2nd EUROTeV Annual Meeting

WP3: Damping Rings

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Damping Ring WP3 Tasks

- ECLOUD: Studies of Electron Cloud and other Instabilities (CERN, DESY, INFN, CCLRC)
- RFSEP: Application of RF Separators and Fast Kickers to DR injection (INFN)
- WGLRDYN: Wiggler Field Modelling and Impact on Dynamic Aperture (INFN)
- LETS: Low Emittance Tuning Simulations (DESY, CCLRC)

2nd EUROTeV Workshop
LAL, Orsay, 15-17 May 06

Second milestone achieved

Presentation of results and detailed implementation at the second workshop

http://events.lal.in2p3.fr/conferences/eaef/

ILC Activity

• This year has seen an intense activity for the preparation of the ILC Reference Design Report (RDR)

• The WP3 participants have contributed to this process and attended the dedicated GDE meetings:

- "GDE Area System Leaders Meeting", KEK (Jp), January 19-20, 2006, http://lcdev.kek.jp/GDE/ASL2006KEK/
- "LCWS06 and GDE Meeting", Bangalore, India, 9-11 March 2006, sito web
- "Vancouver Linear Collider Workshop VLCW06", 19-22 July 2006, http://vlcw06.triumf.ca/index.htm
- "International Linear Collider (ILC) Workshop (ILC-ECFA and GDE Joint Meeting)", Valencia, 6-10 November 2006", http://ific.uv.es/%7Eilc/ECFA-GDE2006/

ILC Activity - Damping Rings R&D

- A task force of the GDE R&D Board (S3 task force) has been established with the objective of preparing an international coordinated R&D plan for the Damping Rings, defining objectives and priorities
- WP3 activity is well inserted in this plan, in particular e-cloud and kickers activities (ECLOUD and RFSEP tasks) have been assigned a very high priority
- A first workshop on Damping ring R&D “Cornell ILCDR06 Workshop” has been held on 26 – 28 September 06.

ECLOUD Task

Task reporter: F. Zimmermann

- The choice of a single 6km positron DR for ILC is based on recent work on mitigation techniques which gives good hope of handling e-cloud instability
- R&D on e-cloud instability has very high priority to validate efficacy of proposed cures
- the WP3 ECLOUD task force has vigorously pursued several advanced technological solutions to the electron-cloud problem including the development of appropriate simulation tools
- The WP3 ECLOUD task force actively collaborates with groups at SLAC, LBNL, BNL, and KEK.

Benchmarking of Simulations

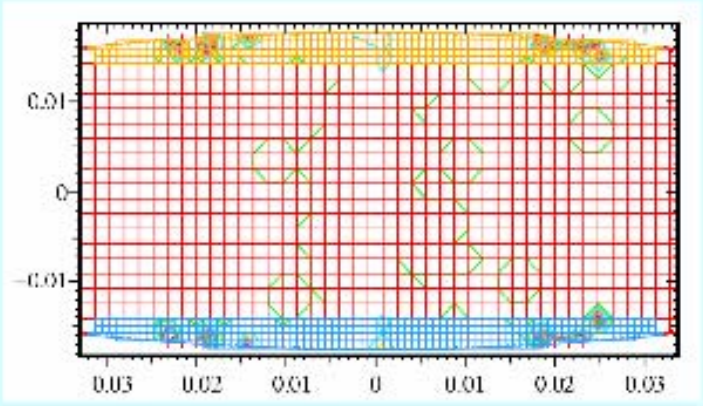
- Electron-cloud build-up simulations were benchmarked at CERN against SPS experimental results and beam observations at DAFNE.
- Single-bunch instabilities and incoherent emittance growth modeled by the simulation code HEADTAIL, as well as multi-bunch growth rates inferred from the program ECLOUD, were benchmarked against beam observations at the CERN SPS and at DAFNE
- Mitigation: The impedance of electron clearing electrodes with microscope-glass insulation, proposed by P. McIntyre et al., was computed using the code GdfidL at CERN

