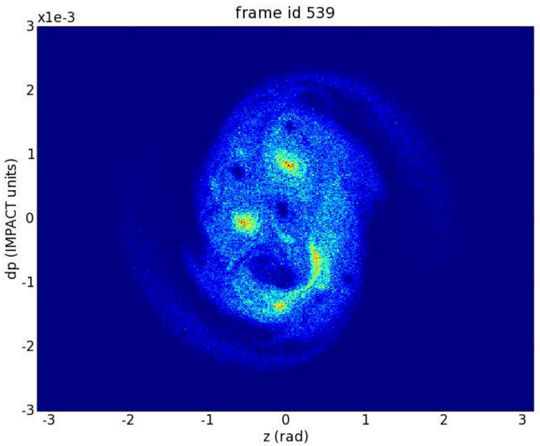
AMR/CPA ILC projects

Συνεργεια

ILC Accelerator Coordination Meeting

P. Spentzouris

10/25/05



http://cepa.fnal.gov/psm/aas/Advanced_Accelerator_Simulation.html

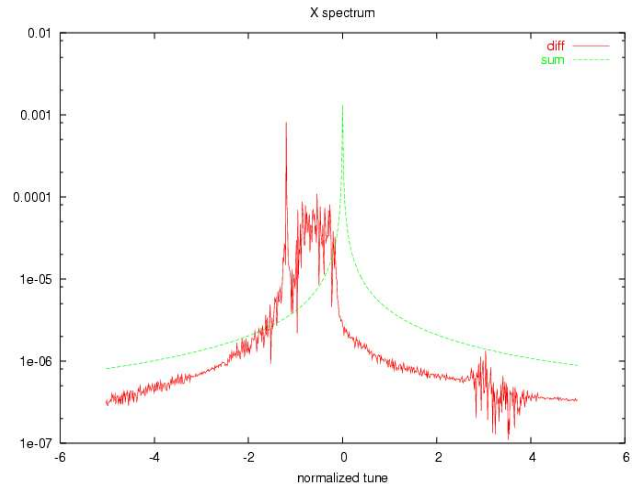
Current ILC related activities

- Optics (Leo Michelotti)
  - Implement electrons in CHEF ("Collaborative Hierarchical Expansible Framework"); "purify" relevant lattices for CHEF
    - understand/study DR lattices
    - work with Paul on linac lattices
- DR space-charge (Amundson, Spentzouris)
  - Fully 3D, self-consistent modeling for at least one DR case (all existing models "frozen-beam")
    - use new solver/framework (work in progress)
  - Compare with existing non-self consistent simulations
    - more cases if discrepancy

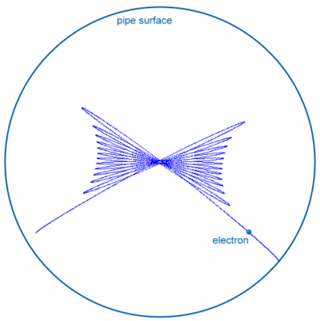
Possible activities

- Beam-beam induced "pinching" @ IP
  - 3D strong-strong model
    - should be straight forward, capability exists & tested

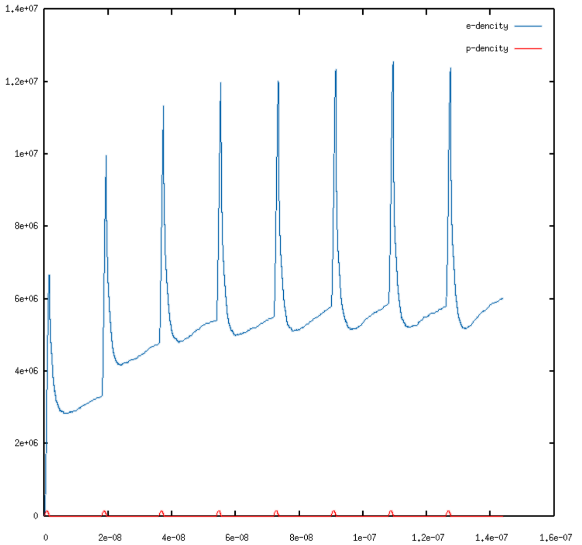
TeV 1 one 1 head on collision coherent tune shift



