PEP-II Report

John T. Seeman
for the PEP-II Staff
SLAC EPAC Meeting
November 21, 2002
PEP-II Topics

- Final summer results
- Summer down
- This year’s run plan
- This year’s projected luminosity
- Future plans
PEP-II $e^+e^-$ Collider
PEP-II Integrated Luminosity for Run 2001-2002

PEP-II Total Delivered Luminosity for 2002

Grand total delivered 101.16 fb$^{-1}$

31.88 fb$^{-1}$
PEP-II Records

Peak Luminosity

$4.602 \times 10^{33}$ cm$^{-2}$sec$^{-1}$

800 bunches  1775 mA LER  1050 mA HER

March 19, 2002

Integration records of delivered luminosity

Best shift (8hrs)  $1083$ pb$^{-1}$  Mar 4, 2002

Best 3 shifts in a row  $3088$ pb$^{-1}$  Dec 22-23, 2001

Best day  $2887$ pb$^{-1}$  Dec 7, 2001

Best 7 days  $1865$ fb$^{-1}$  Oct 23-29, 2001

Best week  (Sun 0:00 to Sat 24:00)  $1836$ fb$^{-1}$  Oct 21-27, 2001

Best month  $666$ fb$^{-1}$  May 2002

Total delivered  $101.16$ fb$^{-1}$
PEP-II Integrated Luminosity since May 1999

Total PEP-II Delivered Luminosity

- 101.16 fb⁻¹
Summer Down

- IR work allowing increased currents
- Two new RF stations
- Planning for reduced $\beta_y^*$
Interaction point improvements for reduced beam heating

- IP bellows cooling (air and water)
- New Q2 chamber
- New Q2 bellows
- New beam loss monitors
- Repaired vacuum valves
- > x5 improvement in beam heating capacity
Forward Cooling Collars
Higher beam currents

- Installed two new HER RF stations
- Commission one new LER RF station
- Shortened abort gap from 5% to 2.5%.
- Improved cooling on bunch feedback kickers
- More shielding near LER IR collimators for backgrounds
- Plan to increase each beam current by $1.4$. 
Shortened Abort Gap
Lower $\beta_y$* from 13 to 9 mm

- New x-y BPMs at sextupoles in both rings for improved steering
- New ring correction algorithms (MIA)
- Better IR coupling control with better lattice model
- Move horizontal tunes to near half integer
- Luminosity gain equals 13/9 or $\sim 1.4$
Today’s PEP-II Status

- PEP-II work finished November 11.
- Personnel Protection System (PPS) checks done by November 14.
- Turn-on started November 15. Linac to 30 Hz.
- HER stored beam late November 15.
- LER stored beam mid-November 16.
- Luminosity reached $8 \times 10^{31}$ on November 18.
- Now beam scrubbing for vacuum.
- Repair day Tuesday for NEG activation.
# Predicted Integrated Luminosity FY2003

## PEP-II Integrated Luminosity for Run 2002-2003

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Days</th>
<th>Peak to Average Luminosity</th>
<th>Peak Luminosity xE33 (at end)</th>
<th>Integrated luminosity per period fb-1</th>
<th>Cumulative integrated luminosity fb-1</th>
<th>Positron current (mA)</th>
<th>Electron current (mA)</th>
<th>Beta γ* (cm)</th>
<th>Beta x* (cm)</th>
<th>Number of bunches</th>
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</thead>
<tbody>
<tr>
<td>2002</td>
<td>November</td>
<td>15</td>
<td>0.20</td>
<td>4.0</td>
<td>0.5</td>
<td>0.5</td>
<td>1850</td>
<td>960</td>
<td>1.20</td>
<td>50</td>
<td>900</td>
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<tr>
<td>2002</td>
<td>December</td>
<td>23</td>
<td>0.45</td>
<td>4.6</td>
<td>3.8</td>
<td>4.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2003</td>
<td>January</td>
<td>24</td>
<td>0.45</td>
<td>5.0</td>
<td>4.5</td>
<td>8.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2003</td>
<td>February</td>
<td>28</td>
<td>0.45</td>
<td>5.5</td>
<td>5.7</td>
<td>14.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2003</td>
<td>March</td>
<td>31</td>
<td>0.45</td>
<td>6.0</td>
<td>6.9</td>
<td>21.5</td>
<td>2200</td>
<td>1100</td>
<td>1.00</td>
<td>47</td>
<td>900</td>
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<tr>
<td>2003</td>
<td>April</td>
<td>30</td>
<td>0.45</td>
<td>6.5</td>
<td>7.3</td>
<td>28.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2003</td>
<td>May</td>
<td>31</td>
<td>0.45</td>
<td>7.0</td>
<td>8.1</td>
<td>36.9</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2003</td>
<td>June</td>
<td>30</td>
<td>0.43</td>
<td>7.5</td>
<td>8.1</td>
<td>45.0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2003</td>
<td>July</td>
<td>31</td>
<td>0.40</td>
<td>8.0</td>
<td>8.3</td>
<td>53.3</td>
<td>2500</td>
<td>1300</td>
<td>0.90</td>
<td>45</td>
<td>1050</td>
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Integrated Lum = 0.0864 x Days x Ave/Pk Ratio x (End period peak lumi + Previous end period peak lumi) / 2.
Path to higher PEP-II luminosity

