Volume 6, Number 7 *July 1975*

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From The Editor

Writing this little editorial is just about the last job we have to do before taking off on a several-week swing through the west, from here to Grand Canyon to Yellowstone and back. It's a trip we've always wanted to get around to sometime before the kids grew up, and by Jupiter this is the year that it's finally going to happen.

Our crew put out the first of the issues in the new *Beam Line* series in August 1974, and since that time we've generated 16 issues including a few specials. The early issues were rather skinny looking, but people from all parts of SLAC helped us work up a head of steam by sending in a growing stream of interesting material. (The 8-pager you're holding is just the pre-vacation, big-Symposium, ain't-no-new-psi blues.) So please keep the stories and ideas for stories coming in. The mix we've had during our first year or so of *Beam Lines* is probably about 40% SLAC people news, 40% SLAC thing information, and about 20% you name it. We find that mix enjoyable and easy to work with, and we plan to keep on truckin' with it as long as the stuff keeps coming in. But not for the next 17 days, because we're gone, man.

--Bill Kirk

MAJOR EXPANSION OF FACILITIES FOR SSRP

The National Science Foundation has recently funded a second main beam line and a general expansion of laboratory facilities for the Stanford Synchrotron Radiation Project (SSRP), located next to the SPEAR storage ring at SLAC. (For a general description of SSRP, see the January 1975 issue of the *Beam Line*.) In anticipation of this additional funding, planning has been under way for several months by SSRP staff and by others at SLAC. Bill Savage of Plant Engineering has worked out plans for expansion of the SSRP building, and Joe Jurow of Mechanical Engineering has been working on the design of the new SPEAR exit chamber.

The new work will begin in earnest when SPEAR shuts down on July 14. Additions to the building and modifications to the SPEAR shielding are planned for the summer shutdown period. The new main beam line to SSRP should be operational early in 1976, and it is expected to provide much-needed relief to the congestion that has built up around the present SSRP facilities.

SSRP recently hosted a beer-and-hamburger luncheon to celebrate the funding approval for these facility expansions. About 70 guests from SLAC, the Hansen Laboratories, other parts of the University and outside participated. The award for the most distant traveller to this event went to visiting Soviet scientist Sergei Kapitza who happened to be at SLAC at the time. Kapitza has been visiting synchrotron radiation laboratories in the U.S. and in Canada, and consulting with others interested in this field of research, in preparation for the construction of a storage ring that will be used exclusively for synchrotron-radiation research in the Soviet Union.

At the present time, SSRP has only one main beam line, which is split into five separate ports that can handle five simultaneous users. On some of these ports, the demand far exceeds the available beam time--even with the extended running schedule of SPEAR. With the second main beam line that is now funded, SSRP will be able to accomodate 10 to 14 simultaneous users.

The most sought-after facility at SSRP continues to be that used for *Extended X-Ray Absorption Fine Structure (EXAFS)* studies. This technique makes possible detailed studies of the local atomic environment surrounding specific elemental constituents of complex materials. More than 20 chemists and biologists, as well as physicists, are presently competing for their small share of running time of this particular port. Brian Kinkaid, who played a major role in the development of the *EXAFS* facility, has just received his Ph.D. from Stanford for his research at SSRP--the first of what should be many Ph.D. theses based on SSRP work.

--Herm Winick

MERLE FLOWERS LEAVES SLAC

Merle Flowers is leaving SLAC after almost nine years of employment here. He had hoped to stay on for at least another year, but his wife's doctor recommended that they move out of this area for the sake of her health.

Merle started at SLAC in February 1967 as a maintenance assistant in the Mechanical Utilities Group, but after several months he transferred to the Liquid Hydrogen Target Group in EFD, where he has been ever since. His work in building and testing target systems, and in servicing them during operation, has been much appreciated by the experimental groups who have used the devices in their research.

Merle and his wife are planning to move to Meadow Vista, near Auburn, where Merle will have a chance to relax and go fishing for as long as he can stand it. After that we wouldn't be surprised to hear that Merle has put his excellent skills back to work on some interesting job.

Merle's many friends at SLAC wish him all the best. He will definitely be missed.

