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PEP*

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INTRODUCTION AND PARAMETERS

Perhaps the fact that the electron-positron colliding beam machine PEP, unlike its sister machine PETRA, is still more than a year away from completion is the reason that a theorist has been given the task of describing it at this conference. In the following, I attempt to give a brief description of the parameters of the machine, the construction effort now going on, and the experiments planned for machine turn-on or soon thereafter.

The parameters of PEP remain essentially as they have been described previously.[1] Both electrons and positrons can be injected directly from the SLAC linear accelerator with energies of 4 to 18 GeV. The filling time should be less than about 10 minutes, with the colliding beam energy being the same as the injection energy. The six interaction regions are spaced symmetrically around a magnet ring 2200 m. in circumference (see Fig. 1). With the RF power of 6 MW expected to be in place at turn-on the luminosity should be greater than $10^{31}/cm^2 \cdot sec$ for beam energies of 4 to 18 GeV, with a maximum of $10^{32}/cm^2 \cdot sec$ at 15 GeV per beam. Provision has been made so that the option is open of doubling the RF power, quadrupling the length of the RF sections, and increasing the maximum beam energy to about 24 GeV in the future.

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CONSTRUCTION

Major excavation and construction work for PEP began a little more than one year ago. At present much of the tunnel and concrete work is completed, although the last of the concrete for some interaction regions is not planned until six months hence. In particular, starting at the south injection tunnel (see Fig. 1 at 9 o'clock) and continuing around counterclockwise to interaction region 2, the concrete enclosure and tunnel for PEP now exist.

So called "beneficial occupancy" of the tunnel for installation of power, vacuum system, magnets, et cetera, has now begun in the south injection tunnel, and will continue counterclockwise around the ring as it is completed. The first beam is now scheduled for October 1, 1979, and we hope to start physics experiments relatively soon thereafter.

EXPERIMENTS

A rather varied program of first generation experiments for PEP has been approved.[2] They are briefly described below in order of their proposal number:

PEP 2 — "Monopole Search"
U. C. Berkeley and SLAC

Probably the simplest PEP experiment, it consists of sheets of CR-39 and Lexan plastic interleaved in a polygonal shape around the interaction point. This experiment, starting in October, 1979, will be in region 10, which is otherwise devoted to machine physics uses.

PEP 4 "TPC"

Johns Hopkins, LBL, UCLA, U.C. Riverside and Yale

The heart of this very powerful general detector is the time projection chamber, which provides charged particle tracking and identification over almost the entire momentum range available at PEP. The chamber sits in a 15 kilogauss thin-coil superconducting magnet. Outside the coil is an electro-magnetic shower detector (for photon detection) and then iron plus proportional tubes to act as a muon detector. A major portion of this detector should be working in region 2 in April, 1980.

PEP 5 "MARK II"

LBL and SLAC

Already working at SPEAR, the "Mark II" consists of a central cylindrical drift chamber within a 5-kilogauss conventional solenoidal magnet. This is surrounded by a liquid argon calorimeter for neutral particles (and electron detection) and then a layered iron filter with proportional tubes in between for muon detection. During the summer of next year, the Mark II will move to region 12 at PEP to be ready at beam turn-on.

PEP 6 "MAC"

Colorado, Northeastern, SLAC, Stanford, Utah, and Wisconsin

The magnetic calorimeter, "MAC", has an inner cylindrical drift chamber in a ~5-kilogauss (can be powered to ~10-kilogauss) conventional solenoid. Over almost the entire solid angle, this is surrounded by a lead-proportional chamber shower detector, and then by a hadron calorimeter consisting of magnetized steel sheets interleaved with proportional chambers. Outer drift chambers are used to detect penetrating muons. In October, 1979, this experiment should be ready in interaction region 4.

PEP 9 "Two Gamma"

U.C. San Diego, U.C. Santa Barbara, U.C. Davis,
and the Foundation for Fundamental Research
on Matter, The Netherlands

Using the TPC as a central detector, the two-gamma experiment adds "small" angle detectors fore and aft to explore two photon physics. Sodium iodide crystals are used in inner detectors to tag small angle electrons while each outer detector, which consists of a septum magnet plus drift chamber plus shower counter plus iron filter, serves to detect hadrons, muons, and electrons. This experiment shares region 2 with the TPC and should also be ready in April, 1980.

PEP 12 "HRS"

Argonne, Indiana, Michigan, Purdue, and SLAC

Using the 17-kilogauss superconducting magnet of the 12-foot Argonne bubble chamber with a cylindrical drift chamber system and shower counters, this experiment is a high resolution spectrometer for charged particles. It should be ready in region 6 in April, 1980.

PEP 14 "Quark Search"

Caltech, Stanford, and SLAC

Employing scintillation counters together with proportional wire chambers and plastic Cherenkov counters, this experiment combines ionization information with time-of-flight measurement to search for quarks. It should be ready at turn-on in region 6.

