Beam Dynamics WG Summary

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LCWS 2014 – Oct 6-10, 2014 – Belgrade, Serbia

Overview of the talks

Tuesday

14:00 Valery Telnov, "Possible effects in high energy linacs due to particle fields"

14:30 Maria Kastriotou, "Status of BLM system for the CLIC Two Beam Module and DR"

15:00 Elvin Harms, "Dark current and radiation measurements at CM2 at NML"

Wednesday

09:00 Jochem SNUVERINK, "Accelerator Simulation Framework based on PLACET"

09:20 J. PFINGSTNER"Improved imperfection tolerances for an on-line DFS algorithm"

09:40 Jakob ESBERG, "Simulations of CSR with shielding"

10:00 Davide GAMBA ,"Beam Dynamics simulations in the CTF3 Delay Loops"

14:00 Lutz Matthias HEIN , Machine protection issues in CLIC

14:20 Andrea LATINA ,Results of BBA tests at FACET and Fermi

14:40 Jack ROBERTS , Phase Feed-Forward experiment at CTF3

15:00 Avni AKSOY, Photo cathode RF gun @ CLIC Drive Beam Linac

Three other sessions joint with Beam Delivery.

Topics discussed

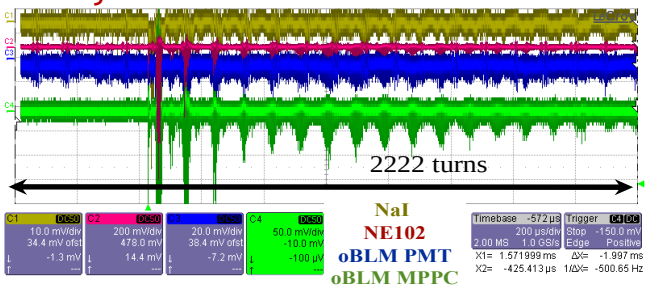
- Machine protection
- Simulation Codes
- Instrumentation
- System tests

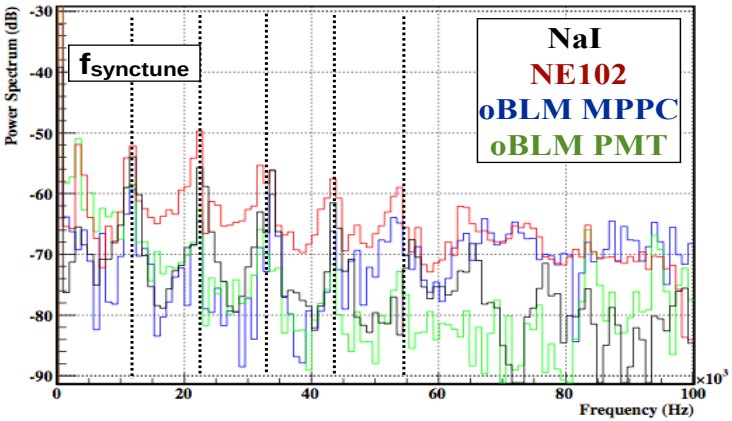
Diagnostics & Machine Protection

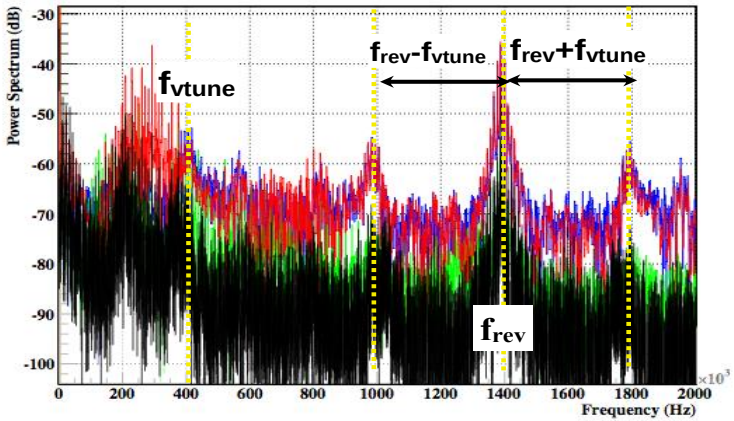
M. Kastriotou, “Beam-loss Monitors for the CLIC Two-Beam Module and Damping Rings”

