INTRODUCTORY REMARKS

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In April 1974, the Lawrence Berkeley Laboratory (LBL) and the Stanford Linear Accelerator Center (SLAC) submitted a joint proposal to the AEC for the construction of a single ring positron-electron colliding beam facility (PEP) at Stanford. The peak design luminosity of 10^{32} cm^{-2} sec^{-1} is reached with 15-GeV beams. The proposal envisions simultaneous use of five separate interaction regions for high energy physics, with a sixth region located deep underground devoted to machine physics. Assuming that the project is fully authorized for FY 76, experiments are scheduled to start in the first half of calendar 1980.

During the preparation of the proposal, only the general scope of the experimental areas was specified. This was done deliberately because it was felt important to involve the whole physics community of potential users at a very early stage in the planning of PEP, and in particular, in the more detailed specifications of the experimental areas.

With this in mind, LBL, SLAC and AUWHEA (Associated Users of Western High Energy Accelerators) sponsored a four-week summer study in Berkeley during the month of August 1974 to acquaint the Physics Community with PEP and its potential scientific program, to prepare designs of typical "small" and "large" experiments, and to use these designs in specifying requirement for the experimental areas.

A Steering Committee was formed in December 1973 consisting of B. Barish (CalTech); D. Cline (Wisconsin); M. Goldberger (Princeton); J. Kadyk (LBL): R. Landers (UC Davis); B. Richter (SLAC); K. Strauch (Harvard), Chairman. Judging, as it turned out correctly, that a very much larger number of physicists would wish to participate than could be accommodated in an effective working group, the Steering Committee decided at its first meeting in January 1974 to devote the first week of the Summer Study to a Teach-In on the glories of e^+e^- Physics, to descriptions of the proposed PEP facility, and to work shops on specific topics. The second, third and fourth weeks were to be used by a group of about 60 participants to prepare designs and specifications for typical experiments and for the experimental areas.

A letter announcing the 1974 PEP Summer Study was sent in January 1974 to all members of the APS Division of Particle and Fields and to major laboratories abroad. The response was most gratifying: 111 colleagues outside of LBL and SLAC indicated interest in participation. It was possible, as had been hoped, to accommodate all those interested in attending the first week. A smaller group participated for the full 4 weeks. Names of participants are listed on previous pages iii and iv.

The first week proved most lively and informative. The program is appended. Up to $s = 25\ GeV^2$, QED is in good shape and the large hadron production is as surprising as ever. SPEAR II is expected to extend substantially our knowledge of e^+e^- physics, but it will take PEP working at $s = 900\ GeV^2$ to bring us into a new and exciting energy region where weak interactions in particular are expected to play a significant role. The design of PEP uses the large experience with e^+e^- storage rings which has accumulated over the last few years and this gives confidence that the performance goals can be achieved. Most of the participants felt like the starving urchins in a Dickens novel looking at the dinner table set for the headmaster: ready to jump and start partaking!

To keep within the informal atmosphere of the first week, the speakers were not asked to prepare manuscripts suitable for publication. Instead, their transparencies were reproduced and made available to participants.

For the remainder of the Summer Study, participants were asked to sign up for one or more groups. As expected, some of the original groups combined or separated as their investigations progressed. The final groups were as follows:

1. Study of QED reactions and of neutral particles.
2. Study of high momentum charged particles.
3. Study of low momentum charged particles and of neutral particles.
4. Study of heavy hadrons.
5. Measurement of the total hadronic cross section.
6. Studies of the weak interaction with the QED reactions.
7. Studies of the effects of the weak interaction in hadronic reactions.
8. Search for new particles.
9. e^+e^- tagging and $\gamma\gamma$ processes.
10. Polarization - production and detection.
11. Streamer chambers at PEP.

12. Backgrounds.

13. Experimental areas.

The Proceedings of the 1974 PEP Summer Study contain the reports and conclusions of these groups. The experimental area group in particular prepared detailed recommendations. Some of the individual papers used in the discussions are also included in the Proceedings.

It would take too long to summarize the individual reports here. Instead, I will make some personal observations.

The time scale of data acquisition at PEP will obviously be determined by the value of the luminosity: at the design value, one $e^+e^- \to \mu^+\mu^-$ event is produced every 100 seconds in each interaction region with beams of 15 GeV each. It took a few days for those participants who had never worked with storage rings, and particularly with e^+e^- rings, to both learn how to live with the expected counting rates, and to appreciate the beauty of clean events, where "clean" refers to low background from beams and, more important, to simplicity of initial state. Soon old and new storage ring hands were hard at work studying exciting experiments and designing apparatus with near 4π geometry capable of recording most details of each event.

