclear Physics from Cornell who was in the first SSP group in 1970. Dr. Stephen McGuire was invited back as a guest lecturer in 1978 the summer before he received his doctorate. Our own Mary James, of Accelerator Physics, was an SSP student in 1976 and expects to obtain her Ph.D. in 1983. Six former SSP students are now doctoral candidates in physics.

-Vicente Llamas



AN OPEN LETTER TO VINCE LLAMAS:

It would be more fitting for the students you've worked with over the years to write a farewell to you, rather than I. But I know I speak for all of them when I say that you've been their prime source of support during their stay at SLAC--friend, mentor, guide and den father, all embodied in one wonderful human being.

I've watched students arrive at SLAC with all the hesitancy a new experience brings, and under your capable direction and guidance, settle into their new environment, work, mature, profit from and contribute to the unique experience that is the Summer Science Program. In addition, you've always been on call around the clock, seven days a week, solving problems (both personal and job-related) for some twenty students each summer. This full and total concern with the well-being of the students is pervasive, and the lab has profited from the special contribution you've made.

We're grateful that you'll be back as an advisor in 1983 for a few short weeks to help the new director and a new crop of students settle into the program. It's like you to have volunteered to do so. This, then, is not a final farewell, rather a vote of thanks from all of us. We're happy that you'll be so wonderfully occupied during the next few summers planning and building a new home. We wouldn't have let you leave for any less a reason!

-Hilda Korner

NEWS & EVENTS...

...continued

ON CAMPUS IN OCTOBER

MUSIC:

The Alma Trio (Stanford's resident piano trio) will play a program of Beethoven's Ghost Trio, Dvořak, Kodaly on Friday, Oct. 8 @ 8:00p.m. in Dinkelspiel Aud., $4.00.

FILMS:

Sundays, 7:00 & 9:30 p.m., $1.50 with Stanford staff card at Mem. Aud.

Oct. 3 - On Golden Pond
Oct. 10 - Star Wars
Oct. 17 - Cat People
Oct. 24 - Rocky III
Oct. 31 - Poltergeist

Discovery Films (Travel) Mondays, 8:00 p.m.
Oct. 4 - Egypt $4.00, Mem. Aud.
Nov. 1 - The River Thames

FOOTBALL:

Stanford Varsity Football
Oct. 16 - U.S.C.
Oct. 30 - Washington

Stanford Stadium, about 1:30 p.m.
Call Atheletic Dept. for ticket prices)

RUNNING:

The Great Race at Stanford (6.2 miles)
Sunday, Oct. 3, 9:00 a.m.
Stanford Stadium, $10.00

CHINOOK CUM SCIROCCO

A new wind blows on Sand Hill Road.
It seems to blow from SLAC.
It's warm, it's clean, it seems to blow
Through minds and hearts. Around and back

It blows a song of lightbulbs burning,
Data sharing, sense returning,
Question asking, problem solving,
Purpose forming, will resolving.

"Satyagraha," the young folk whisper,
"Make it right, and all can win.
We will, you know. We must, you know,
So listen. Watch. Then help--and GRIN!"

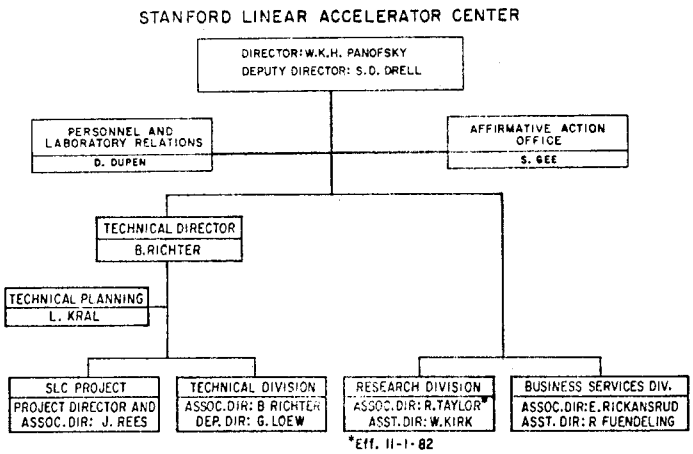
-Mark Barnett

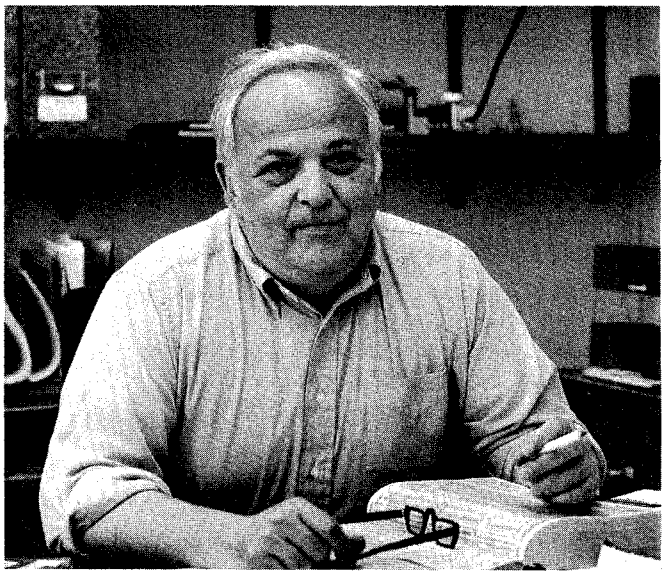
LABORATORY REORGANIZATION--PART 2

(The following is excerpted from a memorandum to all SLAC staff from the lab Director, W.K.H. Panofsky.)

