The Beam Line

Stanford Linear Accelerator Center

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Rapid Cycling Bubble Chamber TURNS ON

BC-82, a search for "exotic" mesons, marks the beginning of physics research using SLAC's new 15-inch diameter rapid-cycling bubble chamber (the "RCBC").

Although the RCBC operated reasonably well at 20 pulses per second during the January cycle for two million pulses, the March cycle will be the first devoted to physics using the new device and the chamber is expected to operate at repetition rates up to 30 per second, making the RCBC the world's fastest bubble chamber.

The chamber was designed specifically with "hybrid" bubble chamber-spark chamber experiments in mind. It ultimately should be able to expand 60 times per second. The chamber is a disc 15 inches in diameter and 5.5 inches high with a vertical axis. The camera system is located below the chamber itself; the lower face is a glass window to accommodate a three-lens single-track 35mm camera system.

The chamber has what might be called an electromagnetic drive system -- the expansion system, like that of a loudspeaker, consists of a steady magnetic field which causes the chamber to expand when a pulse of electric current is sent through an armature coil.

A second magnetic field, used for helping identify particle tracks, is produced by an 18 kilograss superconducting magnet built into the chamber's "vacuum can." Older bubble chambers had bulkier magnets which made it difficult to get detectors near the chamber itself. Steve St. Lorant's group built and tested the magnet, which has operated very reliably.

The experiment, BC-82, will attempt to find "exotic" mesons, defined as those which cannot be made up of simple quark-antiquark pairs.

Arthur (Buck) Rogers, a principal experimenter on the Rapid Cycling Bubble Chamber's first experiment, pointing to the 15-inch diameter, 5.5-inch high "sensitive" region of the chamber prior to reassembly for the experiment.

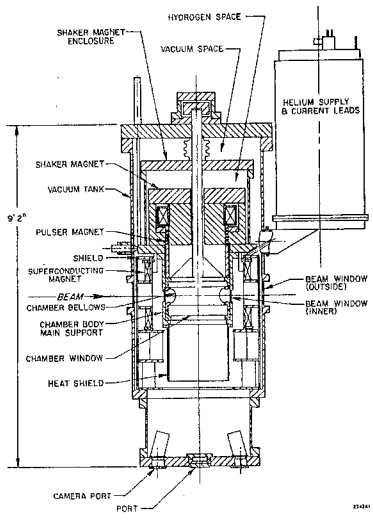


Diagram of the Rapid Cycling Bubble Chamber

Positive pi mesons at 8.5 GeV will be sent into the chamber and those collisions resulting in a neutron being ejected in the forward direction will trigger the cameras. The experimenters will then look for doubly-charged mesons. No such mesons have been seen to date.

They would automatically be "exotic" since quarks can only have one-third or two-thirds of an electron's charge and no combination of two such charges can add up to a net charge of two (try it!).

The quark idea, formulated in 1964 by M. Gell-Mann and G. Zweig, envisions all the observed strongly-interacting particles as being made up of three "superfundamental" particles, the quarks, along with their antiparticles. Mesons (strongly-interacting particles with integral values of intrinsic spin) are made up of two quarks, while baryons (strongly-interacting particles with half-integral values of spin) are made of three quarks, at least in the simplest version of the model.

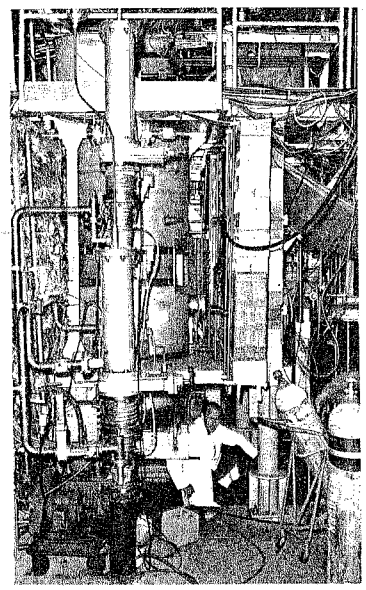
The experiment is "hybrid" in that the forward neutron, itself unobservable because it lacks charge, will be converted into charged particles in a downstream optical spark chamber with its own camera system.

The group wants to obtain 100,000 pictures. About 10 pi mesons per pulse will be sent into the chamber. Since one trigger is expected per 2000 tracks, one picture should be obtained per 200 pulses. Thus, were the chamber not triggerable, 20 million pictures would each have to be analyzed, rather than the 100,000 which are desired.

The experimenters hope to see a few dozen exotic mesons after analyzing the data. If they do, it is an understatement to say that a great deal of excitement will be generated within the physics community.