Improvement of Simulation Codes

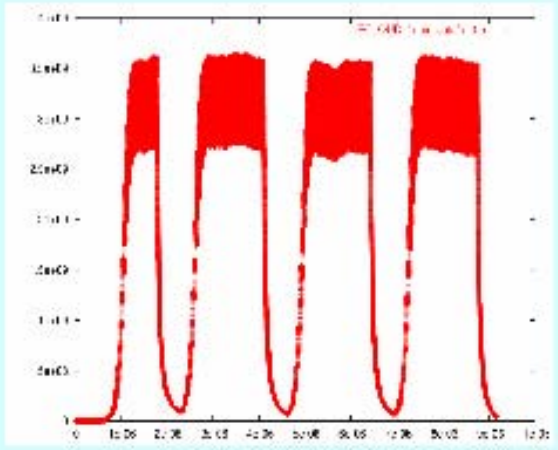
- The code ECLOUD was updated based on SPS benchmarking at CERN
- A new interface between the codes ECLOUD and HEADTAIL was set up.
- The new build-up simulation program, FAKTOR2, has been commissioned. FAKTOR2 can simulate electron and ion formation self-consistently for arbitrary boundary shape and it is fully 3-dimensional.

Electron cloud buildup

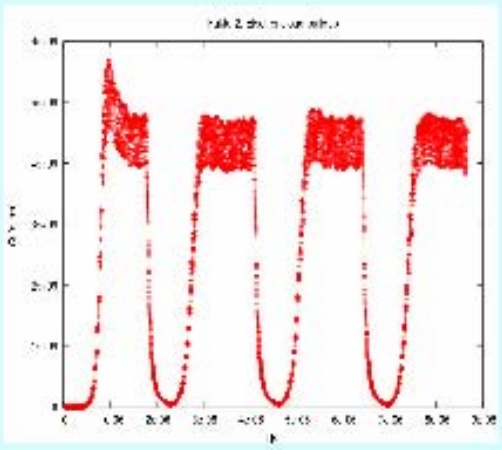
- 2D Results comparable with ECLOUD



Snapshot of charge density



e-/m, computed by ECLOUD



e-/m, computed by Faktor2

Monday 8th, DR: W. Bruns, “Recently developed e-cloud code”

Predict Effect in the Damping Rings

- Instability thresholds with HEADTAIL were simulated for a 3-km, 6-km, 17-km and 2x6-km damping ring at CERN and DESY in collaboration with SLAC and KEK for the Baseline Configuration selection.
- New simulations were run to compare the single-bunch electron-instability threshold for the single and the double 6-km rings

Vacuum Design of Damping Rings

- The vacuum specification can be met only with the use of NEG coating on the entire surface of the vacuum chamber.
- This solution corresponds to the cheapest vacuum design as well.
- A substantial amount of dedicated experimental studies and theoretical work was accordingly focused on the performance of NEG coating.
- The 45th IUVSTA “Workshop on NEG coatings for particle accelerator and vacuum systems” has proven extremely useful for accelerator vacuum design.
- The impact of the electron cloud effect on vacuum has been estimated based on preliminary information. Further work is needed for an accurate final model of the vacuum behavior including electron cloud.

Monday 8th, DR: O.B. Malyshev, “ILC DR Vacuum System”

Fast Ion Instability

- Overview of FII
- Studies with an analytical model
- Preparation of a simulation code
- First simulation results on damping ring performance
- Study of mitigation techniques: low vacuum pressure, gaps in the fill pattern,feedback system
- Proposal of experiments to characterize FII systematically at ATF and to compare to the simulation results

Monday 8th, DR: X. Guoxing, E. Elsen “Status of Fast Ion Instability Studies”

RFSEP Task

Task reporter: F. Marcellini

- After the Baseline Configuration recommendation (November 05) the LNF activity has been focused on fast kickers :

  "The damping ring kickers should be based on "conventional" strip-line kickers driven by fast pulsers, without use of RF separators"

- Study of a strip line kicker for ILC damping ring
  - The kicker performances, in terms of efficiency and field uniformity, have been evaluated for different strip line geometries.
  - The pulser requirements voltage have been determined as well.