PEP 20 "DELCO"

Caltech, Stanford, and SLAC

The DELCO apparatus used at SPEAR is to be improved and moved to PEP. Its principal unique feature is very good electron identification by Cherenkov counters over a substantial part of the solid angle. It also should be ready in October, 1979, and will be in region 8.

As can be seen from the above list of experiments, PEP has a full program of physics already planned. In fact, there is at least one experiment in each interaction region and five out of six regions will have an experiment ready at beam turn-on in October, 1979. From what we already know, the physics is guaranteed to be exciting.

REFERENCES

1. W.K.H. Panofsky, in Proceedings of the 1977 International Symposium on Lepton and Photon Interactions at High Energies, edited by F. Gutbrod (DESY, Hamburg, 1977), p. 911.
2. The experiments discussed in this report reflect in part actions taken at the Experimental Program Committee meeting in early September, 1979, two weeks after this talk was actually given.

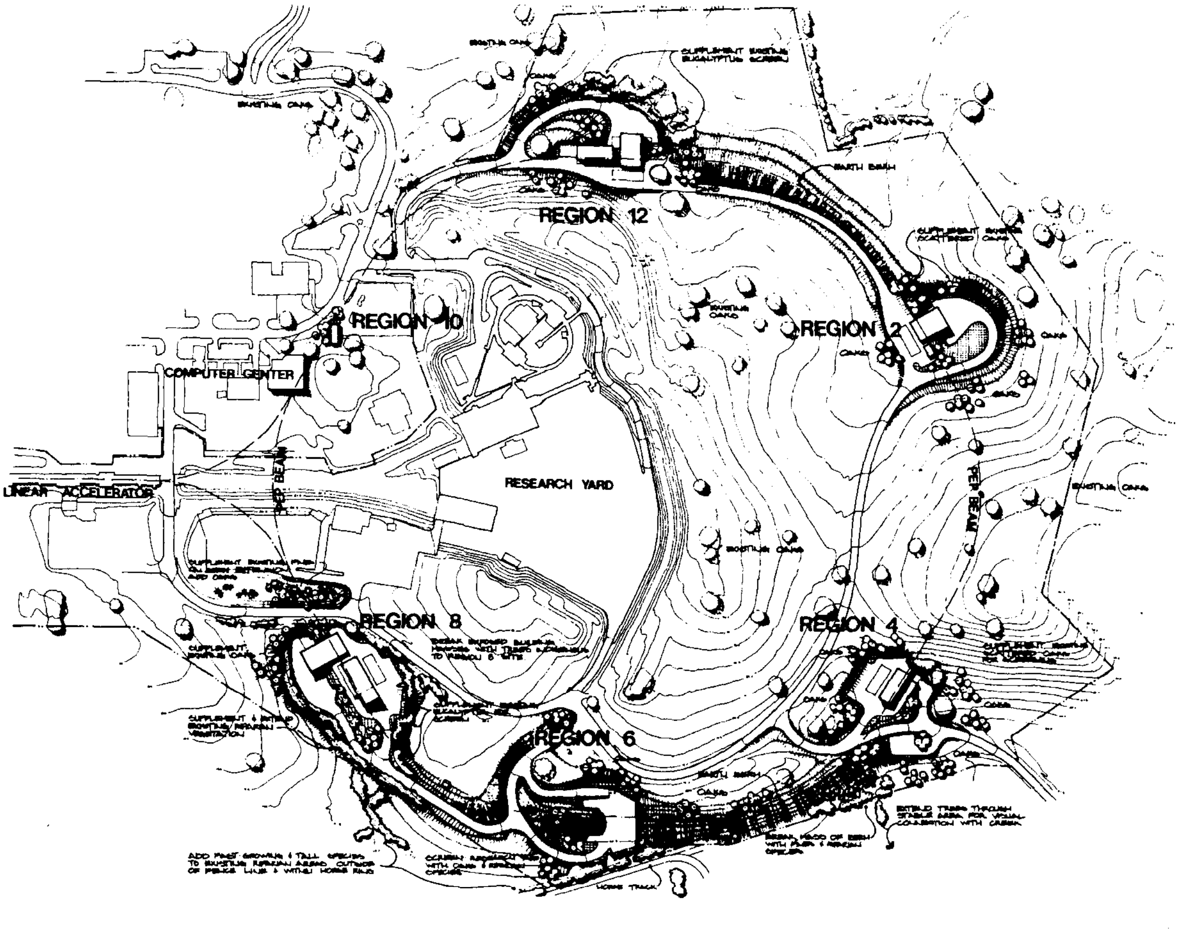
REGION 12
REGION 10
REGION 2
COMPUTER CENTER
LINEAR ACCELERATOR
RESEARCH YARD
REGION 8
REGION 4
REGION 6
EARTH BERM

Fig. 1