In an earlier memorandum I informed the SLAC staff about the impending retirements of Dick Neal and Joe Ballam as Associate Directors of the Technical Division and Research Division respectively. Burton Richter has now assumed his new position as Technical Director for the laboratory and the position of Associate Director, Technical Division.

Richard Taylor will assume the post of Associate Director, Research Division, starting November 1, 1982.

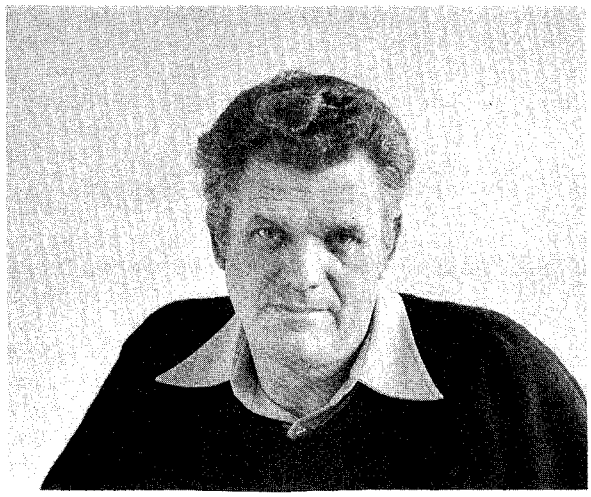




The SLC project, under the direction of John Rees as Project Director, has been formally activated as of August 16, 1982.

Within the Technical Division Ewan Patterson will serve as Department Head of the new Operations Department. Matt Allen has been appointed as Head of the expanded Accelerator Physics Department for a period of two years. Gerry Konrad will head the combined Klystron-Vacuum Department and Norm Dean will be his Deputy. The Technical Planning Department under Larry Kral will report to the Technical Director as a staff function. Owing to the shortage of time, not all organizational decisions have as yet been made.
(The remaining decisions and the organization of the SLC Project will be reported in a future issue.)

Technical Director Burton Richter is shown at bottom left, with Associate Directors John Rees and Richard Taylor at top right and bottom right.



NEW MACHINES FOR THE US--THE LONG VIEW

Nearly 150 physicists met in Snowmass, Colorado for three weeks this past June to discuss the long range plans for new machines for high energy physics. The workshop was organized by the Division of Particles and Fields of the American Physical Society with strong participation by the accelerator user groups.

Discussion groups were set up around a matrix whose rows were the questions of science (such as the Standard Model of the electro-weak interaction) and whose columns were the questions of technique (such as colliders and fixed target machines). Each participant worked in one row and one column group.

One result of this organization was that the electron-positron colliding beam machines emerged as the dominant technique for making quantitative measurements on the Standard Model with its three generations of leptons and quarks and the triplet of bosons of W^+ Z° W^- at about 100 GeV. This is well known to people at SLAC, but the unanimity of the conclusion was a surprise.

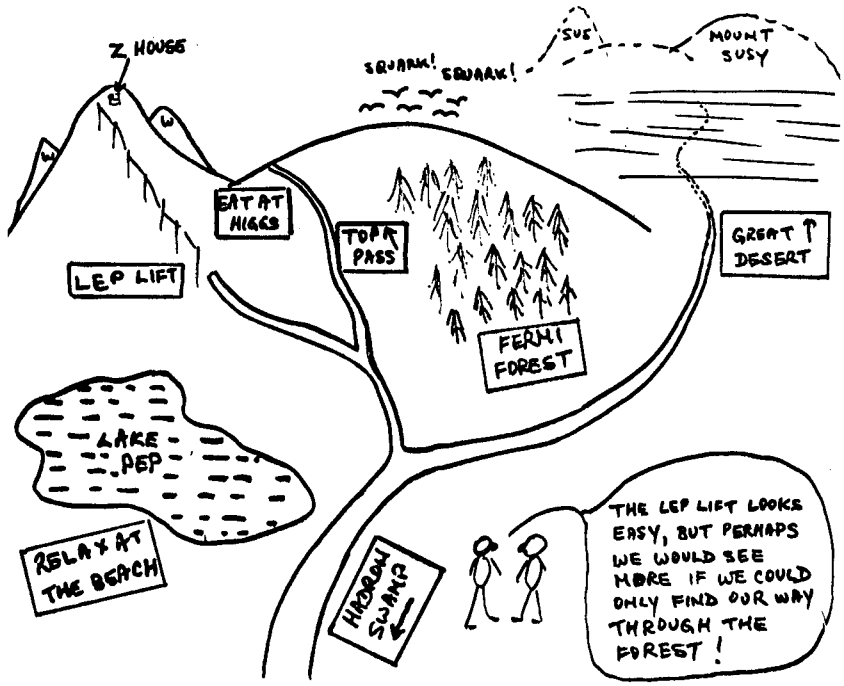
Quantitative measurements could also be made by a colliding electron-protron machine to continue the deep inelastic scattering program which was initiated by the several experiments at SLAC using the electron beam on a hydrogen target. These experiments would be difficult and would require a dedicated facility.