Design and tests of a strip line kicker for beam injection in DAFNE storage rings

- The design of the kicker for DAFNE has been completed
- A commercial high voltage feedthrough has been successfully tested. The design of a dedicated feedthrough which should assure better performances in terms of reliability and impedance matching is in progress
- The specifications for the pulser have been defined and a first prototype of the FID pulser has been tested at LNF. An improved version of the pulser has been realized by FID and five of this pulsers have been purchased by LNF
- The realization of the kickers for installation in DAFNE is in progress.

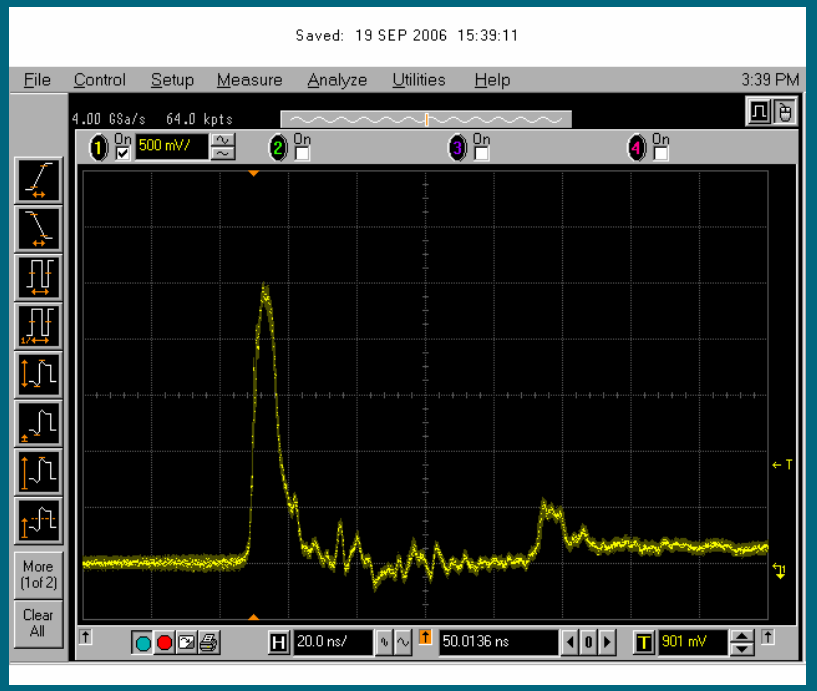
Monday 8th, DR: F. Marcellini “Fast Kickers”

5) R&D and HV tests: the FPG 50-01SP pulser

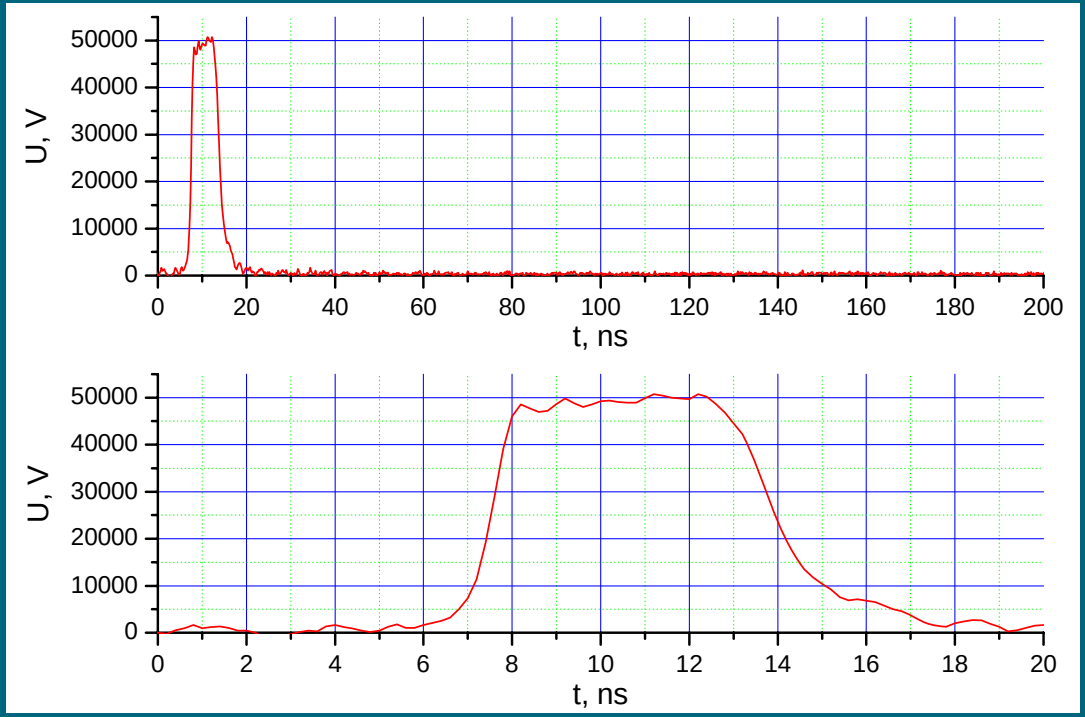
A second version of the 50kV pulser has been developed by FID to improve the pulse shape:

