PEP-II Electron Cloud Instability
LER Beam Blowup

LER beam size vs beam current

VERTICAL WIDTH

Wy Sol ON by 4
Wy Sol OFF by 4

BEAM CURRENT, A
Low Energy Ring - Pumping Chamber
Pattern: by-3, 10 bunches, 6 free (micro gaps)
Pattern width: 10 cm.
ASTS PR02 DATA T_VTX2 - ASTS PR02 DATA T_VTX_1

H1=9.25e-003 (0.10)
L1=2.09e-002 (0.39)
M1=9.26e-002 (0.34)
N1=1.79e-002 (0.01)
a1=1.09e-003 (-0.01)
tg= 249 sec
rms=2.76e+000

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IR (Vertex Chamber) Thermocouples

Part I. Current Dependence

Goal: Determine response of thermocouples to each beam current and product of currents.

Fit the data to:

\[ T = T_0 + H I + L I + M I^2 / N_b + N I_x^2 / N_b + a I I_x / N_b \]

varying the coefficients \( T_0, H, L, M, N, a \).

Part II. Frequency

Goal: Determine resonant frequencies of HOM heating.

Part III. Orbit Dependence

Goal: Determine if orbit affects heating.

Part IV. Bunch Length Dependence

Goal: Determine temperature sensitivity to bunch length by varying RF voltage.

\[ \sigma_y \approx \sqrt{V_{rf}}^{-1/2} \]
$dT/I$ vs. $I_b$

- $N_b=692$
- $N_b=333$
- 1660
- Quadratic $C(I^2 I_b)=0.04$
- $I_b=1$, $d\sigma/dI_b=0.50$
- $I_b=1$, $d\sigma/dI_b=0.25$
lower $\beta^* = 35 \text{ cm}$ (simulation)

HER current in A (692 bunches)

luminosity in $10^{33}$

$\beta^*_{x} = 35 \text{ cm}$

current ratio is 2:1

$\beta^*_{y} = 50 \text{ cm}$
\[ \sigma_{0y,\mp}^* = \sqrt{\varepsilon_{0y,\mp} \beta_{y,\mp}^*} \]

\[ \xi_{0y,\pm} = \frac{r_0 N_+ \beta_{y,\pm}^*}{2 \pi \gamma_+ \sigma_{0y,\mp}^* (\sigma_{0x,\mp}^* + \sigma_{0y,\pm}^*)} \]

\[ L_0 = \frac{N_+ N_- f_0}{2 \pi \sqrt{\left( \sigma_{0x,\mp}^* \right)^2 + \sigma_{0y,\mp}^* \sigma_{0y,\pm}^* \sigma_{0x,\pm}^*}} \]
Issues for 3 × 10^{34} Lumi

- HER current to 1.5 A (more RF)
- LER current to 4 A (more RF)
- Lower beam * (≈ 6 mm)
- Move IP quad inward
- Crossing angle (2 × 3 mrad)
- Stronger bunch-by-bunch feedbacks
- Shorter bunches (lower 1/3rd harmonic cavities)
Even Higher Luminosity?

- To get to $3 \times 10^{34}$, we need to lower $\beta_y^*$ down to 5 mm
  ⇒ Hourglass effect is very large for a 10 mm HER bunch so we need to lower HER bunch length down to 6 mm
  ⇒ LER bunch length can already be made short with the added RF stations
  ⇒ Add one more RF station to each ring giving the LER a total of 5 stations and the HER a total of 7.
- Getting $\beta_y^*$ down to 5 mm will mean very large $\beta_y$ max values in the near IP quadrupoles.
- Propose changing the IR B1 magnets by replacing the last 20 cm of bending field with quadrupole field.
  ⇒ This introduces a crossing angle of ±3.25 mrad at the IP.
  ⇒ The crossing angle separates the beams enough at 31.5 cm from the IP to allow filling every single RF bucket or 3320 bunches. This keeps the bunch current down and allows for more total current
  ⇒ The extra focusing lowers the $\beta_y$ max values by 20% in the LER and 15% in the HER.
  ⇒ Removing some of the B1 bending field reduces the synchrotron radiation power generated in these magnets.
Several feasibility studies underway. Studies with several possible avenues.

A luminosity approaching 3E34 is being added to chamber heating.

The RF stations, the electron cloud, etc. blowup.

There is a definite plan in place to raise the luminosity to 1E34. Big issues are building.

was 129% of design.

and the best integrated luminosity per day.

The luminosity ended at 103% of the design.

The PEP-II Run with Babar went very well.

PEP-II Summary