The experiment is a Purdue-Indiana University-SLAC-Vanderbilt collaboration. Our thanks to Arthur ("Buck") Robers (Group BC) for an interesting discussion on the chamber and on the experiment.

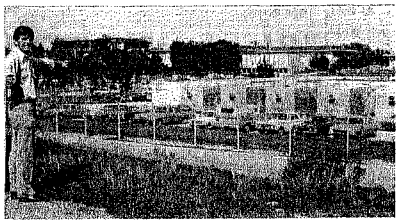
Principal SLAC people involved with the design and construction of the RCBC are Bob Watt (Bubble Chamber Operations head), Frank Barrera (Mechanical Engineering) and Rogers.



Jim Ferrie (Bubble Chamber Operations) working on the 15-inch Rapid Cycling Bubble Chamber camera system, located underneath the chamber and its auxiliary support system.

New Computers / Speedier Physics

It is befitting that SLAC, in causing electrons to accelerate to nearly the speed of light, should also generate a continuing need for faster computer processing of information. As physicists progress in theory toward experiments which outdate the very computer systems they use, the machinery upon which physics knowledge is able to be analyzed must also change to accommodate the thought flow.



Mel Ray points out the new trailer quarters for the SFSCC staff.

SLAC's recent purchase of two IBM 370/168 computer systems will permit work at SLAC to approach the capacity for which the accelerator was designed -- high speed electronic physics.

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Mel Ray (l.), Assistant Director of SFSCC and Chuck Dickens, Director of SFSCC, cogitate upon the new IBM 7 system, which will be used in the real time physics link from the experimental area to the Central Computer Complex.

The Rho Prime SAGA

In the beginning, that is September 1969, Bob Mozley's Group D put out SLAC Publication 666 dealing with the results of a photoproduction experiment done in the two-meter streamer chamber. After looking at 663 events in which a photon-proton collision in the chamber yielded four pi mesons and a proton, the group discovered evidence for an "enhancement" with a mass of about 1.5 GeV and an extremely short lifetime. And so the rho prime meson was born.

The particle itself was not photographed in the chamber because of its extremely short lifetime. It lives only about the time it would take a photon of light to travel a distance equal to the proton diameter. Other participants in this experiment were A. Odian, J. Park, W.P. Swanson, F. Villa, D. Yount, M. Davier, I. Derado, D. Fries, and F. Liu.

A more recent experiment involving a different SLAC group and a University of California group also "saw" the rho prime and helped identify it as belonging to a class of short lived particles called "vector mesons" related to the photon and thought to help explain the way photons interact with nuclear particles.

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New SLAC Computers . . .

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Previous 360/91 Computer System

In October 1968 when the IBM 360/91 (2 million bytes memory) became operational, there was at first only 10% of the Central Processing Unit (CPU) cycles available to the user. Today, some 70-80% CPU power is delivered to the users, with the Computer Center's efforts having brought the 91 to a computer system that is finely tuned to SLAC's needs. However, the need has grown for increased efficiency and speed to process the information that will be generated in experiments planned for SLAC.

Up till now, the 91 has served as a central facility for a number of smaller computers on site where the information is gleaned from the bubble chamber, streamer chamber and spark chambers. The physicist has spent much of his time merely dealing with the logistics of gathering and processing information in a sequential batch system, a state of computing that frequently frustrates the aim of getting direct results of physics experiments.

New 370/168's Will Change Physicists' Lives

The two new computers (each with 3 million bytes memory) will augment the existing 360/91 to form a shared data-base triplex system, and will bring the physicist back into the experiments. No longer will he have to spend valuable time fussing with the logistics during the processing stage. Information (events) from the experiments will be collected in real-time operation by direct communication links of the small computers to the central computer triplex. The physicist will then be able to see apparatus problems and sample results of his experiments online. As a result, the use of the accelerator will become more effective.

Faster turnaround of data analysis work should facilitate quicker adjustments and interpretation of experiments. The drawing-board experiments unable to be performed on the previous slower computer system will provide the higher data rates which could not be processed efficiently even by the acquisition of more small computers, or replacement of the existing 91 system with another single faster computer. A super-system was in order.

Why Two New Computers?

Two powerful computers, in conjunction with the 91, will provide the necessary real-time turnaround to keep pace with and provide room for physics data and will provide the reliability of having always enough computing power to record and sample the data generated while the accelerator is operating.

Physicists who previously collected data at the end stations and brought it to the computers will now collect it directly at the triplex. If one computer is "busy," the shared data-bases concept of the triplex enables the information or "job" to be processed on one of the other two machines, or placed in a work queue for next available CPU.

