POLARIZATION GROUP COORDINATORS SUMMARY

L. K. Resvanis

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D. Buchholz
G. Manning
F. Martin
C. Morehouse, Deputy Coordinator
C. Prescott
L. K. Resvanis, Coordinator
G. Shapiro
H. Steiner
R. Schwitters
K. Strauch
W. Toner
P. Wanderer
W. Wenzel

ABSTRACT

The magnitude and direction of the e^+,e^- polarization are very important parameters at PEP. During the Summer Study many polarization monitors were considered together with methods for rotating and controlling the direction of polarization.

It is very important that PEP will be equipped with a monitor that would enable us to measure the magnitude of the transverse polarization of each of the six bunches stored in the ring. It should be a fast monitor so that one could study the effects of the various machine parameters on polarization. As it is well known, the dependence of the polarization P buildup on time is

$$P(t) = P_o(1-e^{-t/\tau}) \qquad \tau = 98 \text{ sec} \times \frac{R^2_{Bend} \times R_{ave}}{E^5(\text{GeV})} ,$$

radius in meters and $P_o = 0.924$.

Table 1 shows the relaxation time τ as a function of energy for PEP.

It is obvious from this curve that for the high side of the PEP energy range one should be able to complete polarization measurements in times of one to two minutes. It should be sufficient to measure just the transverse polarization even if one would rotate the polarization downstream in the PEP lattice. It is simple to calculate the precession of the electron's spin relative to its velocity in a magnetic field perpendicular to the plane defined by its momentum and spin.

Many monitors were considered during this study. At this time a laser monitor using "backward Compton scattering" of circularly polarized photons from a laser, very much like the one to be used at SPEAR II by the University of Pennsylvania-Wisconsin group, seems to be a very practical fast monitor that would enable us to measure either the transverse or the longitudinal polarization. The detector for the backscattered photons could be either a NaI(Tl) calorimeter with or without proportional chambers or a pair spectrometer. Two possible locations for the laser scattering could be either in the region between two bending magnets in one of the lattice cells or at the straight insertion , say at Q1; in the latter case a "beam bump" that would move the beam at the interaction region with the laser photon by some mrad to the side is essential otherwise the detector will be swamped by the beam-gas background of the very long straight insertion. We recommend that there should be two monitors, one for each beam.

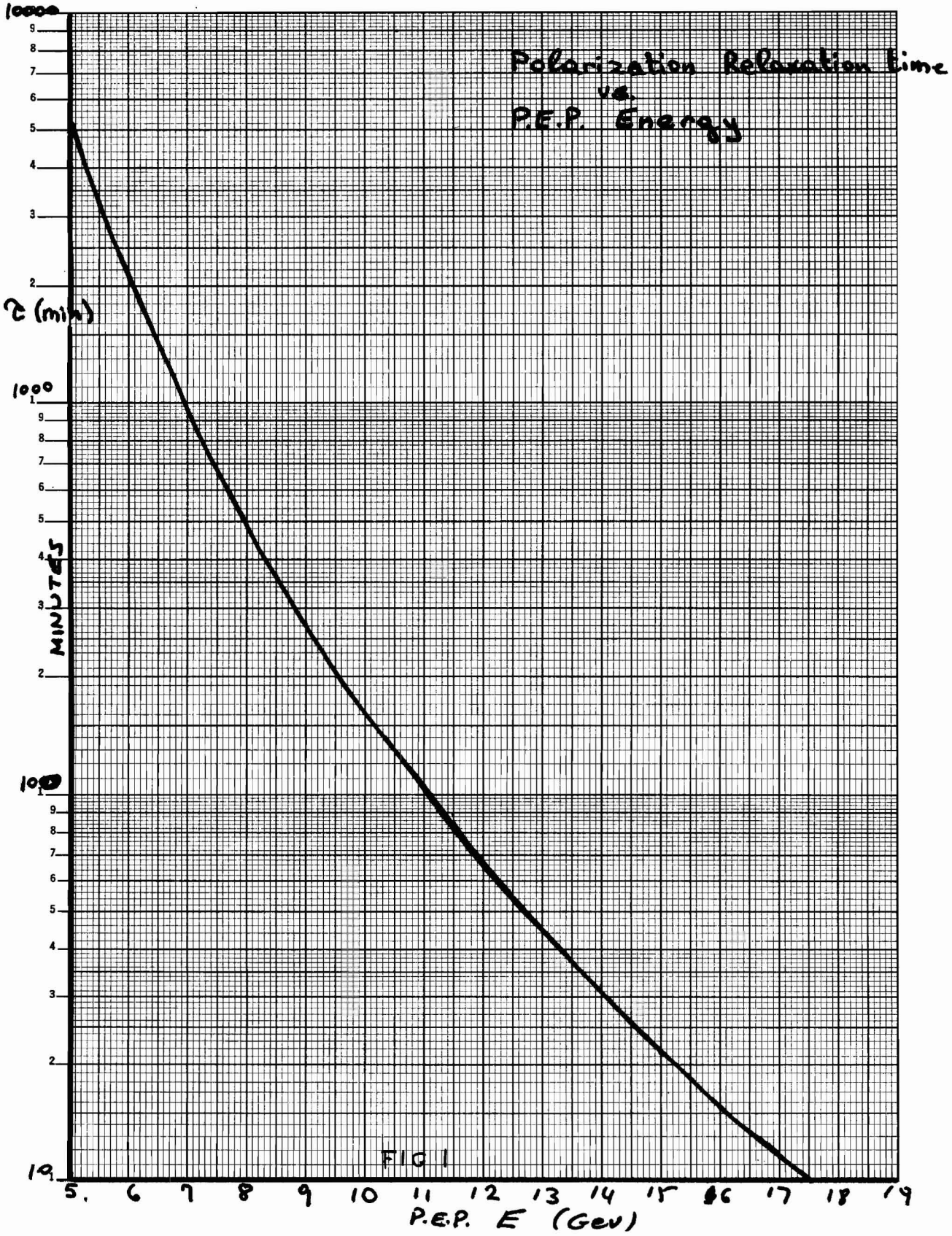
Polarization Relaxation time
vs.
P.E.P. Energy
τ (min)
MINUTES
10000
1000
100
10
1
5. 6 7 8 9 10 11 12 13 14 15 16 17 18 19
P.E.P. E (Gev)

FIG 1

Another monitor, but a very slow one, is some kind of a spectrometer at an interaction region that would measure the $d\sigma/d\Omega$ of $e^+e^- \rightarrow \mu^+\mu^-$ and $e^+e^- \rightarrow \gamma\gamma$. This slow monitor could be used to cross calibrate the fast laser monitor.

A third possibility that was explored only in principle during this summer study is one that uses a polarized electron or atomic beam. The effects that we would get if we scattered a polarized atomic beam onto the polarized stored beam at PEP are very large. For transverse polarization, the asymmetry in the counting rates for the two directions of the spin of the low energy electron beam is $\sim$10% and $\sim$70% for the case of longitudinal polarization. It is clear that it could be a very powerful monitor if one could get high intensity, polarized, low energy atomic beams. These beams should be available in a few years.

Various schemes were investigated for controlling the direction of the polarization. W. Toner has proposed a promising method of using pulsed solenoids to reduce the transverse polarization. This could be implemented to depolarize any or all of the stored bunches. As for rotating the transverse polarization to longitudinal, the method already described in PEP Note 87 is the only practical one at this time. An interaction region should be dedicated for this polarization "rotator" system of vertically bending magnets. Due to the large amount of synchrotron radiation emitted in the "rotator" the operation of any polarization monitor there would be extremely difficult.