SLAC NEWS

VOL.1, NO. 4 — STANFORD LINEAR ACCELERATOR CENTER — JUNE 11, 1970

JACK GOAD

First Slac Retiree

By Ruth Paya

Jack Goad, long-time employee in Manufacturing and Fabrication's Light Machine Shop, retired from SLAC on the 28th day of May. On that date, a luncheon honoring the event, and incidentally Jack's 65th birthday, was held by MFS Shops at the Red Cottage Restaurant in Menlo Park.

Mr. Goad had worked as a machinist and tool and die maker for the past fifty years. He is originally fom Arkansas but in 1920 he made his way to the West Coast where he became an apprentice machinist. His salary, he recalls, was $10.44 a week — with the promise of a four cents an hour raise every six months.

During these fifty productive years, Jack Goad held several interesting jobs, one of which was with the International Totalizer Company. This firm manufactured and distributed mechanical equipment used by race tracks — tote boards, time clocks and ticket machines. For eight years Jack was Service Manager for the firm visiting field installations at tracks (for both dog and horse racing) in Oregon, Colorado and Arizona. During World War II, the company converted temporarily to the production of precision tools and equipment for the defense effort.

Jack remembers his years with this company very fondly, but he also worked at some firms in the immediate Peninsula area. He spent fifteen years as a shop foreman and manager in the Bay Area automotive industry as well as eight years of supervising at Dalmo-Victor and five more at Philco-Ford as a supervisor before coming to SLAC. He was in his eighth year with Stanford.

Jack has been, by his own proud statement, "happily married for 42 years" — an enviable record. He has two grown sons, both married and both sergeants in law enforcement. One is with the San Mateo County Sheriff's office and the other with the San Francisco Police Department. Both sons were the youngest men ever to be appointed to sergeant in their respective jobs. Jack's family also includes three granddaughters.

Over the years Jack has done his share of community service. He is a member of the Masonic Lodge and did his stint as a cub master with the Boy Scouts. He also served as a Red Cross First Aid Instructor for many years for local groups of Boy Scouts and the Police Department.

Almong his favorite sports he includes hunting and fishing. He hopes, upon retirement, to indulge in these more often. He and his wife (who retires from Lenkurt Electric next month) plan to move to a place they own in Grass Valley.

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'Project Leapfrog' Off The Ground

In keeping with its policy of innovating for the future, SLAC has been investigating the possibility of building a 100 billion electron volt (100 Gev) superconducting accelerator. This project, which would cost roughly 66 to 78 million 1969 dollars and require seven years after technical feasibility had been established for completion, could enhance SLAC's experimental capability in a number of ways. The increased energy would open up new areas of investigation using electron and photon beams and beams of secondary particles (pi mesons, K mesons, etc.). The hoped-for capability of the new machine to accelerate electrons continuously at 25 Gev (100% duty cycle) and to a 6% duty cycle at 100 Gev is another significant advance when these numbers are compared to the current duty cycle of less than 0.06%. (Duty cycle is the percentage of the time beam is being accelerated.)

The fundamental "pencil and paper" investigations going on over the past year and a half are now being augmented by a "brute force" project to build a 50 centimeter (20 inch) superconducting accelerator capable of producing a 17 million electron volt (MeV) electron beam. This endeavor is called "Project Leapfrog," since the idea is to "leap over" a systematic and thorough investigation of the properties of superconducting niobium and of engineering and fabrication problems and to proceed directly to the construction of an operating device.

Stage I of the project involves construction of the unit without an electron beam. This will occupy most of calendar year 1970. Stage II is operation with beam. This stage will occupy roughly the first nine months of 1971.

Why use superconductivity to increase energy? What is superconductivity? To answer the second question first, superconductivity is the phenomenon whereby certain metals lose all their resistance to the flow of electricity when they've been cooled to within a few degrees of the absolute zero of temperature (-460°F). It is this property of superconductors which answers the first question: If less power is lost to the electrical resistance in the walls of an accelerator, instead of pulsing the accelerator it's then possible to leave the power on continuously and hence to accelerate electrons continuously (100% duty cycle). In addition, measurements on small niobium test cavities indicate that it may also be possible to increase the energy by a factor of 3 to 5 over that attainable with a conventional electron linac.

To illustrate, SLAC at present has resistive energy losses in its copper accelerator of millions of watts per ten-foot section. When the new accelerator is operating at 25 GeV the superconducting structure would dissipate only twelve watts per ten feet — less than one, one-hundred thousandth as much as the present SLAC structure.