--Herb Weidner

SUMMER VISITORS AT SLAC

There will be many new faces around SLAC this summer. The younger faces will include students who are working and studying here as part of the Summer Science Program, those participating in the Youth Opportunity Program, and those who are simply working here on summer jobs with various groups. In addition to students, we are also expecting a large influx of visiting scientists, particularly during the periods of the annual Summer Institute on Particle Physics (July 21-31) and the International Symposium on Lepton and Photon Interactions at High Energies (August 21-27). Even without the Summer Institute and the Symposium, this year's crop of visiting physicists would have been substantial, since an unusually large number of theorists have made arrangements to spend anywhere from a few days to two months working at SLAC during the period from late June to early September.

In order to provide some sort of working space for our visitors, it seems likely that we will try to arrange for some temporary spaces in various buildings around the site in addition to the usual Central Lab log jam. This may lead to a certain amount of confusion for those visitors who are new to SLAC, so anything that the SLAC old-timers can do to be helpful to the newcomers will be much appreciated.

--Bill Kirk

A naturalist would scarce expect to see ye science of those colours become mathematicall, and yet I dare affirm that there is as much certainty in it as in any other part of Opticks.
--Isaac Newton

MORE ON ELECTRICAL "LOAD-SHEDDING"

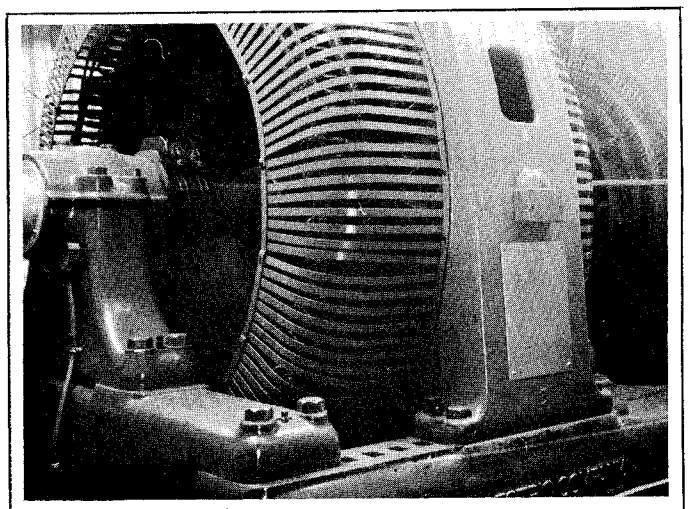
In an article in the November 1974 *Beam Line* ("Electrical Load-Shedding at SLAC") we explained why occasional load-shedding has been necessary at SLAC, and we also described the various factors that help us to determine when such a power reduction is required. Briefly, SLAC receives the major portion of its electrical power from the U. S. Bureau of Reclamation (BuRec) at very favorable rates, and (usually) a smaller portion from the Pacific Gas & Electric Company at considerably higher rates. The BuRec power comes in two categories: (1) a firm power allocation of 25 megawatts; (2) a withdrawable power allocation, presently 12.6 megawatts (MW). As discussed in the earlier article, the demands of BuRec's customers are increasing faster than the available supply, and for this reason BuRec has established a ground rule whereby the withdrawable portion of a customer's power will be reduced under certain heavy electrical loading conditions. As applied to SLAC the BuRec ground rule is as follows:

> If SLAC's peak power demand exceeds our firm allocation of 25 MW at the same time as the total demand upon the BuRec system exceeds their maximum capacity (925 MW), then on *each* such occasion BuRec may elect to reduce SLAC's allocation of withdrawable power, on a *permanent* basis, by an amount that BuRec may unilaterally determine.

Since it is greatly to SLAC's financial advantage to preserve the withdrawable portion of BuRec power for as long as possible, we have tried very hard to live within the restrictions implied by the above rule whenever it is applicable. As a result, SLAC has voluntarily initiated eight separate "brown-outs" during late May and the first half of June of this year. On each of these occasions, we have reduced the pulse repetition rate of the accelerator from 180 to 60 pulses per second, and we have also turned off most of the large power-consuming research devices for a few hours in order to reduce the total laboratory load to a level below 25 MW during the critical peak demand periods. It is likely that more occasions of this kind will occur during the remainder of the running cycle that ends on July 14. By the time the next running cycle starts, on September 29, we expect that the generally cooler prevailing weather will make further brown-outs unnecessary, at least until the holiday-lighting season starts around mid-December.