BLM measurements during topup injections

- AS works on topup mode to keep a constant 200 mA for > 24 hours
- Frequency Analysis
  - SR ~ 0.5 mA / Booster ~ 1.1mA / Injection efficiency ~80%
  - harmonic number Booster/SR = 216/360
  - $1.25 \times 10^{+9}$ electrons lost within the first several turns
- Frequency Analysis
  - 11 kHz band (synchrotron tune)
  - 1.38 MHz (rev frequency)
  - 400 kHz band (vertical tune)

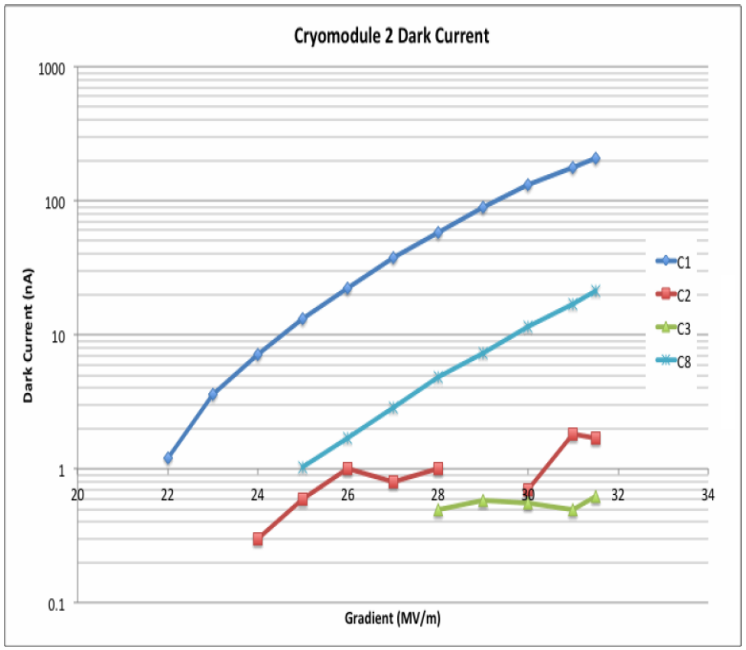


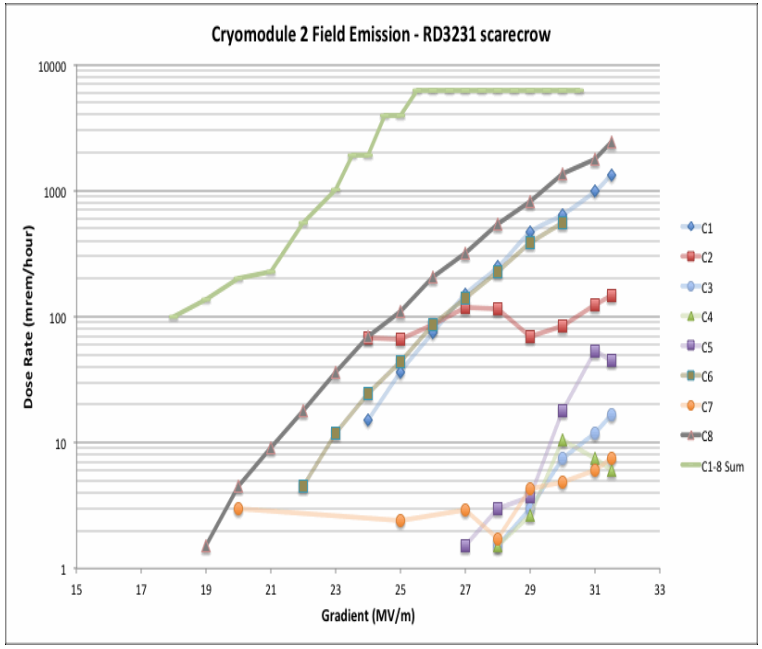




Machine protection

E. Harms, “Dark current and radiation measurements at CM2 at NML”





CM- 2, ILC-like cryomodule, Eacc > 31.5MV/m

- Threshold > 20 MV/m, Cav#1 dominated.
- No external radiation seen
- Variety of detection means available
- TLM’s are promising option for rad. meas.

