

The Last Year of PEP-II B-Factory Operation

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> EPAC 2008 Genoa June 24, 2008



The PEP-II Team





PEP-II was constructed by SLAC, LBNL, and LLNL with help from BINP, IHEP, BaBar collaboration. Many thanks to the US Department of Energy and members of the Machine Advisory Committee.





PEP-II Layout



Two rings: Circumference = 2.2 km.



The PEP-II Collider





LER Magnets and Aluminum Vacuum System (LBNL)

Magnets made by our Chinese — IHEP collaborators

Antechambers Reduce Electron-Cloud-Instability

LER SR power = 2 MW.





LER Wiggler Chamber (LLNL)



Downstream Wiggler Chamber #5

02/03/98



PEP-II HER Copper Vacuum System (SLAC)



Cu chambers absorbing 100 W/cm of synchrotron radiation

Total SR power = 10 MW in the HER



PEP-II interaction region layout

Horizontal layout

Vertical Layout





PEP-II Interaction Region Components near BaBar



Accelerator Systems Division How the beams enter and exit the PEP-II Interaction Region

PEP-II Interaction Region





IR Permanent Magnets





Permanent Magnet Crew



Interaction region vacuum chambers









Interaction Region Support Tube





MS_140 Support Tube ready for Installation

06/08/98



Be chamber

Silicon Vertex Tracker SVT





The BaBar Detector





Brief PEP-II History

- 1987: Physics: asymmetrical energies preferred.
- 1991: First PEP-II CDR.
- 1993: Second CDR.
- 1994: Construction started.
- 1997: First stored HER e⁻ beam.
- 1998: First stored LER e⁺ beam.
- 1998: First collisions July 23, 1998.
- 1999-2007: Y4S data for BaBar (433 fb⁻1)
- 2008: Y2S (30 fb⁻¹), Y3S (15 fb⁻¹), and small energy scan for BaBar.
- 2008: Turned off PEP-II April 7, 2008.



PEP-II Peak Luminosity by Month (1999-2008)







SLAG





PEP-II total integrated luminosity: 557 fb⁻¹





 ξ_v is the beam-beam parameter (~0.06)

 I_b is the bunch current (1 to 3 mA)

n is the number of bunches (~1700)

 β_y^* is the IP lattice optics function (vertical beta) (10 mm) E is the beam energy (3.1 and 9 GeV) (fixed) Luminosity (10³³ cm⁻² s⁻¹)

$$L = 2.17 \times 10^{34} \frac{n\xi_y EI_b}{\beta_y^*}$$



PEP-II Parameters for 3.1 GeV x 9.0 GeV

Doromotor	Linita	Design	April 2008	2008
Parameter	UIIIts		Best	Potential
I+	mA	2140	3210	3700
I-	mA	750	2070	2200
Number bunches		1658	1722	1740
β_{y}^{*}	mm	15-25	9-10	8.5
Bunch length	mm	15	11-12	9
ξ _y		0.03	0.05-0.06	0.07
Luminosity	x10 ³³	3	12	20
Int lumi / day	pb ⁻¹	130	911	1300
	4 times design		7 times design	



Running before Trickle (Continuous) Injection





Continuous Injection for PEP-II



01/29/2008 10:10:15



PEP-II RF Cavity



Early design and testing at LBL.

High power production cells.

Fully fitted cavity units with HOM dampers.

CAV_17

PEP-II

PEP-II High Power RF Cavity

8-19-97







B-Factory RF Klystrons (1.2 MW)





Optimal klystron operating points for stable beams



SLAG Bunch-by-bunch feedback systems (John Fox: Wed)





Frascati longitudinal kicker





LBL transverse kicker

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LER and HER RF Stability Limits



Adequate margin for 2.2A, with proper kicker timing.



Close up of tile and RF seal damage

HOM damage on RF seals .

HOM damage on absorbers







HER blows up in 14 msec



Streak camera Timing plots

Bunch arrival time



HOM Absorbing Bellows





Final sliding bellows solution

The new MKIII bellows





Luminosity drop in "long" mini-trains from ECI \rightarrow Solenoids





Lower β_y^* to increase luminosity



SLAG

Beam-beam observations

Set fractional tunes (x/y) = 0.508/0.572

Corrected lattice optics to design criteria for optimal emittances







Beam-beam parameters



I⁻ increases LER y size.
I⁺ increases LER x size.
I⁺ increases HER y size.



 $\xi_y = 0.05 \text{-} 0.06$

 $\xi_x = 0.03 - 0.09$



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Accelerator Systems Division

BaBar IP measurements reported online

- Luminous Region
 - centroids { x, y, z}
 - sizes { x, z }
 - tilts { dx/dz, dy/dz }
 - dL/dz fit { Σ_z , β_y^* , z_w , z_c }
- Boost Trajectory
 - mean { x', y' }
 - spread { x'_{HER} , y'_{HER} }

every 10 minutes

every ~hour

every 10 minutes every 30 minutes

e- beam

e+ beam

Luminosity measurements at 1Hz



IP Beam Size Measurements with BaBar





IP Beta Function Measurements (BaBar)





PEP-II General Accelerator "Achievements"

- Introduced beta-beats to help chromatic corrections near IR.
- First collider to continuously inject into a ring with the physics detector taking data.
- Installed 2 km of solenoids on the e⁺ LER ring to suppress the Electron Cloud Instability ECI.
- Held the overall luminosity record for several years. Now second to KEKB (1.2 vs 1.7 x 10³⁴)
- Highest stored electron current (2.1 Amps)
- Highest stored positron current (3.2 Amps)



PEP-II Records

Peak Luminosity

Last update: April 8, 2008

12.069×10³³ cm⁻²sec⁻¹ 1722 bunches 2900 mA LER 1875 mA HER

August 16, 2006

Integration records of delivered luminosity

Best shift (8 hrs. 0:00, 08:00, 16:00)	339.0 pb ⁻¹	Aug 16, 2006
Best 3 shifts in a row	910.7 pb ⁻¹	Jul 2-3, 2006
Best day	858.4 pb ⁻¹	Aug 19, 2007
Best 7 days (0:00 to 24:00)	5.411 fb ⁻¹	Aug 14-Aug 20, 2007
Best week (Sun 0:00 to Sat 24:00)	5.137 fb ⁻¹	Aug 12-Aug 18, 2007
Peak HER current	2069 mA	Feb 29, 2008
Peak LER current	3213 mA	Apr 7, 2008
Best 30 days	19.776 fb ⁻¹	Aug 5 – Sep 3, 2007
Best month	19.732 fb ⁻¹	August 2007
Total delivered PH	557 fb ⁻¹ CP-II turned off April	7, 2008



PEP-II 1998-2008: Thanks to all!