The Leapfrog accelerator (and, ultimately, the 100 GeV machine) will be made out of niobium metal and supercooling will be provided by a liquid

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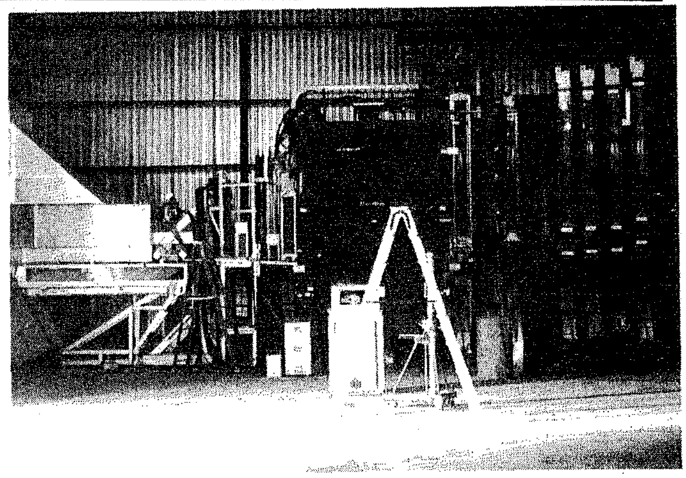

Photo of apparatus used in muon scattering experiment.

Inelastic Muon Experiment at Slac

By Steve Kociol

In last month's SLAC NEWS we outlined some properties of one of nature's most mystifying particles — the muon. This article will continue the discussion.

SLAC's Group E physicists are the local muon experts and, in the course of a far-reaching experimental program, have completed the world's first study of inelastic muon scattering from hydrogen. Inelastic scattering occurs when the incoming projectile (beam particle) imparts a significant fraction of its energy to a target particle. In this case, muons were the projectiles and protons the target. The experiment was undertaken mainly to investigate possible muon-electron differences, but other processes were also of interest.

In order to do muon physics, it's necessary to have a nice coherent beam of muons to work with. SLAC, being an electron accelerator, is able to produce intense fluxes of muons and, under the direction of M. L. Perl, Group E decided to build such a beam.

Why is SLAC much more effective in producing muons than, say, a proton machine like the one at Brookhaven National Laboratory, on Long Island? The reason is that muons aren't produced directly when a high energy proton hits a target. Instead, charged pi mesons (pions) are produced. They live about 26 billionths of a second and then decay into a muon and a neutrino. So, with a proton machine, the muon source is pion decay and since all the pions don't decay at the same point, the source may be over 150 feet long. This leads to a muon beam of large diameter, large angular spread, and large energy spread. All of this is bad, from the experimenters point of view.

But at SLAC, muons are produced directly when the electron beam goes through a 5.7-inch long copper target. This copper muon source actually produces 70% muons with 30% pion contamination. This contamination turns out not to be much of a problem since almost all of the pions can be filtered out by passing the pi-mu mixture through 18 feet of beryllium. After this filter, there is only one pion for every 300,000 muons (on the average).

In the end, the muon source appears as a one-inch diameter disc — a distinct improvement over the 150-foot long cylindrical source of the proton machine. The beam diameter, angular spread, and energy spread of particles within the beam can be kept small. All of this is good.

But there is a kicker. At the Brookhaven proton synchrotron the beam is on about 25% of the time. This amounts to about 22,000 seconds of beam per day. At SLAC there are only about 22 seconds of beam per day. (In one second of operation, an experiment may receive 180 pulses of electrons, each lasting only 1.4 millionths of a second. So the fraction of the time beam is being accelerated equals 180 times .0000014 or .025% Since there are 86,400 seconds per day, this gives 21.6 seconds of beam per day. Physicists say that SLAC has a low "duty cycle.") The result of this is that it is necessary to run 1000 times more particles (per apparatus resolving time), making life more difficult.

Several experiments besides inelastic muon scattering were carried out using this beam. Group "E" measured particle fluxes, searched for new particles and looked for quarks (with a group from HEPL). Visitors to SLAC (University of Washington) studied muon scattering from electrons.

Now that we have a beam of muons, how do we do an inelastic scattering experiment?

The apparatus which does the job is illustrated in the photograph and explanatory drawing. It is necessary to direct the muon beam into a liquid hydrogen (proton) target and then observe the way those muons which collide with protons are deflected (scattered); that is, the angle of scatter and the final energy of the scattered muon. These data allow calculations of the important results of the experiment, namely the probability that a muon will be scattered into a certain angle depending upon its energy — the so-called

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'Love' A Big Hit

On May 20 and 21, the SLAC Choral Group presented their latest production in the Auditorium. Both performances of "A Thing Called Love" were met with well-deserved cheers and applause from the audience.

Weeks of hard work and preparation were involved in these performances and the cast gave a lot of their leisure hours to the numerous rehearsals required. SLAC has many talented individuals and we are fortunate when some of them, such as the Choral Group, are willing to share their good voices and musical ability with us.

At the beginning of the show the stage was blacked out except for a spotlight directed on Charlie Hoard of ME, narrator for the show. He opened with some brief, humorous remarks about love and spring and followed with a quote from Omar Khayyam. In 800 years, the Great Tentmaker's poetry had lost none of its wit or charm. The stage was then lit up to show a background of blue sky and lacy white spring foliage; and, on stage, tables, bright-colored chairs, and potted trees and plants created the illusion of a street cafe. The members of the chorus came on stage and seated themselves about the tables while they sang "What is This Thing Called Love" — an old Cole Porter favorite. Each succeeding number was then introduced in the same manner as the first. A full black-out, narration and poetry quotes by Charlie Hoard, and then an individual solo, duet or chorus was presented. Among the songs offered by the chorus were "Love is the Sweetest Thing", "Love is Blue", and Bert Kaempfert's "L-O-V-E".

