Presented at the U. S. -Japan Seminar
on High-Energy Accelerator Science,
Tokyo and Tsukuba, Japan,
November 5-9, 1973

LBL-2422

PEP PROJECT STATUS

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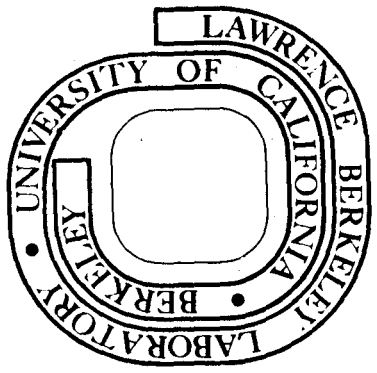
November 1, 1973

Prepared for the U. S. Atomic Energy Commission
under Contract W-7405-ENG-48



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DISCLAIMER

PEP PROJECT STATUS*

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The colliding beam system that provides both proton-electron collisions and electron-positron collisions has been called PEP by its originators at the Stanford Linear Accelerator Center and the Lawrence Berkeley Laboratory.(1) The study of its design and its utilization for high energy physics has been a joint effort by these two laboratories.

The very differing requirements of an electron storage ring and a ring for protons have been made compatible in a design having two rings in a common tunnel. The electron energy at 15 GeV would be governed by the practical level of power lost as synchrotron radiation; the proton energy at about 150 GeV would be limited by the need for high magnetic guide field. To reduce problems associated with a high circulating charge, it was proposed to utilize strong bunching of the beams and to provide low β at the interaction points. The bunching also permits the intersection region to have zero crossing angle but requires a system for bunching the protons. For proton-electron collisions, the luminosity needed has been set at 10^{32} $cm^{-2}sec^{-1}$.

*Work done under the auspices of the U. S. Atomic Energy Commission.

Until recently, the PEP designs had for each type of particle only a single circulating bunch.[1,2] With the high peak currents this provided, the desired luminosity could be attained with only 5×10^{12} protons and 5×10^{12} electrons. Further studies of the collective interactions between beams has brought attention to an uncertainty in the intensity limit that may apply for the proton beam. Therefore, to reduce this beam-beam effect, the design of PEP has moved toward more bunches and wider beams at the interaction points; there has been a consequent increase in the number of protons. I believe Dr. Morton will discuss these considerations in his report on the recent PEP Summer Study.

The basic arrangement of the two rings remains unchanged, as shown in Fig. 1. Magnets in the electron-positron ring are conventional with field strengths of about 3 kilogauss. The proton ring employs superconducting magnets with field near 40 kilogauss. A tentative list of parameters is given in Table I. The reader will note that there are now

bunches of protons. Each straight section contains two interaction regions, for a total of eight. Not listed are the parameters of the special magnets in the straight sections where the beams are brought to coincide and matched to the low-β region.

In 1974 it is expected that SLAC and LBL will submit a joint proposal for the construction of PEP. The proposal will be based on a 2-stage design in which the first stage of construction will omit the full-energy proton ring. It will consist of a 15 GeV electron-positron ring and possibly a 50 GeV proton ring with conventional magnets. These first rings and the tunnel would be made compatible with the final arrangement that would have a superconducting ring for protons. The development of the design and the 2-stage approach is proceeding through

the joint studies underway and the experimental work at SPEAR and at ESCAR.