- Fall time shortened
- No secondary pulses
- Improved flatness of the pulse.

We are waiting for the delivering of this improved version of the pulser.



Waveform of the first version of the 50kV pulser measured at LNF



Waveform of the improved 50 kV pulser measured by FID

WGLRDYN - Wiggler Field Optimization

- The activity of this task has been delayed due to the difficulties in recruiting a postdoc at LNF

- A collaboration with the Yerevan Physics Institute has been set up to perform an optimization of the field quality for a permanent magnet wiggler.
- The objective is to minimize the influence of the wiggler on the ILC Damping Ring dynamic aperture

- A study of the modification of the pole shape of the DAFNE wigglers in order to reduce the nonlinear field components on the beam trajectory has been carried out in collaboration with CERN
- A spare wiggler will be modified and measured to be installed in DAFNE for tests with beam measurements

LETS

Task reporter: J. Jones

- Progress on the LETS task has been hampered by a lack of available effort from both relevant laboratories (CCLRC & DESY) and some of the project milestones have had to slip into the following year
- analysis using simulation codes of various damping ring designs were performed
- the simulations were improved to include secondary effects, such as ground motion etc.

LETS

Task reporter: J. Jones

- The results have so far shown that the damping rings have reasonable tolerances in terms of extracted emittances, and that these emittances can be maintained for extended periods with periodic application of the tuning algorithms
- Review of the various techniques for low emittance tuning has been performed. Some simple comparative estimates of the tuning algorithms has been done

WP3 Meetings

- “ILC-European Regional meeting“, LAL, Orsay (Fr), 15-17 May 2006, Guiducci, “WP3:Damping Ring”, http://ilcagenda.cern.ch/materialDisplay.py?contribId=3&sessionId=6&materialId=slides&confId=293
- Visits by Oleg Malyshev to CERN on February 21 and March 1, 2006, for discussions with F. Zimmermann which provided input needed for the vacuum design
- 45th IUVSTA Workshop on Non-Evaporable Getter (NEG) Coatings for Particle Accelerators and Vacuum Systems, Catania, Italy, April 5-8, 2006; this workshop was co-organized by ECLOUD task member O. Malyshev of CCLRC
- European Particle Accelerator Conference (EPAC’06), Edinburgh 26-30 June, 2006; numerous contributions from WP3
- ILC Damping Rings R&D Workshop (ILCDR06) from September 26 to 28, 2006; presentations: “Summary of CERN e-Cloud Activity” by G. Rumolo, “Kicker R&D at LNF” by F. Marcellini
- 9th International Computational Accelerator Physics Conference (ICAP 06), Chamonix, Mont-Blanc, 2-6 October, 2006; presentations on several electron-cloud simulation codes developed within the ECLOUD task (e.g., ECLOUD, HEADTAIL, FAKTOR2, MOEVE)
- Third ATF2 Project Meeting and ATF Technical Board & System/Group Coordinators Meeting, KEK, Tsukuba, December 18-20, 2006; proposals and discussion of future fast ion experiments at ATF
- Super B-Factory Meeting at LNF 11-12 November 2005 presentation “fast Kicker Design” by D. Alesini

