Accelerator Instrumentation and Technology for High Energy Physics

John Byrd
Center for Beam Physics
LBNL
PEP-II Electron Cloud Diagnostics

- Question: How to get a more global view of the low energy electrons in the beam pipe?
- Initial idea: Measure electron induced modulation of first TE waveguide modes transmitted in the beam pipe. (Caspers and Kroyer, 2004)
- The results should be directly related to the averaged electron cloud density.

The phase shift for an angular frequency $\omega$ is given by

$$\Delta \phi = -\frac{1}{2} \frac{\omega_p^2}{\omega_c} L$$

with the plasma frequency

$$\omega_p = \sqrt{4\pi \rho_e r_e c^2}$$

For $\rho_e=10^{12}/m^3$, $\Delta \phi \approx 1$ degree

A similar effect can be observed in the ionosphere, limiting the accuracy of GPS.
PEP-II Beam Pipe Transmission Expt

- Hardware installed in Region 12 straight
- Solenoid field available to vary electron density
- Initial tests can run parasitically with operations

Solenoid windings to control $\rho_e$

≈30m

PEP Tunnel

Long coax cable down to tunnel

2.84GHz, -25dBm

Digital Scope Agilent 54621A

Spectrum Analyser HP 8560A

High Pass

~ beam

1 dB

180° 0°

0° 180°

$P_{max} = 15$dBm

PEP-II LER

John Byrd, LBL  
Uli Wienands, SLAC  
Ron Akre, SLAC  
Alan Fisher, SLAC  
Fritz Caspers, CERN  
Tom Kroyer, CERN
Initial observations

An initial test shows some effect. Further studies starting now.