"Brown-outs" are undoubtedly inconvenient to many people at SLAC, especially to experimenters who are trying to carry out their research work. But we hope the fact that SLAC's annual power bill is about $240,000 less than it otherwise would be as a result of the continuing availability of the withdrawable portion of BuRec power provides adequate compensation for these inconveniences in the form of additional accelerator operating hours and expanded research opportunities.

--Dick Neal & Alex Tseng



--Photo by C. A. "Slim" Harris

Not all of the large power supplies in use at SLAC are examples of "modern electronics." The machine shown in this photograph was built in 1922 and is one of two similar large motor-generator sets which SLAC purchased in 1968. Each of these units is capable of supplying 5000 amperes at 300 volts. Since the noise level in the vicinity of these machines is about 105 decibels, those working close by are not necessarily all that unhappy when a "brown-out" causes them to be shut down for awhile.

NEUTRINOS

Neutrinos they are very small.
They have no charge; they have no mass;
They do not interact at all.
To them the earth is just a silly ball
Through which they simply pass;
Like dust maids down a drafty hall,
Or photons through a pane of glass.
They scorn the most impenetrable wall,
Impregnate steel and sounding brass,
Insult the stallion in his stall;
And ignoring barriers of class
Infiltrate you and me. At night they enter
at Nepal
And pierce the lover and his lass
From underneath the bed. You call
It wonderful. I call it crass.

--John Updike
The New Yorker

SEPTEMBER OPENINGS FOR THE STP

An annual, though subdued, event at SLAC is the recruiting of new students for the Skills Training Program (STP) and the Alternate Cooperative Education program (ACE). These programs are a part of the Affirmative Action policy of SLAC whereby disadvantaged students take classes at Foothill College while receiving on-the-job training (OJT) at SLAC.

The first and historically older training program, STP, is a three-year program in which each student takes only one college course every quarter (to a maximum of 11 study hours per week). The rest of the work week is devoted to OJT. By the end of the training period, the student will have satisfied most of the technical courses required for an AA degree, but none of the other requirements (except for those gluttons for punishment who take night courses). The second and newer program, ACE, is a two-year program in which a student from Foothill alternates full-time school and full-time work on a quarterly or semi-annual basis, being paid by the college (under contract with SLAC) only for the working quarters. For those who have difficulty with this higher mathematics, this schedule averages out to a half-pay program.

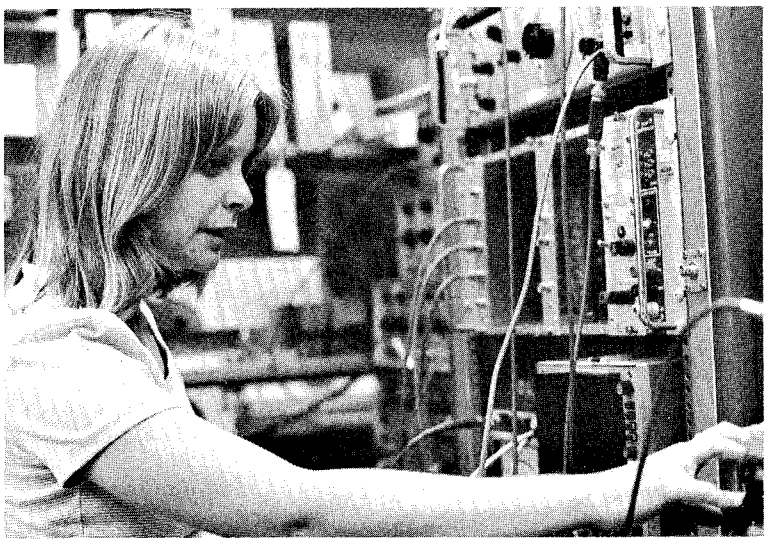
At the end of the two-year training period in the ACE program, the student will have completed all of the techical, and most of the other, requirements for the AA degree. The two-year, half-pay program is primarily for non-SLAC employees, although it is offered as an option to SLAC employees who may be interested.