Polly Lea's solo "I Love You" against a background of men's voices was very effective; and Evelyn Barnes and Ronda Dave, singing "Love is a Many-Splendored Thing" as a duet drew heavy applause. Later, Ronda sang another duet, this time with Vernon Smith from ES — two attractive people whose voices blended very pleasantly.

Hunor for the show was supplied by Charlie Hoard's rendition of the love poetry used, and by DeeDee Mayes and Bob Laughead in a burlesqued version of the song "Temptation". DeeDee started it off by playing some heavily schmaltzy chords which she abruptly broke off by sliding along the piano bench and joining Laughead at the microphone. There, to the accompaniment of much scarf swishing by DeeDee and a good deal of cow-eyed ogling by Bob, they clowned their way through the song. At the line "You were born to be kissed...", DeeDee began an amorous attact on Bob that brought down the house.

The whole production was light-hearted and fast-paced and all the participants seemed to enjoy their show as much as the audience did. DeeDee Mayes, as producer and writer deserves particular credit. She also acted as pianist for all the numbers as well as presenting Edvard Grieg's "Ich Liebe Dich" as a piano solo. The other musicians were Frank Noga on tenor guitar and Ted Syrett on bass guitar. Additional credits: Property & Staging, Ronda Dave, ADA; Lights, Willie Johnson, EB; Scenery, (Art) George Lee, ME and (Carpentry) George Petri, PE; Posters, Susan Reupke, MED; Photography, Walter Zawojski, PUB; Publicity, Ruth Paya, MFS; and Program Cover, George Lee.

Donations for SERA, SLAC's Emergency Relief Association, were collected in the lobby, and were later presented by the Choral Group to SERA as an addition to the Association's funds.

The Choral Group will take a temporary break during the vacation months but hope to present another show in the Fall. They also plan to prepare the annual Christmas Show. Anyone who would like to participate will be given an opportunity at that time. Watch your SLAC NEWS for further announcements concerning this.

Choral Group in Finale of "A Thing Called Love."

Craft Shops' Picnic

On Saturday, June 20th, Craft Shops will have their annual picnic. This year they are holding it at the Palo Alto Elks Club which has an attractive picnic area. Located behind the club, off El Camino, there are five acres of deluxe picnic grounds with a pool for swimming also available.

The menu for the day includes steak, salads, garlic bread, corn on the cob and traditional items such as hamburgers and hot dogs. There will also be ice cream and various beverages available — all for a token price of approximately $2.00 for adults and $1.00 for children.

Don Ewings, who is in charge of arrangements, indicates that all of the Plant Engineering Group (of which Craft Shops is a part) are invited. They may bring guests if they desire, and reservations can be made by calling Craft Shops on extension 2371.

Special features of the picnic will include door prizes for both adults and children, as well as entertainment, games and prizes for all.

Want Ads

CHILD CARE: Stanford Community Children's Center extends its summer day-care program to include 5-8 yr olds, 6/15 - 9/4. Full and part-day care available. Call 327-7814 anytime.

BABY CLOTHES: Wanted to fit child 6 mo. to 2 yrs. Also, "Baby Bouncer." Call Wendy, ext. 2216; 854-6086 eves.

FOR RENT: Small, secluded cabin, ideal for recreation or retreat, Del Monte Forest, Carmel. Available $40/weekend. Call Mike Menke, ext. 2775 or 941-2093.

FOR SALE: German Shepherd puppies, black & tan, 8 weeks, large. Call John Hotchkiss, ext. 2486/2487.

READER WANTED: For visually handicapped person. Level, about Scientific American. Few hours a week, on tape or in person. Call Charles Oxley, ext. 2204.

SLAC Dictionary

ELEMENTARY PARTICLE

The next term to be defined in the SLAC dictionary is a controversial one — "elementary particle". What is an elementary particle? In what sense, if any, is it elementary? Does elementary in any sense imply fundamental?

W.K.H. Panofsky, in his chapters on "Particle Physics," (written in collaboration with Oxford theorist R.H. Dalitz and published in Nuclear Energy Today and Tomorrow) notes that the question of whether or not the "indivisible" exists was first asked by Thales of Miletus around 580 B.C. Democritus, a century later, said that reality itself is composed of many kinds of particles which are never annihilated. In 1911 Rutherford proved that atoms consist of a very small positive nucleus surrounded by negative electrons.

At present it is known that all atoms are made up of neutrons and protons, which determine the nucleus, and electrons. We might be tempted to say an electron is an elementary particle but a Uranium atom isn't, simply becuase it is made up of electrons, protons and neutrons — in a word, it is a composite structure. Likewise, molecules are groups of atoms.

But how does this relate to the well-over 100 short-lived subnuclear particles produced in accelerators or by cosmic rays which we've observed. They're certainly not atoms or molecules. The physicists Lee and Yang give this operational definition which includes subnuclear particles:

"We believe we understand what is meant by an atom, a molecule, and a nucleus. Any small particle which is not an atom, not a molecule, not a nucleus (except the hydrogen nucleus) is called an elementary particle."