WP3 Reports

- F. Zimmermann, D. Schulte, R. Cimino, S. Guiducci, C. Vaccarezza, R. Wanzenberg, Electron Cloud in Wigglers, EUROTeV-Report-2006-001 (2006).
- G. Xia, E. Elsen, Analytical Estimates of Beam Amplitude Blow-up due to Fast Beam-Ion Effects in the ILC Damping Rings, EUROTeV-Report-2006-003 (2006).
- G. Xia, E. Elsen, Ion Effects in the Damping Rings for ILC – An Introduction, EUROTEV-Report-2006-004 (2006).
- F. Zimmermann, W. Bruns, D. Schulte, Ion Effects in the Damping Rings of ILC and CLIC, EPAC'06 Edinburgh, MOPLS136, EUROTeV-Report-2006-032 (2006).
- W. Bruns, D. Schulte, F. Zimmermann, FAKTOR2: A Code to Simulate the Collective Effects of Electrons and Ions, EPAC'06 Edinburgh, WEPCH137, EUROTeV-Report-2006-029 (2006).
- G. Xia, E. Elsen, Preliminary Studies of Ion Effects in ILC Damping Rings, EUROTeV-Report-2006-047 (2006).
- M.T.F. Pivi, T.O. Raubenheimer, L. Wang, K. Ohmi, R. Wanzenberg, A. Wolski, F. Zimmermann, Simulation of the Electron Cloud for Various Configurations of a Damping Ring for the ILC, EPAC'06 Edinburgh, TPCH075, EUROTeV-Report-2006-070 (2006).
- O. Malyshev, Vacuum Systems for the ILC Damping Rings, EUROTeV-Report-2006-094 (2006).
- H. Fukuma, J.W. Flanagan, T. Kawamoto, T. Morimoto, K. Oide, M. Tobiyama, F. Zimmermann, The Effect of the Solenoid Field in Quadrupole Magnets on the Electron Cloud Instability in the KEKB LER, EPAC'06 Edinburgh, TPCH051, EUROTeV-Report-2006-100 (2006).
- E. Benedetto, G. Franchetti, F. Zimmermann, Incoherent Effects of Electron Cloud in Proton Storage Rings, EUROTeV-Report-2006-101 (2006).
- A. Markovik, G. Poplau, U. van Rienen, R. Wanzenberg, Tracking Code with 3D Space Charge Calculations Taking into Account the Elliptical Shape of the Beam Pipe, ICAP'06 Chamonix (2006)
- D. Alesini, S. Guiducci, F. Marcellini, P. Raimondi: "Fast Injection Kickers for DAFNE and ILC Damping Ring", I-17, 6/6/2006, EUROTeV Report 2006-025
- D. Alesini, S. Guiducci, F. Marcellini, P. Raimondi: "Design and Tests of New Fast Kickers for the DAFNE Collider and the ILC Damping Rings", 10th Particle Accelerator Conference (EPAC2006), 26-30 June, 2006 - Edinburgh, UK; LNF-06-23(P), 07/09/06, EUROTeV Report 2007-002
- S. Guiducci: Damping Rings Toward Ultra-Low Emittance", 10th Particle Accelerator Conference (EPAC2006), 26-30 June, 2006 - Edinburgh, UK; LNF-06-23(P), 07/09/06, EUROTeV Report 2006-049
- A. Babayan, D. Melkumyan, V. Nikoghosyan, Wiggler Magnet Optimization for Linear Collider Damping Ring, EUROTeV-Report-2006-011 (2006)
- J.K. Jones Tuning Algorithms for the ILC Damping Rings, European Particle Accelerator Conference (EPAC2006), 26-30 June, 2006 - Edinburgh, UK EUROTeV-Report-2006-049 (2006).

Conclusions

- Most of the 2006 tasks have been completed
- A big effort has been dedicated to the R&D items considered as high priority by the GDE
- EUROTEV participants are providing a substantial contribution to the DR design for the ILC Global Design Effort