Simulation Code Developments

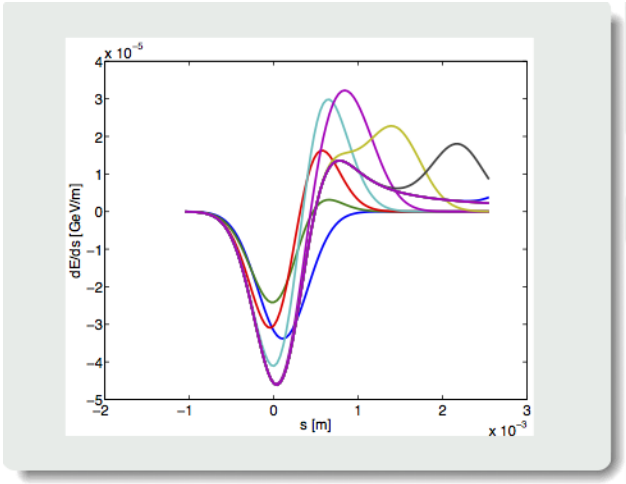
J. Snuverink, "Linear Collider Simulation Framework based on PLACET and Guinea-Pig"

- Common simulation framework for ILC, CLIC, FACET, ATF2 to ease simulation studies

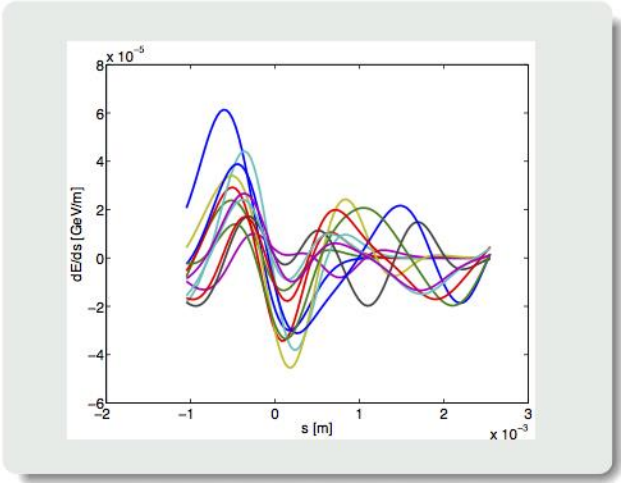
J. Esberg, "CSR with shielding in PLACET"

- CSR relevant in CLIC recombination complex, and FEL -> proposed implentation in PLACET
- CSR with shielding first implemented in PLACET
- Benchmarked against other relevant codes: CSRTrack, Bmad, …