This, of course, is a working definition and does not imply that there be anything fundamental about the particles.

SLAC's J.D. Bjorken thinks the Lee and Yang definition is a good one, but believes an improvement might be: "electrons, protons, neutrons, photons, and all other metastable states of matter (excluding nuclei, atoms, molecules) formed by collisions between them." This definition does away with the vague adjective "small" and incorporates the fact that particles like pions, muons, etc. are observed after being formed by collisions.

Charles Zemach of SLAC's theoretical group connects the ideas of elementary particle and fundamental understanding by noting that the explanation for their existence probably stands at the beginning of a deductive explanation of the properties of all matter. He also brings out the distinction between "non-composite" and "elementary." The so-called bootstrap theory opposes the notion that the two terms are synonomous. Very roughly, the bootstrap hypothesis considers each particle participating in the nuclear force to be a found state of all the particle states with which it can "communicate." Here, we say two different particles states communicate if they have the same values for spin, atomic number, and some other quantites, although not necessarily mass. In this scheme, a given particle is generated by lots of other particles and, in turn, helps generate them.

Zemach finally notes that even if compositeness is accepted, elementary particles can still be distinguished as having large binding energies as compared with the energies of their constituents.

All of this is discussed in the following statement by SLAC Deputy Director, Sid Drell:

"There does not exist at this time a satisfactory definition of an elementary particle in fundamental terms.

"In a purely descriptive language we say that the elementary particles are the building blocks from which all matter, living and dead, is made. At one time molecules, then atoms, then electrons, and nuclei, and more recently electrons, neutrinos, p[illegible] mesons, and protons have been candidates for these building blocks. By now so many cousins or other close relatives of the pi mesons and protons have been produced at high energy accelerators that we can do little more than group them into families that exhibit similar behaviors under similar conditions. In this way we can order the phenomena but we no longer look to each of these family members as being elementary particles. We much prefer to hope that these very large and extensive families can themselves be built up out of a few constituents ("quarks"; "Partons";?) just as all of the world's many thousands of different kinds of molecules and atoms can be constructed simply from electrons, protons and neutrons alone. The big trouble so far has been that Nature very effectively hides these constituents from us, if indeed they exist! She does this by having them interact with one another by very strong forces. Thus when we "look into an atom" we can pretty well see the electron because it is almost free. However the energies binding togethe[r] the constituents forming a proton whatever they may be, are hundreds of millions of times stronger — exceeding those binding the atomic electron just as do the energies released by hydrogen bombs exceed the energies released by sticks of TNT or chemical fires. Thus these constituents are not readily seen when we "look into a proton" because of the influence of these very strong forces and we don't know what one of them would look like if seen alone and all by itself. That is why we cannot answer at this time solely in terms of observables and with precision: "An elementary particle is...." But maybe the next experiment or the next accelerator will provide a crucial clue!"

So here we have the views of a numbe[r] of physicists on what an elementary particle is. The attempt to find this out i[s] the very reason for the existence of high energy accelerator facilities such a[s] SLAC, and provides for job security!

Distaff Club Fling

Stanford's Distaff Club, which includes a number of SLAC ladies, is having their SPRING FLING, on Friday evening, June 12th, at Holbrook-Palmer Park on Watkins Avenue in Atherton. Sara Butler of the Controller's Office is Publicity Chairman for the event, and she announces that there will be an elegant wine tasting session starting at 6:30, with an excellent dinner following at 7:30. They will have strolling musicians during the wine tasting hour and music, singing, and other entertainment during th[e] dinner.

The cost per person for the event i[s] $4.00, and the deadline for reservations i[s] immediate because of the lateness of thi[s] issue of the NEWS. Call Ruth Kaiser Women's Gym, extension 8-4895, or Sar[a] at extension 8-4195, if you are presentl[y] a Distaff member and wish to attend thi[s] function or if you would like to become [a] member of the Club and have this serve [a]s your introduction to their many activitie[s]

Slac Soccer Team Socks It To 'Em!

By Roger Coombes

In the spring of 1968 George Cruickshank of MFS, who had played professional soccer in Scotland, and Sam Stevens, then at SLAC, and an all American player at Stanford a few years before, organized some after-work soccer practices.

Soon there were enough players to make up a team and the SLAC Soccer Club was formed. The first season was very successful and the team won most of its games, including beating the Stanford Varsity Team. There was talk then of entering a team in the Peninsula Soccer League (PSL) and playing in more serious competition. This idea was dropped, however, since it was not compatible with the Soccer Club principle of enabling the largest possible number of people to participate (only 4 substitutes are allowed in PSL games). The club thus took on its present form, fielding an off-season team that is active only through the summer months. These matches are played after working hours in the evening.

Anyone associated with SLAC is welcome to join the club even if they have never played soccer before. We have practices and training sessions and during matches make frequent substitutions so that everyone has a chance to play. We play against several local teams, such as Gus Mozart, General Electric, Wilbur, Syntex, etc., with the matches generally starting at about 5:30 on the Stanford Soccer Field.