At the present time, the STP is focusing mainly of the field of electronics because this is the area where the greatest demand and a healthy turnover exist. Other fields will be considered if an immediate SLAC need can be demonstrated. The Foothill College courses in electronics are strongly mathematical, so only those who have some interest in electronics and at least an average aptitude in mathematics should attempt them. The courses are E51-M71, E52-M72, E53, E54 and E58 (E=electronics, M=math). The OJT begins in the electronics assembly shop at SLAC, where good soldering and manual skills are learned. The student then progresses to the electronics development area for training in the use of electronics test equipment and high-speed electronics techniques.

Classes begin in September, so new students must be selected by about mid-summer. Those who may be interested in this program should begin preparation for the simple math proficiency exam that will be given sometime in July. "Proficiency" means being able to work with negative numbers, and to convert fractions into decimals. Sample problems are available for the asking. If interested but rusty, some tutoring help can be arranged before exam time.

According to Stanford, "disadvantaged persons" include females as well as ethnic minorities, so the program should find some interest among women at SLAC. Anyone interested enough to want further information should contact either Ted Jenkins (x2345) or Gerry Renner (x2351) fairly quickly.

--Ted Jenkins



--Photo by Ted Jenkins

Barbara Elder is a Foothill College student who is presently participating in the Alternate Cooperative Education (ACE) program. She had completed the E51-M71 and E52-M72 courses at Foothill, and also one quarter of on-the-job training at SLAC. Barbara plans to return to Foothill for further electronics courses in October, after having worked this summer with Gene Cisneros in the Electronics Development Shop. She has been learning high-speed electronics at SLAC.

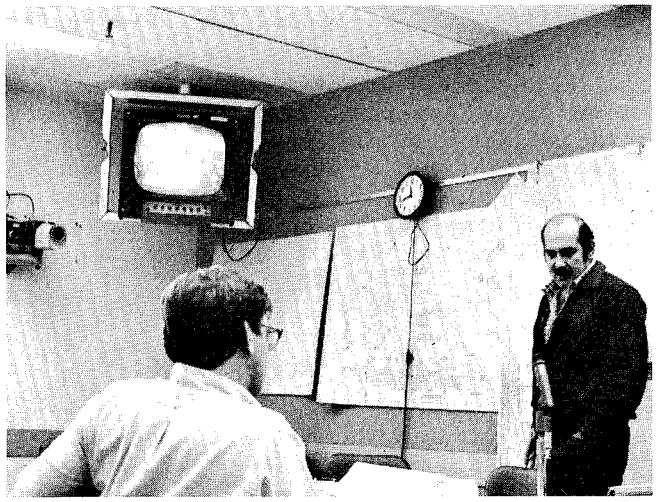
SLAC-LBL VIDEO/AUDIO LINK

We have recently put into operation between SLAC and the Lawrence Berkeley Laboratory a microwave video/audio link. The system is used by the PEP groups at Berkeley and at SLAC as an energy- and time-saving device which eliminates the need for much of the back-and-forth automobile travel. The system connects one of the conference rooms in Berkeley with the PEP conference room in the SLAC A&E Building, and it provides simultaneous pictures and sound for the groups assembled in the two rooms.

The system is used almost daily by small groups at Berkeley and at SLAC. The first general PEP meeting using the link was held in late March, with about 12 to 15 people present at each end. The system has provisions for televising a chalkboard at each end as well as the assembled people.

The antenna for the SLAC end of the system is a six-foot parabolic dish installed on the roof at the southeast corner of the A&E Bldg. The line-of-sight signal path to Berkeley is slightly less than 32 miles long and crosses the approach to the San Francisco Airport and the end of a runway at the Oakland Airport. The microwave beam passes across the bay at an elevation of 400 to 600 feet, rising to its Berkeley terminus in Building 50B.

The equipment at each end of the system has been designed to operate in a "hands-off" manner, so that those participating in the meeting need not be concerned with frequent adjustments of either the video or audio signals. At present, one video and one audio signal is transmitted in each direction, but the micowave system has sufficient capacity to add more audio, video or computer-data channels in the future if desired.



