Status of PEP-II and BABAR

Presentation on behalf of

SLAC / LBNL / LLNL PEP-II Group, SLAC Accelerator Department

and the

71 Institution, 9 Nation BABAR Collaboration



Lepton Photon '99 Stanford Linear Accelerator Center August 9, 1999





SLAC B Factory Chronology

October 1993	President Clinton endorses <i>B</i> Factory project at SLAC
December 1993	Inaugural meeting at SLAC to form BABAR Collaboration
January 1994	DOE Releases \$14M to begin construction of PEP-II
	PEP-II was built as a collaboration of LBNL, LLNL and SLAC
March 1995	BABAR Technical Design Report complete
July 1998	PEP-II complete First Collisions observed July 22, 1998
December, 1998 to March, 1999	Cosmic Ray Commissioning of BABAR
March-May 1999	BABAR is moved onto PEP-II beamline Machine and Detector are readied for opertation
May 26, 1999	First Observation of hadronic events
June 15-17, 1999	Scan of $\gamma(4S)$ resonance





PEP-II Parameters

	e +	e -
CM energy (GeV)	10.580	
Beam energy (GeV)	3.119	8.973
Beam current (A)	2.15	0.75
$\beta_{\mathbf{x}} * \mid \beta_{\mathbf{y}} * (\mathbf{cm})$	50 1.5	50 1.5
ε _x ε _y (nm)	49 1.5	49 1.5
σ _{x*} (μm)	157	
σ _{r*} (μm)	4.7	
σ z (mm)	12.3	11.5
Luminosity	3 x 10 ³³	³ cm ⁻² s ⁻¹
Tune shift	0.03	
Beam aspect ratio (v / h at IP)	0.03	
Number of colliding bunches	1658	
Bunch spacing (m)	1.26	
Beam crossing angle	0 (head-on)	













USA

[34/349]

California Institute of Technology UC. Irvine UC, Los Angeles UC, San Diego UC. Santa Barbara UC, Santa Cruz U of Cincinnati U of Colorado Colorado State Florida A&M U of Iowa Iowa State U LBNL LLNL U of Louisville U of Maryland U of Massachusetts, Amherst MIT U of Mississippi Mount Holyoke College Northern Kentucky U U of Notre Dame ORNL/Y-12 U of Pennsylvania Prairie View A&M Princeton Rutgers SLAC U of South Carolina Stanford U U of Tennessee U of Texas at Dallas Vanderbilt U of Wisconsin

The BABAR Collaboration

9 Countries 71 Institutions 652 Collaborators

Canada

[5/17]

U of British Columbia McGill U U de Montréal TRIUMF U of Victoria

China

Inst. of High Energy Physics, Beijing

France

[5/71]

[1/6]

LAPP, Annecy LAL Orsav LPNHE des Universités Paris 6/7 Ecole Polytechnique CEA, DAPNIA, CE-Saclay

Germany [2/21]

Ruhr U Bochum Technische U Dresden

Italy [12/92]INFN. Bari INFN, Ferrara

Lab. Nazionali di Frascati dell' INFN INFN, Genova INFN, Milano INFN, Napoli INFN, Padova INFN. Pavia INFN, Pisa INFN, Roma and U "La Sapienza" INFN, Torino INFN, Trieste

Norway U of Bergen

[1/4]

Russia [1/15] Budker Institute, Novosibirsk

United Kingdom [10/77]

U of Birmingham U of Bristol Brunel University U of Edinburgh U of Liverpool Imperial College Queen Mary & Westfield College Royal Holloway, University of London U of Manchester Rutherford Appleton Laboratory