Installation of the 370/168's and peripheral equipment is spread over the latter half of 1973; however, some units have been delivered early to permit design and development of the software system to proceed.

Computer Housing

When the AEC first set out on its multiple laboratory computer acquisition program, SLAC faced a real problem in providing space for the new system. Computer Center personnel were required to give up existing office space for the new computers and move into even more modest quarters.

The temporary buildings which used to house staff are now reassigned to the computers. The work stations which used to be in one building are now separated -- dispatch, disks, tapes, unit record equipment and CPU's now occupy five buildings. The staff has moved to government surplus trailers which were brought in from the AEC Nevada test site and are located south of the computer complex.

Challenge Ahead

The advent of the new triplex system will call for the Computer Center staff to plunge into its own brand of unknown territory -- that of a computer system yet to be brought to operational and fully functional status. Their modern version of a round-up is to "get 'em up and move 'em out" -- circuits, control units, terminals, magnetic tape, that is -- to draw together the inanimate bits of metal and wire into an integrated power source for compiling physics data at speeds commensurate with growing needs.

The physicist's mind acts and speculates on an experiment which can only be tested on pieces of computer matter which do not yet exist. The folks at the Computer Center react and built the material ladder for further physics research into the "non-material."

Physics information in a further concentrated state enables the speed of experimental processing to go up another notch, a significant one.

CHARLES R. PRYKE

The Mechanical Fabrication Shops reports that Charles Roland Pryke died of an apparent heart attack Tuesday morning, April 3, 1973, while playing golf. Mr. Pryke had been employed at SLAC since 1964 and had been assigned as a machinist on the evening shift in the Light Machine Shop.

Charlie emigrated from Ontario, Canada where he was born in 1916. He had a history of heart problems dating back to 1961.

Layoff TASK FORCE Report No. 2

In the last issue of the Beam Line, we reported on the progress of the Personnel Department's Placement Assistance Task Force in registering SLAC people on layoff notice, in preparing resumes, and in arranging interviews.

According to Personnel Director, Doug Dupen, all this activity is beginning to show results. Of the 72 employees given layoff notice last month, 12 have been reemployed at SLAC. Another 2 have taken jobs in other parts of the University with 2 more offers being considered as of press time. And 10 others have found employment in local industry. There are still 2 job openings to be filled at SLAC, presumably by people who have received layoff notice.

This leaves only around two-thirds of the employees to go out of the original 72. And there are still 90 days to go.

Another change has taken place since the last Beam Line issue. Seven more formal grievances were submitted before last Friday's deadline. A total of eight grievances are now being studied by the University to determine further action.

The Task Force has completed its first two-week long series of workshops on resume writing, job searching, and interview techniques. Another two classes have begun the same curriculum. Within the next two weeks the Personnel office expects to issue a directory of job opportunities on the Peninsula. This is now being compiled by the efforts of several workshop participants and the Personnel office staff and will be available to anyone interested.

The 6-member Task Force of people from SLAC and the campus continues to meet formally weekly and informally more often. Their work will continue until all affected have been successfully placed.

The next issue of the Beam Line will describe in detail the working of the Placement Assistance Task Force.

The Rho Prime Saga

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This experiment also involved photon-proton collisions, but this time in SLAC's 82-inch bubble chamber. The photons were produced with the help of a laser beam directed against electrons from the two-mile long accelerator and then directed into the bubble chamber. Photographs were taken of bubbles of hydrogen gas left by particles produced in the chamber and again the existence of the rho prime was inferred from collisions resulting in four pi mesons being produced.

SLAC people involved in this bubble chamber experiment were J. Ballam, G. Chadwick, Y. Eisenberg, E. Kogan, K. Moffeit, P. Seyboth, I. Skillicorn, H. Spitzer, and G. Wolf. Physicists from the University of California were H. Bingham, W. Fretter, W. Podolsky, M. Rabin, A. Rosenfeld, G. Smadja and G. P. Yost.

One of SLAC's most important contributions to high energy physics has been in the area of investigating the way light (photons) and matter can interact via the nuclear force. This addition to the world's list of vector mesons is another important step in this study.

Three vector mesons, the rho, omega, and phi mesons, were known prior to the discovery of the rho prime -- the last of these was discovered in 1962.

The ESA BATALION

Battles go on all the time at End Station A. Battles to meet deadlines, to design a new piece of machinery, to install it properly and then, of course, make it work. There is a constant struggle to fit all the human and mechanical pieces together so that SLAC can go forward.