--Photo by Bob Bell

John Voss of SLAC (left) and Tom Elioff of LBL are shown in the PEP conference room in SLAC's A&E Bldg. The group assembled in the Bldg. 50B conference room in Berkeley is shown on the TV screen. This combined video/audio microwave link between the two laboratories has resulted in a considerable saving of time and effort in coordinating the activities of the PEP groups at SLAC and at LBL.

We are working on better methods of sending and receiving pictures of drawings and schematics at the present time. A Xerox 410 telecopier now being tested appears to be quite suitable for many of our graphic needs for the immediate future.

--W. C. Struven

Rutherford discovered the nucleus [and published the discovery] in 1911. . . . One might have expected that it would create a stir in the world of physics. But in a recent lecture E. N. daC. Andrade said of this event: "At the time, I was working in Lenard's laboratory in Heidelberg, a very active center of research in electronic physics. I have no recollection of any attention aroused by Rutherford's atom." In 1913 Rutherford published a book, *Radioactive Substances and Their Radiations*, in which the structure of the atom, consisting of a nucleus with surrounding electrons, was for the first time clearly spelled out. This book was reviewed in *Nature* by Lord Rayleigh, surely as broad-minded and versatile a physicist as one could find. The review does not mention the subject of atomic structure.

--Freeman J. Dyson
Scientific American
September 1958

SUMMER CHARTER FLIGHTS AVAILABLE

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Sep. 25	New York to San Francisco	$95
Aug. 19 (Round trip) Sep. 15	Oakland - Paris	$450

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NATIONAL ENERGY RD & D PLAN OUTLINES PRIORITIES AND CALLS FOR MAJOR CHANGES

[ERDA News Release]

The Energy Research and Development Agency (ERDA) today [June 30] submitted to Congress a national energy research, development and demonstration plan that outlines priorities for the development of U.S. energy resources and reflects ERDA's determination that five major changes are needed in the nature and scope of the nation's RD&D program.

Dr. Robert C. Seamans, Jr., ERDA Administrator, said: "We have a serious and continuing energy problem in this country. Our problem now is that we are limited in our choices. More than 75% of our energy comes from oil and gas--a dwindling resource. About 20% of our energy is imported.

"The United States must shift to new primary forms of energy. Twice before it has happened: from wood to coal in the 19th century, and to oil and gas in this century. Each time it took about 60 years to reach maximum use. We cannot afford to take another 60 years to accomplish the changeover we need now."

The national plan establishes priorities for three time periods--the near-term to 1985, the mid-term from 1985 to 2000, and the long-term after 2000.

To carry out the program, the plan calls for five changes which must be made rapidly and simultaneously in the nature and scope of the nation's energy research, development and demonstration program. The changes consist of:

--Giving emphasis to overcoming the technical problems inhibiting expansion of current major energy sources, notably coal plants and light-water nuclear reactors.

--Focusing immediately on energy conservation efforts: extending the technology, improving capabilities, demonstrating feasibility of methods and widely disseminating the results. The primary targets are automotive transportation, buildings and industrial processes.

--Accelerating commercial capability to extract gaseous and liquid fuels from coal and oil shale to gain needed experience with large-scale synthetic fuel production.

--Including the solar electric approach as a high priority among the virtually inexhaustible energy resources of the future, joining fusion and the breeder reactor in this category.

--Increasing the attention on underused new technologies that can be rapidly developed, principally solar heating and cooling and the use of geothermal power.

ERDA's task is to provide the research, development and demonstration efforts to assure the best use of the energy sources now available and to stimulate the promising new primary energy options.

"Implementation of the national plan will require coordination and cooperation among all sectors of society," Dr. Seamans said. "We will work closely with state and local governments and with other federal agencies that have responsibilities for energy-related programs. Academic institutions will be called upon to provide expertise and experience in research and training efforts. And, there will be a strong interaction with private industry which ultimately will be responsible for integrating new energy technologies into society."

For the long-term (2000 and beyond), the plan calls for vigorous pursuit of three essentially inexhaustible resources--solar power, fusion power, and the breeder reactor.