<table>
<thead>
<tr>
<th></th>
<th>Luminosity</th>
<th>I+</th>
<th>I-</th>
<th>Beta y*</th>
<th>Beta x*</th>
<th>Bun. Length</th>
<th># bunches</th>
<th>Vert. emit</th>
<th>Horiz. Emittance</th>
<th>Crossing angle</th>
<th>Tune shifts (x/y)</th>
<th>Number RF stations</th>
<th>Date hardware ready</th>
<th>Date for luminosity</th>
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<tr>
<td></td>
<td>4.6E33</td>
<td>1E34</td>
<td>2E34</td>
<td>4E34</td>
<td>5.0</td>
<td>5.0</td>
<td>1700</td>
<td>0.9</td>
<td>40/50</td>
<td>0</td>
<td>7.5/3.9</td>
<td>7</td>
<td>Jan 02</td>
<td>Jun 02</td>
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<tr>
<td></td>
<td>1800</td>
<td>2700</td>
<td>3600</td>
<td>5000</td>
<td>50</td>
<td>13</td>
<td>1700</td>
<td>13</td>
<td>35/45</td>
<td>(+/-8?)</td>
<td>7.9/5.9</td>
<td>15</td>
<td>Nov 02</td>
<td>Fall 03</td>
</tr>
<tr>
<td></td>
<td>950</td>
<td>1400</td>
<td>1800</td>
<td>2400</td>
<td>50</td>
<td>0.6</td>
<td>1700</td>
<td>15</td>
<td>40/53</td>
<td>+/-8</td>
<td>8.7/6.2</td>
<td>15</td>
<td>Nov 05</td>
<td>Fall 06</td>
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<td>11.5</td>
<td>9</td>
<td>7.0</td>
<td>5.0</td>
<td>50</td>
<td>0.8</td>
<td>1300</td>
<td>0.9</td>
<td>40/50</td>
<td>+/-8</td>
<td>8.7/6.2</td>
<td>0</td>
<td>Nov 07</td>
<td>Fall 08</td>
</tr>
</tbody>
</table>

Units: mA, mm, cm, nm, mrad, x100
PEP-II upgrade with Permanent Magnet Quadrupoles

Possible $4 \times 10^{34}$ Interaction Region with a $\pm 3.25$ mrad Xangle

M. Sullivan
Jun. 14, 2000
PEP-II Summer 2003 Projects

- New HER # 8 RF station (+200 mA).
- New HER collimator (30 m upstream).
- New Longitudinal feedback kickers.
- Improved low level RF feedback circuits (higher I).
- More x-y BPMs in IR2 region.
- LER straight section solenoid upgrade.
- Octupoles for tune shift with amplitude studies.
Projects for $2 \times 10^{34}$ by Summer 2005

- Accelerator improvements:
  - Three more RF stations.
  - New IR vacuum chamber and cooling.
  - Significant bunch-by-bunch feedback upgrades.
  - Some high power chamber upgrades.
  - Bunch shortening hardware (HER only?)
  - Crossing angle optics and vacuum (?)
Super B-Factory Studies

- Studies underway with discussions with other $e^+e^-$ collider laboratories.
- New set of parameters established in May 2002.
- Limiting site power will likely require:
  - Higher RF frequency (952 MHz)
  - Larger bore vacuum chambers (x2 to x3)
  - Softer dipole bend radii
Present Parameters for 1E36 (using PEP-II Tunnel)

- Beam particle          e+       e-
- Beam energy (GeV)       8.0      3.5
- Circumference (m)       2200
- Number of bunches       7000
- Bunch length (mm)       1.75
- Beam lifetime (min)     7        5
- Beam current (A)        10.3     23.5
- Beta* (x/y) (mm)        15/1.5
- Emittances (x/y) (nm)   44/0.44
- IP beam sizes (microns x/y)  81/0.8
- Beam-beam tune shifts   0.10
- RF Frequency (MHz)      952
- Luminosity (/cm^2/s)    10^{36}
- Wall plug power (MW)    ~105
IR for a $10^{36}$ B-Factory

PEP-II $10^{36}$ B-Factory +/- 12 mrad xing angle Q2 septum at 2.5 m
PEP-II Summary

- PEP-II has delivered >101 fb\(^{-1}\).
- Summer down went well.
- Turn-on started November 15 as planned and is going better than expected.
- Upgrades and running for FY2003 on track.
- Need to put more effort on out-year improvements and upgrades.