May, 1999





BABAR Detector System Performance Parameters

Detector	Technology	Dimensions	Performance
SVT	Double-sided silicon strips	5 layers r=3.2 to 14.4 cm $-0.87 < \cos \theta < 0.96$	$\sigma_z = \sigma_{xy} = 50 \mu\text{m} / p \oplus 15 \mu\text{m} \oplus 90^{\circ}$ $\sigma_{\phi} = \sigma_{\theta} = 1.6 \text{mr} / p \oplus 90^{\circ}$
DC	Drift chamber	40 layers <i>r</i> =22.5 to 80 cm	$\sigma_{p_t} / p_t = [0.21\% + 0.14\% \times p_t]$
		-111< <i>z</i> <166 cm	
PID	DIRC	$1.75 \times 3.5 \text{ cm}^2 \text{ quartz}$	$N_{pe} = 20 - 50$
_		$-0.84 < \cos\theta < 0.90$	$\geq 4\sigma K / \pi$ separation for all <i>B</i> decay products
CAL	CsI(Tl)	16 to 17.5 X_0	$\sigma_E / E = [1\% / E(\text{GeV})]^{1/4} \oplus 1.2\%$
		~4.8 x 4.8 cm crystals	$\sigma_{\theta} = 3 \text{ mr} / \sqrt{E(\text{GeV})} \oplus 2 \text{ mr}$
MAG	Super-	IR = 1.40 m	B = 1.5 T
	Segmented steel	L = 3.85 m	
IFR	RPC	18-19 planar layers	ε_{μ} > 90%
		+ 4 cylindrical layers	for $p_{\mu} > 0.8 \text{ GeV} / c$











Silicon Vertex Tracker











Drift Chamber and Endcap Calorimeter



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Calorimeter Main Support Cylinder



Module Insertion 04/01/98













First Collisions in BABAR Hadronic Event May 26, 1999

PEP-II, showing the High Energy (below) and Low Energy Rings



PEP-II Interaction Region prior to installation of BABAR



M(γ) = 10.5841 <u>+</u> 0.0007 GeV Γ (γ) = 11.1 <u>+</u> 3.4 MeV





PEP-II Luminosity, July 1999







PEP-II / BABAR Typical of the Best Performance Achieved to Date



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PEP-I



PEP-II HER Performance Results

Parameter	<u>Units</u>	<u>Design</u>	Commissioning: <u>No Detector, "best"</u>	Running with B _A B _{AR} , "typical"
Energy	GeV	9.0	9.0, ramp to 9.1 & back	9.0, ramp 8.84-9.04
Single bunch current	mA	0.6	12	0.55
Number of bunches		1658	1658	415
Total beam current	Α	0.995	0.75	0.25
Beam Lifetime	hours	4	8 hrs @ 250mA	6 hrs @ 250µamp
Max. Injection Rate	mA / sec	2.1 @ 60Hz	2.5 @ 10Hz	0.6 @ 10 Hz

PEP-II LER Performance Results

Parameter	<u>Units</u>	<u>Design</u>	Commissioning: <u>No Detector, "best"</u>	Running with <u>BaBar , "typical"</u>
Energy	GeV	3.1	3.1	3.1
Single bunch charge	mA	1.3	7.0	1.9
Number of bunches		1658	1658	415
Total charge	Α	2.14	1.171	0.8
Beam Lifetime	hours	4	50 min @ 800 mA	120 min @ 800 mA
Max. Injection Rate	mA / sec	5.9 @ 60 Hz	3.0 @ 10 Hz	2.7 @ 10 Hz





PEP-II Luminosity Performance: Best Achieved

<u>Parameter</u>	<u>Units</u>	<u>Design</u>	Commissioning: <u>No Detector</u>	Running with <u>BaBar</u>
Luminosity	cm ⁻² sec ⁻¹	3x10 ³³	5.2x10 ³²	5.6x10 ³²
Specific Luminosity	cm ⁻² sec ⁻¹ mA ⁻²	3.1x10 ³⁰	1.7x10 ³⁰	2.1x10 ³⁰
Horizontal Spot Size	μm	220	220	220
Vertical Spot Size	μm	6.6	8.6	10.8

PEP-II delivered 150 pb⁻¹ in June and July





Physics Running

- Both PEP-II and BABAR are performing efficiently
- As of the end of July 1999, BABAR has logged 150pb⁻¹
- Detector device occupancies are < 20% of the allowable levels at $\mathcal{L} > 5x10^{32}$ cm⁻² sec⁻¹
- Occupancies are linear with current / luminosity
- Radiation levels, including injection, are ~20%
 of pre-ordained budget
- Current run will continue until Xmas 1999, with a two-week hiatus in October to install the 8 missing DIRC Barboxes
- Running will commence again in February 2000. Anticipate a two-month shutdown in September 2000









BABAR

Tracker Occupancies vs LER Current









EMC digi's (>10 MeV) vs. LER current



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Detector Performance Studies

- Clearly it is much too early to expect physics results
- What we show today are plots which are representative of the process of tuning up and monitoring the performance of BABAR. This is an evolving process, and much work remains to be done











PEP-II





















Invariant Mass/GeV

