

US LARP

Electron Cloud and Beam-Beam at LBNL: Progress and Plans

Miguel A. Furman (LBNL)
mafurman@lbl.gov

US LARP Collaboration Mtg.

FNAL, Feb. 26-27, 2004



BNL-FNAL-LBNL

LARP mtg., 26-27 Feb. 2004. M. Furman: Electron Cloud and Beam-Beam at LBNL p. 1

LARP Personnel, Collaborators and Contacts

- LBNL-LARP:
 - J. Qiang (beam-beam)
 - M. Furman (electron cloud)
- CERN:
 - F. Zimmermann
 - F. Ruggiero
 - W. Herr
 - J. M. Jiménez
 - G. Arduini
 - N. Hilleret
- SLAC:
 - M. Pivi
 - R. Kirby
- BNL
 - W. Fischer
- In addition, related work (PSR, APS, PEP-II, ...) in collaboration and/or consultation with:
 - R. Macek (LANL)
 - M. Blaskiewicz (BNL)
 - K. Harkay (ANL)
 - G. Rumolo (GSI)
 - R. Cimino (INFN-Frascati)
 - I. Collins
 - A. Adelmann (PSI)
 - J. L. Vay (LBNL)
 - A. Wolski (LBNL)



BNL-FNAL-LBNL

LARP mtg., 26-27 Feb. 2004. M. Furman: Electron Cloud and Beam-Beam at LBNL p. 2

Electron-cloud progress

- Code improvements
 - Rectangular cross-section chamber (SPS)
 - Combine POSINST (2D) with WARP (3D, parallel PIC; done in collaboration with HIF under an LDRD)
 - Tech-X is “official” distributor of EC computer modules developed at LBNL
- Further code calibration at PSR
 - At beam extraction
 - EC decay implies $\langle \rangle(0) \sim 0.4\text{-}0.5$, consistent with expectations



BNL-FNAL-LBNL

LARP mtg., 26-27 Feb. 2004. M. Furman: Electron Cloud and Beam-Beam at LBNL p. 3

Electron cloud tasks

- Understand ECE at RHIC, test code predictions, identify important parameters
 - Arcs vs. warm sections
- SPS:
 - Reproduce measured spectrum and spatial distribution
 - Reproduce calorimeter results; understand parameter sensitivities
 - Understand POSINST-ECLOUD differences
 - Investigate train pattern dependence
- Better measurements for simulation input:
 - SEY at low energy (<20 eV); reproduce CERN data (Cimino-Collins)
 - Photoelectric yield and photon reflectivity (cold vs. RT; B-field effect (?)) for actual sawtooth beam screen samples; resolve existing discrepancies (at ALS?)
- LHC
 - CERN will install an ECE diagnostic bench in IR4 (J. M. Jiménez) similar to SPS
 - Simulate and predict!
- Collect more information at ECLOUD04 ICFA workshop
 - Napa, California, April 19-23, 2004
 - co-sponsored by ICFA, LBNL, CERN, ORNL and SNS
 - <http://www.cern.ch/icfa-ecloud04>



BNL-FNAL-LBNL

LARP mtg., 26-27 Feb. 2004. M. Furman: Electron Cloud and Beam-Beam at LBNL p. 4

Electron cloud tasks (contd.)

- Main deliverables for FY05-06 (list subject to revision):
 - Good understanding of SPS and RHIC observations
 - Good understanding of parameter sensitivities for LHC
 - Improved data on SEY, photoelectric yield and photon reflectivity



BNL-FNAL-LBNL

LARP mtg., 26-27 Feb. 2004. M. Furman: Electron Cloud and Beam-Beam at LBNL p. 5

Beam-beam progress

- Code BEAMBEAM3D (J. Qiang)
 - Benchmarked against KEK and SLAC codes (K. Ohmi and Y. H. Cai)
 - Good agreement for both impulse approx. and long-bunch approx.
 - However, discrepancy in convergence rate in long-bunch approx.
- Coherent modes computed at RHIC (with W. Fischer)
 - Both single-bunch and multibunch modes (3 bunches/4 IPs)
 - Effects of bunch-to-bunch intensity dependence on spectrum: degeneracy lifted



BNL-FNAL-LBNL

LARP mtg., 26-27 Feb. 2004. M. Furman: Electron Cloud and Beam-Beam at LBNL p. 6

Beam-beam tasks

- Benchmark BEAMBEAM3D against CERN fast multipole code
- Exercise crossing angle&finite bunch length features for hadron colliders
 - Especially concerning LBNL “sweeping beam” luminometer
 - So far, done only for e+e- colliders; agreement with K.Ohmi
- Emittance growth for separated beams
- Further study long-time behavior (so far, done 10^6 turns in LHC/single IP)
- Parasitic collisions for LHC (so far, for TEVATRON only)
- Characterize the beam-beam limit for the LHC



BNL-FNAL-LBNL

LARP mtg., 26-27 Feb. 2004. M. Furman: Electron Cloud and Beam-Beam at LBNL p. 7

Beam-beam tasks (contd.)

- Main deliverables for FY05-06 (list subject to revision)
 - Good understanding of RHIC observations
 - Benchmark BEAMBEAM3D against CERN code (fast multipole method)
 - Reasonable understanding of crossing angle + finite bunch length effects



BNL-FNAL-LBNL

LARP mtg., 26-27 Feb. 2004. M. Furman: Electron Cloud and Beam-Beam at LBNL p. 8

Commissioning plans

- Potential people for SPS shifts summer 2004:
 - Andy Wolski (LBNL)
 - Mauro Pivi (SLAC)
 - Marco Venturini (LBNL)
 - Andreas Adelmann (PSI) (?)
 - Miguel Furman (LBNL) (?)
- Participate in LHC EC diagnostic bench measurements since day 1
 - to be discussed with CERN
- Present and foreseen effort in the LARP Program Proposal (in FTEs):

	FY04 (actual)	FY05	FY06
BB	0.1	0.1	0.2
EC	0.13	0.4	2



BNL-FNAL-LBNL

LARP mtg., 26-27 Feb. 2004. M. Furman: Electron Cloud and Beam-Beam at LBNL p. 9