ESA is unique and is always in a state of flux. The flow is idea to paper to construction of equipment to testing-and-learning to disassembling equipment to startover. Much effort goes into designing and building new equipment which may then only be used once and discarded. If the experimental results are very good (or very bad) the equipment may be used again. (Of course the 3 main spectrometers are permanent as well as the smaller pair spectrometer.) A phenomenally short period of time is required to disassemble one experiment and assemble another. Many men do their creative design "on the spot" with perhaps only 10 days to make all the changes for a new experiment to start.

Usually at least 3 experiments are in process at one time in ESA. (1) one being thought about, (2) one having hardware built, (3) one running. Sometimes as many as 75 men (sorry, Ms.) are required to set up an experiment. After the new equipment is brought in, plumbers from Crafts Shop hook up the plumbing (ESA magnets are water-cooled), electricians hook up wires to and on the magnets and the precision alignment team comes in to check alignment and give the go-ahead signal for the experiment.

Spectrometer Facility Group's Role in ESA

The SFG (headed by Charlie Sinclair) invents and runs equipment in ESA for physics experiments. Much coordination is needed so SLAC physicists and outside physicists know what kinds of equipment can be designed for them. For instance, with experiment E-73 Group F presented a proposal to have the experiment approved, after which they consulted SFG to see what the intended spectrometer would be like -- how much shielding, number of counters and magnets.

Bob Eisele of SFG

Bob designed the concrete shielding blocks for the 8 GeV spectrometer. He also designed a 10-ton carriage for a 309-ton weight of magnets, shielding and counter for the E-73 experiment and gave it some personality by painting and naming it the Green Dragon (color inspired by an Irish contractor, Sean Dyer, who calls Bob's creation the "green monster").

In his work Bob uses his drawings to explain to contractors what pieces of equipment need to be built and installed -- if his drawing is wrong, he eats his words and comes in at night or weekends to correct his mistake to meet the deadline.

Bob calls one of his designs "WOK" (World's Oddest Karriage), and another carriage (for E-29) "Snoopy" because it looks like "some kid's crazy airplane." "The Turtle" is now respectably known as the pair spectrometer. When Bob was building the 8 GeV spectrometer blocks, he was the local Superman of ESA, flying from wall to wall in a bosun's chair suspended from a crane, feet dangling in mid-air and brandishing a broom to sweep away any sand or dirt on the blocks which might act as ball-bearings and permit sliding of the blocks.

Although Bob doesn't use the bosun's chair anymore, he finds his work challenging as well as enjoyable. As Bob puts it, "There is a total shifting of gears in what everyone does in ESA. You may have one big ugly job followed by a little delicate one. Nothing stays the same."

Ever Changing

If a movie projector were bolted in a corner of the ceiling in ESA and time lapse pictures were taken, say at one month intervals, there would result a fascinating picture of men moving in and out talking, (arguing?), joking, and making constant shifts in the life and scenery in ESA. That's how some of our SLAC'ers spend hours in their lives here.

SLAC Job Opening

Physical Science and Engineering Technician II

The Experimental Facilities Department has a day shift opening for an Electronic Technician to work under the supervision of a PS&E Tech III to perform work in electronics such as: install, terminate and check out multiconductor and coaxial cable; fabricate, assemble and wire electronic chassis, panels and distribution frames; install various electro-mechanical devices in the Research Area; install and service video equipment and other electronic equipment. Qualifications desired: ability to read diagrams, experience in fabrication and wiring of chassis and racks, knowledge of electronic theory and the ability to trouble-shoot simple electronic control circuits using schematic diagrams; mechanical aptitude; knowledge and skill such as are usually acquired through completion of a technical college course and related experience in electronics. The salary range for this position is $730 - $932.

University Job Openings

The following jobs available at Stanford are just a few of many jobs available on campus. For more information, contact SLAC Employee Relations, extension 2355.

PS&E Technician III. Shift work. Operate and maintain four-channel TV network. Requires second class FCC license (or better). No. 13740. Salary $844-$1078.

PS&E Technician III. Construction of various "hardware boxes" including equipment associated with low-power radar transmitters. No. 13748. Salary $844-$1070.

Facilities Engineer III. Technical assistance to architects for in-house projects. Degree in Mechanical Engineering. No. 17126. Salary $940-$1458.

"Bloodmobile" in Menlo Park

The Peninsula Memorial Blood Bank mobile will be at the Recreation Center at Mielke and Alma streets in Menlo Park on Friday, April 13, 1973 from 3:00 p.m. to 7:00 p.m.

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