During the 1969-70 PSL season, Ernie Frei of ME and MFS, coached the Fairchild League team and three players from SLAC played on that team. This opening remains available to any SLAC players who wish to play regularly during the winter. The team tied for first place in the Third Division of the PSL but lost the play-off game. One of the players, George Cruickshank, also plays for the Scots in the San Francisco league. That team is consistently at or near the top of the first division with that league and one of the strongest teams in California.

The 1970 season got off to a bang! The first game was played on the Stanford Soccer Field on campus, as are all games, and was against the Gus Mozart team. SLAC won 6-2! Our second game was with Holt Tool and Die Company and we sequaked by them with a score of 2-1. The next game will be at 5:30 on June 10th against Syntex, and the game following that will be with a "pickup" team of Stanford noon players on June 17th, also at 5:30. Several other matches will be scheduled for the weeks following that.

If you would like to play, come and join us. Tennis shoes are fine — if you learn to kick properly (important if you have a high pain threshhold!). If you would like to watch, come and root for us; or, if you're not interested in soccer, meet us in the Oasis in Menlo Park after the game — and help us with the most important function of all!

Engineer Re-Elected

Keith W. Henderson, Accelerator Electronics, has been re-elected for a third term as a director of the National Society of Professional Engineers.

The society's Peninsula Chapter has awarded him its Member-of-the-Year certificate this year, in recognition of more than a decade of outstanding and dedicated all-around service to the engineering profession.

Keith formerly served as secretary, vice-president, and president of the chapter, and as a director of the California state society. He also founded the chapter's monthly bulletin, the PENINSULA PROFESSIONAL ENGINEER, and has served as its managing editor for more than ten years.

Diamonds Play Vital Role In Experiment

By Charles Oxley

Be they square cut or round cut, "diamonds are a girl's best friend." And in the production of high quality polarized gamma rays, using diamonds complements the use of laser beams.

With both diamonds and lasers, there is a similarity to the sound wave produced by a boy running a stick along a picket fence, the stick being a high energy electron. The pickets are the atoms regularly arranged in the diamond. Or for the laser beam, they are the wave structure of the light itself. The idea here is to produce a coherent wave of energy.

In the case of the laser beam (as discussed in the first issue of SLAC NEWS), the light is automatically of excellent quality and coherence. With diamonds, however, girl appeal or gem quality is not enough. A single crystal of very regular structure is required. After a very special search, the diamonds to be placed in our electron beam as a means of producing a photon beam were found by Roy Schwitters, Lou Osborne, Joe Leong and Dave Luckey, all of MIT. They consulted experts on diamond physics, but were not given much encouragement or guidance, so they ended up by developing criteria as they went along. For examining the perfection of uncut diamonds, they used the double x-ray spectrometer at the National Bureau of Standards. Drawing on the stock of Harry Winston, the New York diamond dealer, and sources in the Netherlands, they found two excellent diamonds. Two slices were cut from a four-carat diamond, and one from the other. Curiously enough, these very perfect single crystals are of marginal gem quality and contain some nitrogen impurity. This may have contributed to their preservation by strengthening them against geological forces.

Production of high energy photons (also called gamma or x-rays) from high energy electrons does not occur spontaneously in a vacuum, but requires acceleration of the electron. In the process known as "bremsstrahlung," (German for braking radiation), the force of acceleration is usually furnished by the electric field of an atomic nucleus. As the electron interacts, a photon or gamma ray is emitted, and the nucleus recoils. Convervation of energy and momentum restrict the possibilities for the velocities involved and also the energy of the gamma ray.

Rather surprisingly, the whole diamond crystal can take up the recoil at high energies. Due to relativistic effects, recoil becomes less and is more easily taken up by the crystal without disruptive effects. The process of cooperative enhancement by action of the whole crystal is known as coherent bremsstrahlung. The orientation of the diamond crystal with respect to the electron beam critically affects the radiation.

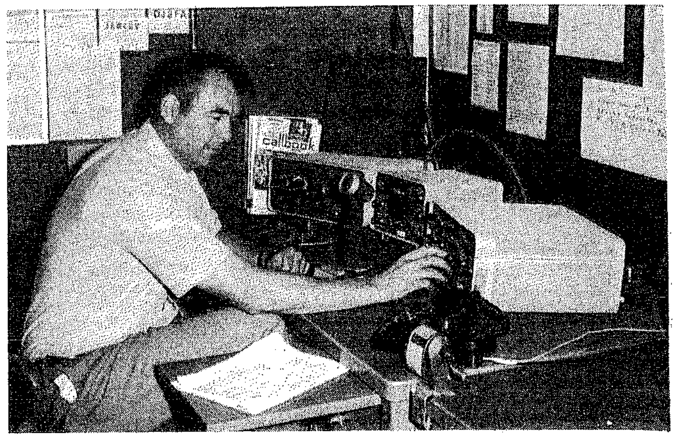
The crystal brought to SLAC by the MIT group is mounted in double gimbels in a goniometer arrangement. A goniometer is a device for measuring crystal angles. The angles are adjustable and are critical to a few seconds of arc. The diamond crystal is about 1/4-inch square by 1/16-inch thick. The goniometer was designed and built by MIT for SLAC and will remain here.