Very few of the experiments that can be done on the hadron-hadron colliders can be interpreted quantitatively, and such machines are not too useful in probing the standard model beyond finding the bosons themselves. The W bosons will probably be seen at CERN's $p\bar{p}$ collider in the next year or two.

Hadron colliders are most likely to provide the highest energies available in collisions. It is true that the advantage in beam energy in such machines is somewhat degraded because the energy must be shared among the constituents of the hadrons: the typical quark or gluon only carries about 20% of the momentum. Since the energies of hadron collider beams are more than five times larger than those of electron colliders, however, the net energy is higher in the hadron collider. Higher energies are important because the Standard Model is still incomplete; theorists guess that new things may show up at energies of 1 TeV. The only way to explore that region at reasonable cost now would be with a hadron collider with 2 TeV beams.

New sites will probably be necessary for the machines of the 21st century. The rings will be tens of miles across and linear colliders will be of similar size. Talk about machines of that size and cost brings home the need for new accelerator ideas if our march of increasing energy is to continue.

--Malcolm Derrick



Some of the points pondered at the Snowmass conference are illustrated in this cartoon by Malcolm Derrick. The Z° and W peaks are clearly visible. Mount Susy, super symmetry, commands a view of the desert of no particles (maybe). A note about that lake: Derrick and his collaborators installed the HRS detector on the shores of PEP one year ago and now have running a facility with the best momentum resolution of any storage ring detector in the world. They must be relaxing at some other beach.

NEWS & EVENTS...

SLAC FOOT RACE

First call for the 11th annual SLAC Foot Race on Thursday noon, December 2nd. Start training now. The 3.8 mile course runs up and back along the north side of the Klystron Gallery.

REMEMBER: Winning is not important, but there will be prizes for the winners. Participation *is* important, and there will be ribbons for all finishers. Dehydration *is* important, and there will be foamy and frosty drinks for all finishers. Hoopla is not important but there will be SLAC RACE T-SHIRTS on sale.

CHINESE LUNCHEON

A delicious Chinese luncheon was enjoyed under the oaks and in the warm sun on the Cafeteria patio on Friday, Sept. 10th by 250 SLAC gourmets.

The mushroom soup was rich, the Mongolian chicken was spicy, the ribs meaty, the scallion cakes subtle, the pudding soothing, and the Chinese beer zesty.

Dave Tsang led associate cooks Yin Yan, Lucy Cheung, Betty Jane Ferandin, Yan Wu-guang, T.V. Huang, Jou Ju-cheng and members of the BEPC Design Group in preparing this gourmet feast.

This was the second in a series of international gourmet luncheons. Call Joyce Marshall or Cecily Joost, x3111, for information about future feasts.

STRIKE SETTLEMENT

Stanford University and Local 715 of the Service Employees International Union reached a settlement on Saturday, October 9. The union had been on strike since noon Friday, September 10. About 480 SLAC workers are in the bargaining unit represented by the union and the SLAC main entrance was one of several places picketed during the strike.

WANT ADS..

FIREWOOD For Sale: Madrone, Oak, Manzanita, Fir or Pine--Split to Order. $165/cord. Good honest wood. Call Bob, SLAC ext. 2300.

BOOKMOBILE

Starting in October the Bookmobile day at SLAC will be changed to Thursday. The location will still be behind the Test Lab Building. The schedule for the rest of the year:

Oct. 7	Nov. 18
Oct. 21	Dec. 2
Nov. 4	Dec. 16
Dec. 30	

BASEBALL HONORS

After suffering a tough first half, the SLAC ATTACK softball team clinched an overall third place in the B-1 league due to outstanding performances from every team member.

Rod Harrison was selected Most Valuable Player from nominees Rob Fritts, Jim Minich and Gus Stevenson. Rod (on the right) is shown receiving his trophy from manager, Nate Peairs.

We thank all of our fans for their enthusiastic support during this successful season.

-Nate Peairs

(NEWS AND EVENTS continued on Page 5)

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