While the group structure encouraged the concentration of effort on particular problems and the design of apparatus optimized for particular reactions, this structure was not meant to, and did not, limit the group effort to the primary interest. Since nearly all of the envisioned apparatus covers a large solid angle and since data taking will require substantial running time, observation of additional processes can often be carried out at relatively little additional cost of equipment and/or time. Many differences in the design of proposed experiments result to a large extent from differences in the nature of these additional observations. Experience has shown that practical detectors are not universal in the sense that they cannot study a very substantial fraction of the potential physics with equal efficiency or quality. Indeed, the existence of five interaction regions devoted to high energy physics provides an opportunity to study some of the more important processes with different apparatus and thus differing biases. Two very important examples where such parallel efforts are likely to be most beneficial are provided by measurements of the total hadronic production cross section and studies of the effect of weak interactions on the charge asymmetry in muon pair production.

Much thought was given to the efficient use of the five major interaction regions. The possibility of rapid insertion and/or interchange of apparatus is clearly highly desirable. With this in mind, a straightforward solution is recommended in which a movable shielding wall near the interaction region will permit complete assembly and test of equipment close to the final location. Since building walls are no longer needed for shielding, advantage can be taken of the California climate by making some of the walls suitable for future changes.

Many of the proposed experiments fit into a magnet-free interaction region 10 meters long and would benefit from operation at highest possible luminosity. A gain by a factor of 2 over the 10^{32} cm^{-2} sec^{-1} design luminosity seems quite possible in such a shortened region, and it is recommended that the final interaction regions consist of a mixture of standard 20-meter-long and higher luminosity 10-meter-long interaction regions.

If three expressions can characterize the 1974 Summer Study, they are hard work, excitement and hope. We all had much to learn from each other, and it was a great pleasure to do so. Despite the considerable attractions of the Bay Region, the top floor of Building 90 was very active during working hours and beyond; the three meeting rooms were seldom empty! High Energy Physics is as exciting a field as ever, and no branch is more exciting than e^+e^- Physics. With PEP, a new energy region will become accessible. If the past provides one lesson, it is that much new important information and understanding will be gained with this new window into the fundamental properties of matter. All members of the Summer Study very much hope for an early authorization and successful completion of PEP, and for their own participation in the exiting physics program which will take place!

The work of the Summer Study would not have been possible without close collaboration with the PEP design group under John Rees and Tom Elioff. They and their colleagues rapidly produced answers to a great variety of technical questions, and in turn, through their own questions and comments helped to keep the Study on a steady and realistic course.

The Study greatly benefited from the presence of several colleagues from the CERN, DESY, Frascati, Orsay and Rutherford laboratories. We thank

them for helping us and sharing their thoughts and experience with us. We appreciate the effort of the management of their home laboratories which made this participation possible.

Since the Summer Study took place in Berkeley, the work of organization and running landed on the shoulders of LBL, and particularly the Physics Division headed by R. W. Birge. The LBL staff did a superb job providing accommodations for participants and their families, and giving all the support needed to make the Study a success. Too many persons worked hard on the various necessary tasks to be named individually; however, Suzanne Krantz spent special long hours preparing and helping, and always did so effectively and with good cheer and great charm.

Much of the pleasant atmosphere in which we worked was due to the social events, formal and informal, organized by the LBL and SLAC staffs and by our local colleagues and their spouses. It will be a long time before we forget the cocktail party at the end of the Berkeley Marina in the middle of the Bay during which President Nixon announced his resignation, the exciting visit to SLAC with the barbecue under the California Oaks, and the dinner at the Mondavi Winery with the sun setting over the beautiful Napa Valley. Our families in particular appreciated the help and hospitality provided by their local host families.

We thank the AEC whose support made the Summer Study possible. We trust that our reports are of help to Pief Panofsky, Andy Sessler and their associates in the planning of the facilities and program of PEP, and that the great interest shown by the large number of participants in all aspects of the future research program will speed up the transformation of PEP from an interesting proposal to a most exciting tool for the entire U. S. High Energy Physics Community.

Karl Strauch
Chairman
Steering Committee

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