The spectrum of gamma ray energies produced in a narrow beam rises from a low value at low energies to a peak with a sharp drop-off and some small structure above the drop-off energy.

The sharp cutoff can be used to high advantage in the experiment set up by the MIT group, and Adam Boyarski, Stan Ecklund and Bob Siemann of SLAC. The study is of single positive pion photoproduction from hydrogen. The pions produced are analyzed in the 20 GeV, 1700 ton, magnetic spectrometer in End Station A. The sharp cutoff in the gamma ray spectrum is reflected in the counter-detected pions as displayed on a computer output. Analysis can be made almost equivalent to that obtained from a much-sought after, mono-energetic gamma ray beam such as is produced here in positron annihilation or from the back-scattered laser light.

The interest in redoing the oft-repeated meson production lies in its still poorly-understood dynamics. The fact that the diamond-produced gamma rays are highly polarized is their telling quality.

Previous experiments have been done at lower energies by groups at Cambridge Electron Accelerator, the German Electron Synchrotron, and in Japan. Also, an experiment here at SLAC with a UC Berkeley group using a polarized proton target yielded somewhat different detailed information about the process. The present experiment uses the same energy as that experiment to bring full light on the process. A choice among several theoretical models, each reflecting the state of our ignorance, may be possible when this experiment is complete.



Dick Collins tunes in at SLAC Station WA6NUP.

Amateur Radio Club In Full Swing

On January 4, 1970, Dick Collins of the Klystron Group was listening to the 15-meter amateur-band radio in the SLAC Radio Club station under the Central Control Building when he picked up a call from Station 0A4F in Lima, Peru. The call was for a contact by phone patch with a party in Mountain View, California. At the time, there was political upheaval in Peru and normal commercial channels of communication were not available.

Dick tuned his transmitter to the calling frequency and answered. Thus a phone patch was set up between a worried family in Mountain View and a fortunate person in Peru who had learned how amateur radio can be of service to private parties under unusual circumstances. (Contact between SLAC and Lima has been established again during the current quake aftermath.)

The SLAC Radio Club, operating Station WA6NUP, began in 1968 when a questionaire was circulated to employees requesting interest in such a club. Vic Waithman, Don Farwell, Ted Constant, (the first club president), Warren Struven, Jim Spitler, and Shorty Freitas spearheaded the planning. The response showed that there were enough license holders and others who wanted to participate to obtain licenses through the Club so that the matter was pushed forward. Funds were obtained from the SLAC recreation fund and a space was found in the basement of the Central Control Building to house the station. Starting from a half-dozen people as an active nucleus, the Club has grown to a membership of 55 and the station has almost full-power coverage of allocated amateur radio bands.

Membership in the organization is available to any interested SLAC employee and is obtained through application to a Club officer. Besides excellent transmitting and receiving facilities, the club has assembled a library on amateur radio, has test equipment for checking components they might assemble, and a code practice bench where code lessions are available at multiple earphone outlets.

Current officers of the club are Dick Collins, President, Ted Constant of Accelerator Physics, Vice President, Don Farwell of RAD, Secretary, and Warren Struven of Accelerator Physics, Trustee. Executive Committee Members are Fred Coffer, Klystron Group, Harry Saal, Physical Electronics, and Ron Baggs, Experimental Group E.

Amateur radio is licensed under the Federal Communications Commission with regulations designed to make bands available to not only general hobby use, but for special emergency and disaster communications. The most simple license for the beginner beyond the amateur's citizens' band is a novice license which requires a capability of five words-per-minute Morse code and sufficient technical knowledge to keep the operator within frequency allotments. The license is good for two years, which should allow the beginner time to become proficient enough to advance to the general class license.

The novice license may be obtained by examination from any licensed amateur general class radio operator or higher. The advanced types of licenses require either increased facility with Morse code or a demonstration of higher capability, or both. With advanced licenses go extra priviledges in allowable operating frequencies and power. Morse code is required of license holders because, under difficult circumstances of reception or interference, it has greater communication penetration.

The SLAC station operates mostly during the noon lunch period. Visitors who go down the outside steps on the east of CCR and find their way through the doors to the inner club "shack" will be welcomed almost any noon hour. The station facilities are available to members at other hours by contacting the CCR or one of the Club Officers when the Control Room is not manned.

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SLAC PERSONALITY-

Anna Laura Berg

Anna Laura Berg is a SLAC secretary working in Burton Richter's Experimental Group C. This marks her 27th year at Stanford.

Born in Pocatello, Idaho, Anna Laura went to Logan, Utah to attend college at Utah State. There she obtained her B. S. degree in dietetics. Graduating during the depression years, she was able to find work as a dietitian for only one year after which she had to see any job available. During that one year she conducted a family living survey for the U. S. Department of Agriculture in the city of Logan. Advised by the Department that she could hire a secretary from the WPA relief rolls, she made a request only to be told that depression or no, there were no secretaries on relief. Secretaries were not in surplus. That should be an encouraging piece of information for secretaries everywhere.