Possible activities



- Electron cloud in DR. Currently developing physics module for MI
  - use M. Furman's e-cloud generation code
  - field solver from Synergia
  - for DR will need photons && possible modifications in geometry package for antechamber
- Dynamics physics module
  - use QuickPIC? (visitor in November)



Ecloud @ ILC DR M.Pivi, Snowmass '05

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The electron-cloud effect (ECE) in a nutshell:

- Beam residual gas ionization and photons produce primary e-
- Number of electrons may increases/decreases due to surface secondary electron yield (SEY)
- Bunch spacing determines the survival of the electrons

Especially strong effect and possible consequences:

- Single- (head-tail) and coupled-bunch instability
- Transverse beam size increase directly affecting the Luminosity
- Vacuum pressure and excessive power deposition on the walls

In summary: the ECE is a consequence of the strong coupling between the beam and its environment:

- many ingredients: beam energy, bunch charge and spacing, secondary emission yield, chamber size and geometry, chromaticity, photoelectric yield, photon reflectivity, …

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Working plan from Snowmass

- Pertinent parameters for three different rings (17 km, 6 km and 3 km circumference) [: "For some studies (e.g. electron-cloud build-up) it probably is not necessary to study every lattice in detail, but pick one in each circumference."]
- Electron cloud build up is simulated for the different regions (arcs, wigglers, straights) considering different secondary emission yields.
- For the wigglers simulations the field can be modeled at various levels of sophistication, and the importance of refined models has to be explored;
- Single-bunch wake fields and the thresholds of the fast single-bunch TMCI-like instability are estimated;
- Multi-bunch wake fields and growth rates are inferred from e-cloud build up simulations;
- Electron induced tune shifts will be calculated and compared;
- Predictions of electron build up from different simulation codes are compared;
- Implemented in the simulations will be countermeasures which may be proposed as the ILC DR design evolves.

More ambitious possible activities

- Implement realistic wakefields based on detailed geometry of cavities
  - simple implementation (for the beam dynamics part), but
    - need to run 3D EM codes; no manpower or expertise.
  - the rest is the simple part
    - parameterize result (moments)
    - implement as a "kick" in tracking

SBIR with TechX

- Introduce arbitrary order rf maps from field measurements on the surface of the cavity. Could be a useful ILC application.

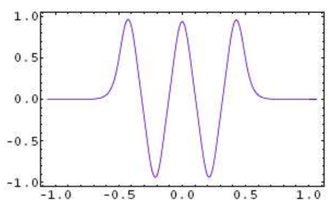

FIG. 5: Comparison of on-axis longitudinal field values computed analytically (blue) and from data with 10% relative noise (red). The latter curve is just barely visible above the left-most peak.

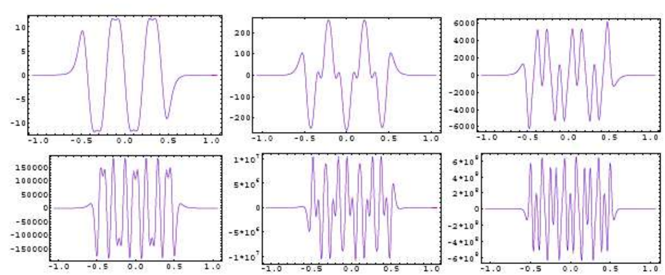

FIG. 6: Comparison of the first six derivatives (right-to-left, then top-to-bottom) of the on-axis longitudinal field computed analytically (blue) and from data with 10% relative noise (red).

D. Abel, TechX