CSR no shielding



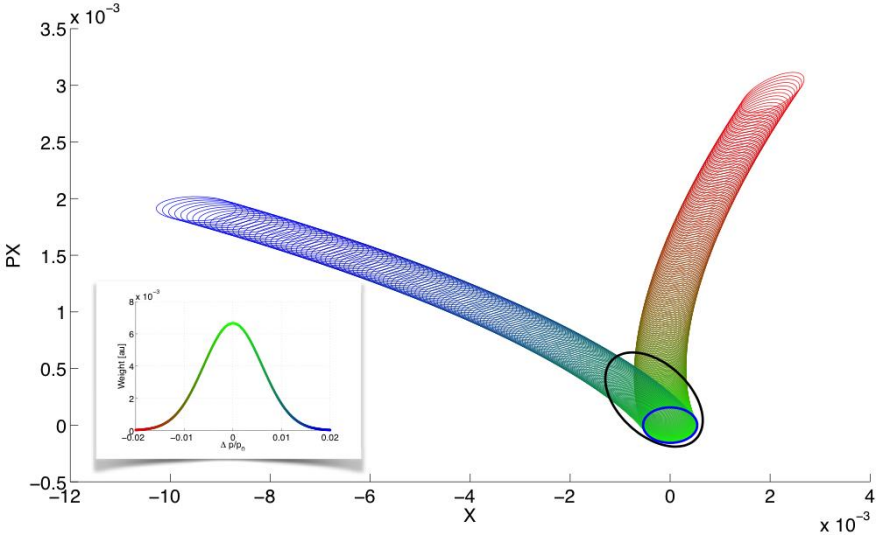
CSR with shielding

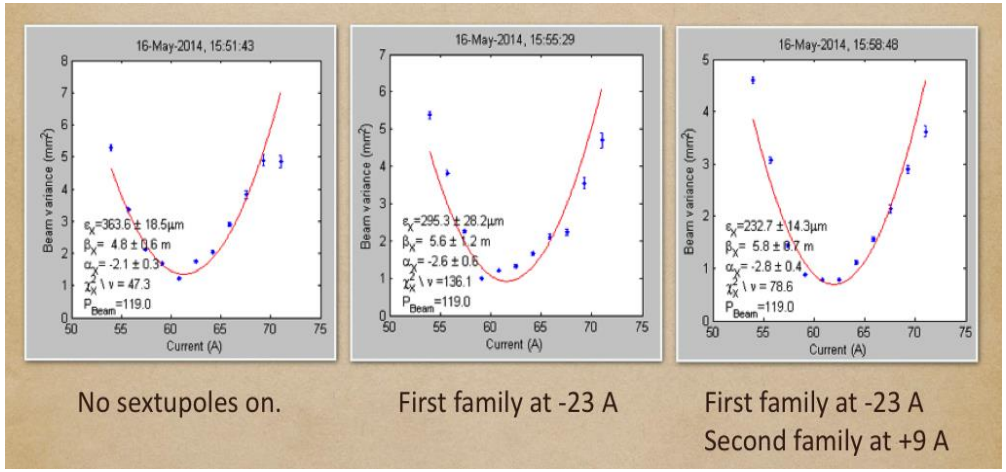


Beam dynamics studies

D. Gamba, “Beam dynamics in CTF3 Delay Loop”

- Theoretical study of non-linear dispersion in the DL
- Applied to reduce the emittance growth using sexupole magnets



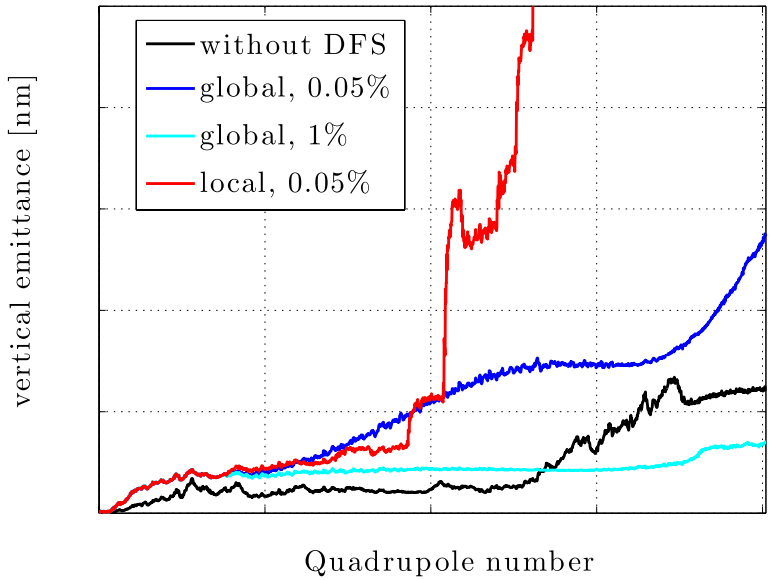


L. M. Hein, “Machine protection in the CLIC Drive Beam”

- Started to study MP issues in the decelerators:
  residual gas scattering, transverse kicks, …
- On-going study