However, while these long-term priorities are being pushed, energy options must be expanded in the near- and mid-term in order to meet demands throughout the remainder of this century.

In the near-term, until 1985, the plan places priority on expansion of existing major energy systems: coal, nuclear (light-water-cooled reactor) and gas and oil, both from new sources and from enhanced recovery techniques in existing fields.

Conservation is stressed throughout the ERDA report, with an especially significant impact in the near-term using known techniques to increase efficiency in all aspects of energy use.

In the mid-term, 1985 to 2000, the plan places priority on accelerated development of new processes to produce synthetic fuels from coal, to extract oil from shale, and to increase the use of such underused fuel forms as solar heating and cooling and geothermal energy, as well as more energy from waste heat.

Although all three of the long-range options are under development, none is now ready or assured of large-scale use in the future. Each could contribute energy before the year 2000 but the major contributions would come in the 21st century. Each also has unresolved technical, economic, environmental or social questions. . .

The national energy RD&D plan stresses that in order to deal effectively with the serious and continuing energy problem in this country, the task of creating choices for the future must be addressed now on an urgent basis. The nation's RD&D activities must be designed to shorten the changeover time to new forms of fuel and not only must new choices be developed for the future but care must be taken to avoid overemphasis of single approaches that might tend to foreclose other options. The nation's economy, national security, and ability to determine life-style are all dependent upon these efforts.

THE CURRENT STATE OF PARTICLE PHYSICS

[Reprinted from *New Scientist*, 27 February 1975]

Steven Weinberg in 1967 and Abdus Salam in 1968 created a unified "gauge theory" of the weak and electromagnetic interaction. Theirs and similar gauge theories are one of the main causes of excitement in 1970's particle physics. Here Weinberg, Higgins Professor of Physics at Harvard, explains why there's still no complete theory of the particles.

There is indeed no complete theory of elementary particles available yet. In my view, the difficulties that have plagued us stem from the nature of the task we have set ourselves: to understand the laws of nature on the most fundamental level. This has forced us to turn our attention to phenomena which are inexpressibly remote from everyday life--there are some sixteen orders of magnitude separating the size of an elementary particle from the size of a man. This remoteness in turn makes extraordinary demands both on the physical resources of the experimentalists and the imagination of the theorists.

EXPERIMENT

Our experimental problems are easy to understand. For many years we had to make do with just those particles that happen to exist copiously in nature--electrons, protons, neutrons and photons. Only gradually did it become clear that the ubiquity of these particular particles is an accident, having mostly to do with their long lifetime. In order to get an unbiased view of the laws of nature we have to study other particles which have to be made in the laboratory. *It is as if we tried to do zoology, but found that the only animals available for study in nature were the tortoise and the parrot, and we had to make the others ourselves.* Further, we know of no way of making these particles, and of studying their interactions at a sufficiently fine distance scale, that does not require the construction of enormously expensive accelerators.

IMAGINATION

The problem of imagination is perhaps even more serious. The scale of the elementary particles is so small that they must be described in quantum-mechanical terms, so that ordinary classical concepts, such as force, size, shape, and even composition, lose most of their meaning. For instance, many of us now believe that some of the so-called elementray particles are in some sense composed of more elementary constituents called quarks and gluons, but that the quarks and gluons can never even in principle be extracted from the observed particles.

SYMMETRY

The one guiding principle, that seems to be able to replace our ordinary physical intuition, is that of symmetry. Everywhere we look the answer to our questions of why things are the way they are seems to be that they are forced to be that way by a set of symmetry principles. Among these are the familiar exact symmetries of space-time--translational, rotational, and Lorentz invariance. Many others seem to refer to internal degrees of freedom unrelated to space-time structure, such as the exact symmetry between particles and antiparticles, and the so-called "gauge invariance" of electrodynamics. But most of the known symmetries are much less apparent, because they do not seem to be exactly realized by physical states. For instance, in 1957 physicists made the traumatic discovery that one of the supposedly sacred symmetries of space-time, the symmetry under interchange of right- and left-handed coordinate systems, is respected by the strong and electromagnetic interactions but not by the weak interactions. Even earlier, it had been observed that the masses of the proton and neutron are so close that there must be some symmetry between them (now known as isotopic spin invariance) and yet their masses are not exactly equal.