About 1937, Anna Laura took a job for a year with the Utah Power Company as a home service demonstrator. This

ANNA LAURA BERG

involved showing farmers' wives how to use their newly purchased electrical appliances, and gave her a chance to become acquainted with a good deal of rural Southern Idaho and Northern Utah.

Anna Laura held other jobs after that, most of them secretarial in nature, but by the end of 1938 she had decided to come to California. She recalls applying for her first job in Berkeley and insisting that she must make $100 a month. The employment office told her they considered this unreasonable — despite her experience and a college degree. She held out, however, and ended up with the pay she wanted on a job in nearby Emeryville.

By 1940, Anna Laura had moved to Palo Alto where she applied for and got a job at Stanford working for a professor of Education who, on his own, was doing public relations work in education. Then 1941 brought Pearl Harbor and another change. Anna Laura recalls her boss telling her, "You have some vacation coming...why not take it now and look for other work?" The very next day she landed a job in the Graduate School of Business where she worked as a Secretary to Professor Paul Kirkpatrick, then acting head of the Department of Physics. That was the beginning of her long association with the physics profession.

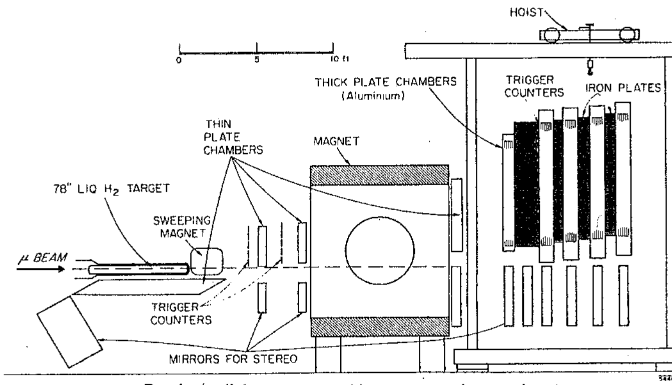
Dipping into a vast store of information concerning physics activities here at Stanford, Anna Laura came up with some interesting notes. She told us that the Physics Department, though well known, was quite small before World War II. All the professors, except Professor Kirkpatrick, and most of the regular students were either off to war or working in defense. Al Baez, father of the then 2- or 3-year old Joan Baez Harris, was one of the graduate students who was also an instructor in physics. In 1942-43 the Department of Physics was requested by the Army to instruct fifteen hundred physics as part of the Army Specialized young men at Stanford in engineering and Training Program. Classes ran from seven in the morning until eleven at night and labs and problem sessions were even held on Sundays, which caused some complaint on the part of the Stanford Church. Anna Laura smiled as she recalled some of the emergency teachers' backgrounds. There were professors from the School of Education and the Department of Music and from San Mateo and San Jose colleges. There were graduate students from Anatomy, Chemistry and Mathematics. In fact, anyone who had successfully completed a course in physics sometime in his past and who was willing to contribute his time was pressed into service. The students worked hard, however. Those failing the course ended up in the South Pacific in the infantry.

Although all of this was an interesting time for Anna Laura, the really exciting part of her association with Physics began as the war ended. Students majoring in Physics, graduate students and new ones, came flooding to the campus and began the major expansion of the Department and its program. Dr. Terman, now Provost Emeritus, returned from the Radio Research Laboratory at Harvard, and brought with him several outstanding students. Others came from the Radiation Lab at MIT and from Sperry (where Professor W.W. Hansen, for whom the Hansen Labs are named, spent the war years). From 1948 to 1966 Anna Laura lived on campus at Hacienda and continued with the Physics Department. She remembers that Professor Hansen's group "worked on a shoe string" in developing the first accelerator in a tiny room of the Physics Building basement. The space was so small there was barely room to fit the fledgling accelerator and its parts into the available space. In a room nearby was a cot for helpers to rest on as they worked through the night improving and expanding the accelerator, and Anna Laura sometimes contributed her time "holding voltage" and calling out the readings on the public address system. I can still hear, she told us, Dr. Hansen saying "I know it's going to work!" And work it did, helped out by the efforts of research students and Dr. Felix Bloch, first man at Stanford to receive the Nobel Award. Professor Willis Lamb, now at Yale, and Professor Hofstadter, still at Stanford, also received the Nobel Award during her stay in the Department. Anna Laura recalls these award times as intensely exciting moments since she was usually aware of the awards prior to their being made public but was sworn to secrecy concerning them.

About 1962, Anna Laura left Physics temporarily and spent four years in the Asian Languages Department at Stanford. Here she picked up a continuing interest in the Chinese language and culture. She started an evening class in Mandarin Chinese through adult evening high school and is still taking lessons, currently on Wednesday nights at SLAC, under the direction of Alex Tseng of the Plant Engineering Department. She is the only native American in the class. The other members number a Dutch man, a French girl, two Japanese scholars and two Chinese-American women.