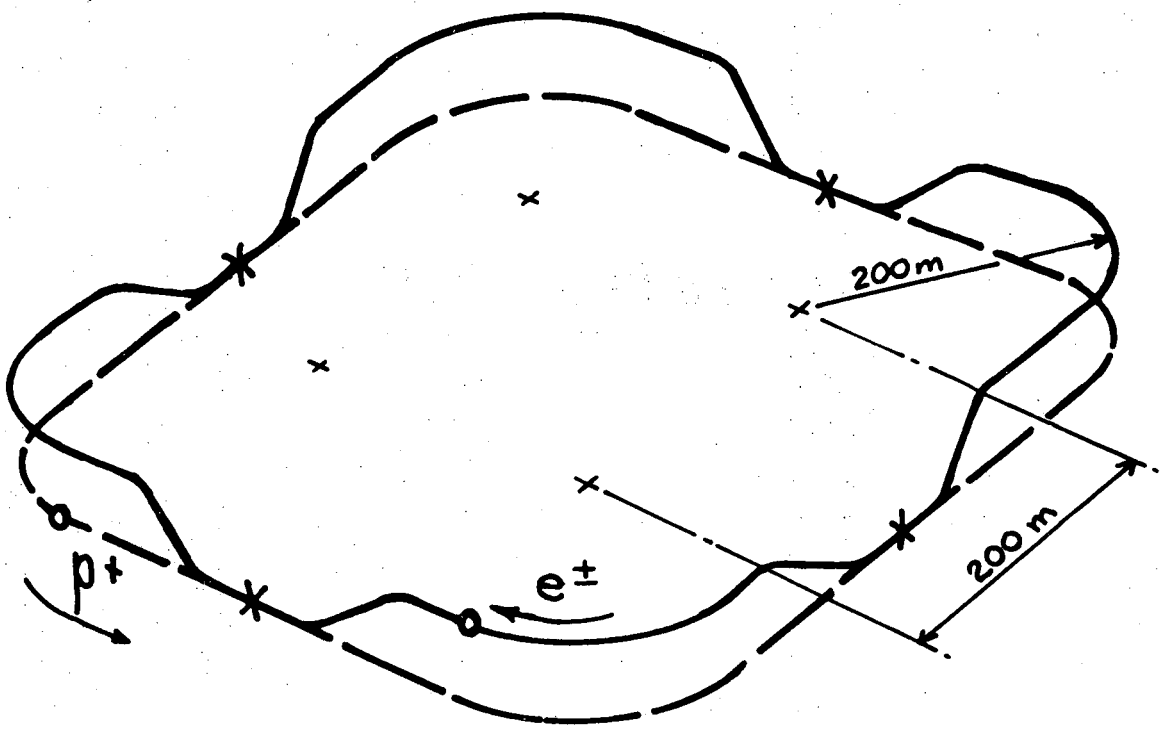
References

1. C. Pellegrini et al., "A High Energy Proton-Electron-Positron Colliding Beam System", Proceedings of the 8th International Conference on High-Energy Accelerators, CERN, 1971, p. 153.

2. T. Elioff, "Proton-Electron-Positron Design Study", Proceedings of 1973 Particle Accelerator Conference, San Francisco, Calif., March 5-7, 1973, p. 1039.

Table I. Mod 8 PEP Parameters, p-e Operation

	p^+		$e^\pm$	
Maximum Momentum	200		15	GeV/c
Number of Particles	3.5×10^{13}		7.5×10^{12}	-
Number of Bunches	28		28	-
Number of Interaction Points		8		m
Length each Int. Region		20		m
Luminosity per Crossing		10^{32}		$cm^{-2}sec^{-1}$
Number of Straight Sections		4		-
Length of Straight Section		185		m
Radiated Power	0		4.5	MW
Circular Quadrants ---				
Radius		216		m
Dipole Field	41.6		2.91	kG
Half Aperture-Radial	6		5.1	cm
-Axial	3		1.6	cm
Intersection Points ---				
Crossing Angle	0		0	deg
Beta Function-Radial	4		1.0	m
-Axial	1		0.25	m
Dispersion	0		0	m
RMS Bunch Length (σ_ℓ)	25		2.6	cm
RMS Beam Width-Radial (σ_x)	0.07		0.07	cm
-Axial (σ_z)	0.018		0.011	cm
Normalized Emittance-Radial ($\beta\gamma\epsilon_x$)	0.016π		8.0π	cm rad
-Axial ($\beta\gamma\epsilon_z$)	0.004π		0.8π	cm rad
Beam-Beam Tune Shift-Radial ($\Delta\nu_x$) per crossing	0.002		0.031	-
-Axial ($\Delta\nu_z$)	0.004		0.038	-



P.E.P. Configuration

XBL 7310-1388

Fig. 1
Schematic of PEP Configuration

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