BROKEN SYMMETRY

Increasingly, it is believed that the symmetries of nature are in fact exact, but they are symmetries of the underlying field equations, and are not obeyed by the solutions to these equations. Thus, in order to understand the guiding principles of elementary particle physics, we have to make extremely indirect inferences of what these symmetries are, rather than reading them directly off from tables of elementary particle properties. In this way we have come to the tentative conclusion that there is an exact symmetry relating the weak and electromagnetic and perhaps even the strong interactions, but that this symmetry is spontaneously broken and therefore thoroughly obscured in most experimental data. *There is a growing feeling at least among some phsyicists that despite all the practical and conceptual difficulties we face, the pieces are at last beginning to fall into place.*

--Steven Weinberg

. . . Charged-particle beam systems propel electrons and protons at velocities approaching the speed of light with expanding energy levels during transmission. This technology may also be exploited for use in ABM kill mechanisms, some observers of the Soviets said, but evidence in this area is still sketchy in comparison to laser developments.

The U.S. is pursuing similar charged-particle beam technology with development in Stanford University's linear accelerator.

Aviation Week & Space Technology
April 21, 1975

Not so's you'd hardly notice, Dummy.

PEP PASSES HOUSE

Near the end of June we learned that the ERDA authorization and appropriations bills, which include a $2.9 million dollar appropriation in Fiscal Year 1976 for the PEP project, had been passed by the full House of Representatives. The Senate has not yet acted upon these bills. If the Senate does approve the bills, it may be that a House-Senate conference commitee will be convened to iron out any differences in funding levels that may exist between the House and Senate versions. This process would likely take until mid- or late August. If PEP were to progress that far, the next step after full Congressional approval would be for the ERDA bill to go to the White House for the President's signature.

What this means is that the joint SLAC-LBL proposal for PEP authorization in FY 1976 has gone a lot farther toward approval than seemed likely a few months ago. In fact, there now seems a very good chance that PEP will actually get started by the early fall.

--Bill Kirk

In Gregory's *Inorganic Chemistry*--the most recent work on the subject published in our country--we find that there are now 61 simple substances (elements) known to chemists, and of these 14 constitute the great mass of the earth and the atmosphere; the remainder occur only in small quantities, and some are very rare.

--*Scientific American*, Nov. 1856

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ECFA URGES EUROPEAN e^+e^- RING

[*Reprinted from The June 1975 CERN COURIER*]

At a Plenary Meeting on 6 June, ECFA, the European Committee for Future Activities (European Committee for Future Accelerators that was), passed a resolution in support of the construction of a higher energy electron-positron ring in Europe. ECFA is representative of the full high energy physics community in Europe and reflects the concern of the community to have world class research facilities for electron physics, in addition to the research facilities for proton physics which are concentrated at CERN.

The statement reads--

'The European Committee for Future Activities, ECFA, considers that

i) electron-positron storage rings with centre of mass energy above 20 GeV would be an extremely valuable addition to the European high energy physics facilities, complementing present proton accelerators and national electron-positron facilities at lower energies,

ii) it is of primary importance that such a project is realized with a minimum of delay,

iii) the exploitation of the storage rings should be open to the European scientific community,

iv) there should be no duplication of similar accelerators within Europe.

In view of these considerations ECFA will, if the Laboratories concerned agree, set up a working group to study and make recommendations about the international exploitation of an electron-positron storage ring facility.'

As mentioned above in reporting work at DESY, there are two projects--PETRA and EPIC--under discussion in Europe. The concern for an early start on construction of one of these machines, reflected in the ECFA statement, is related to the existence of the equivalent project, PEP, at Berkeley/Stanford in the USA. The new particle discoveries, in particular, hold out the tantalising prospect that the first of these machines to come into operation could cream off some spectacular physics.

> . . . In this respect EPIC stage 1 is similar to the US machine SPEAR at Stanford, California, which has produced such fundamental and sensational results in the past year (including the psi particles), and has undoubtedly had the most brilliant debut of any high energy facility yet constructed. . . .
>
> --Dr. Wilbur Venus
> *New Scientist*, 8 May 1975

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