Another outside interest is cooking, retained from her early years and which probably prompted her to major in dietetics in college. She makes her own bread and occasionally brings a cake to work to share with her co-workers.

Although she has no immediate plans, Anna Laura looks forward to having the time and money to travel. First on her list, when that time comes, will be Norway, her father's homeland. Meanwhile Anna Laura Berg works in the Central Lab in...yes, that's right, the Physics section.



Drawing outlining aparatus used in muon scattering experiment.

Muon Experiment

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scattering cross-section.

The target consisted of about two meters of liquid hydrogen. The small magnet following the target was used to sweep away obnoxious low-energy electrons "liberated" in the target. Thin-plate spark chambers placed before and after the large-aperture magnet tracked the scattered muon's trajectory and the thick-plate chambers made sure it was a muon which was being observed. Particles which participate in the nuclear force, like pi mesons, are stopped quite rapidly in matter. To illustrate, a 10 billion electron volt (10GeV) pi meson will suffer a nuclear collision after passing through only 20 centimeters of aluminum, while it takes 2000 centimeters of aluminum to stop a 10 GeV muon!

The final results of this experiment are still being worked on. The most unexpected result so far was a much bigger cross-section for inelastic scattering than any one had expected. At the same time, the SLAC Group A-MIT collaboration was finding the same result for inelastic electron scattering, of course with much greater statistical precision since SLAC accelerates electrons. This result was not surprising, since the muon and electron always seem to behave in the same way. A detailed comparison of the electron and muon results is being made: to date no startling discrepancies have been seen.

This experiment, in addition to being the first to study inelastic muon scattering, covers a four times bigger range of "q^2" that previous studies of elastic scattering. q^2 is a parameter which measures the violence of the collisions: the bigger q^2, the more violent the collision, and the "closer" one comes to the nucleus.

As well as studying muon scattering from protons, Group E has measured the scattering from complex muclei. From their data they can deduce that the scattering from neutrons is very similar to that from protons, perhaps a little less. They are also studying a peculiar "shadowing" effect first observed by the UC Santa Barbara Group working with protons at SLAC. Muon scattering, electron scattering and photon absorption are all very closely related: the scattering processes are explained in terms of the absorption of "virtual" photons.

In addition to the inelastic data mentioned above, Group E has been involved in other investigations of the muon. Being analyzed now in collaboration with a group from LRL, Berkeley, are 1.6 million photographs taken at SLAC of sea level cosmic ray muons. It is expected that a few hundred muons with energies greater than one trillion electron-volts will be observed.

'Leapfrog'

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helium jacket surrounding the disk-loaded niobium structure. Some major parameters of Leapfrog are the same as envisioned for the two-mile machine. These include klystron frequency (2856 MHz), energy gain (30 MeV per meter), and klystron power 1640 watts per meter). The 50 cm of disk-loaded waveguide differs from the present copper structure in internal shape as well as material.

Getting back to the 2-mile machine, it will be divided into 30 sectors as is the present accelerator. Each sector will consist of sixteen, 20-foot accelerator sections housed in a thirty-inch diameter cryostat (helium tank and heat shield). Different klystrons will be used, but there will still be one every 40 feet. While present klystrons have 20 to 30 million watts peak power capability, the tubes to be used in the superconducting machine will need peak capability of only 20 thousand watts. These new klystrons will be roughly 50% efficient in converting input power to radio power, compared with a typical efficiency now of 35 to 40% for all tubes on the machine (SLAC's own klystrons, however, are about 47% efficient).

It is anticipated that the use, to the extent possible, of existing facilities will result in a cost savings of 10%.

How long would SLAC be off the air during construction of the new two-mile superconducting machine? Only two years! As mentioned earlier, seven years will be required after proof of feasibility for total conversion. The first two years will be devoted to preliminary design and testing. During the next three years, final designs would be fabricated and stored while the existing accelerator is operating with a full schedule. During the sixth year, operation of the existing machine would cease and hardware installation take place. The seventh year would involve checkout and testing. The experimental program would then be able to begin.

For more detailed technical information on this fascinating project, see SLAC Publication 749 (June 1970).

Jack Goad Retires

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Here Jack will hunt, fish, repair antique clocks (a hobby of 25 years) and do some hand-tooled copper work — another hobby he has enjoyed for some time. He hammers, anneals, cleans and polishes copper plate into attractive ornaments and pieces of art such as bracelets, ashtrays, candle-holders and dishes. Jack says he plans to have Mrs. Goad, who is a licensed real estate agent, "keep herself out of mischief" by keeping her hand in as an agent. He says she is a consistent winner at Black Jack. She can tell at a glance every card that is played or unplayed at the table. Jack, it seems, is no slouch at the game himself.

Jack Goad is a big man who stands tall, who likes to smoke and take a drink as well as gamble. He's retiring because he's sixty-five — but that's the only reason!

EIDTORS NOTE: Jack is the first SLAC'er whose initial retirement was from SLAC. Other employees have retired from the project, but they had either previous military, civil service or similar retirement before coming to SLAC.