Beam dynamics studies

J. Pfingstner, “On-line DFS in the CLIC Main Linac"



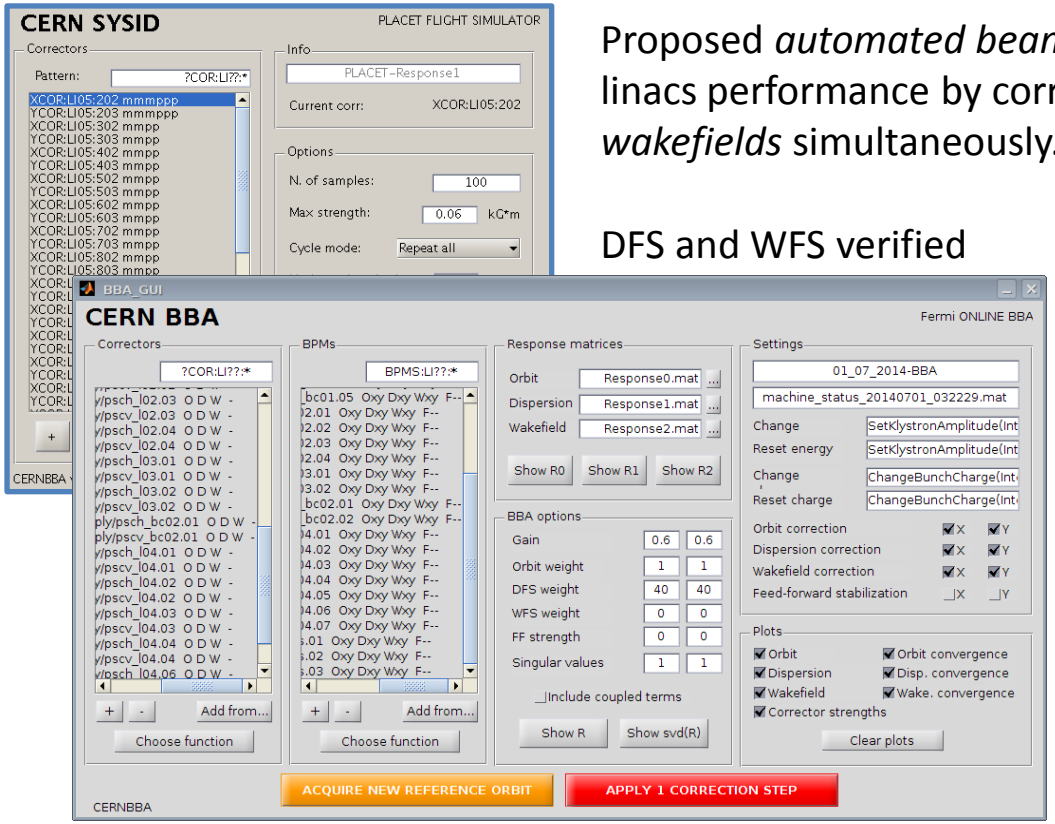
- On-line DFS studies
- Limiting factor is the structure tilt
- Performance depend on wakefield monitors
- On-going study

A. Aksoy, “Photo cathode RF gun @ CLIC Drive Beam Linac”

- An option for a photo cathode RF gun for the CLIC Drive Beam showed promising performance
- Drawbacks need to be understood

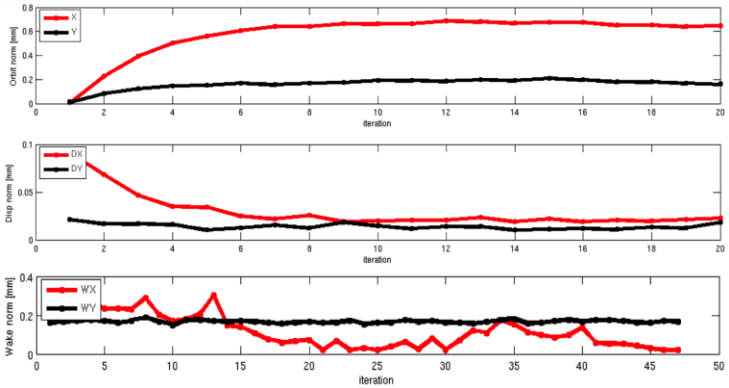
System tests

A. Latina, “Beam-Based Alignment tests at SLAC and FERMI”



Proposed *automated beam-steering methods* to improve the linacs performance by correcting *orbit, dispersion,* and *wakefields* simultaneously.

DFS and WFS verified



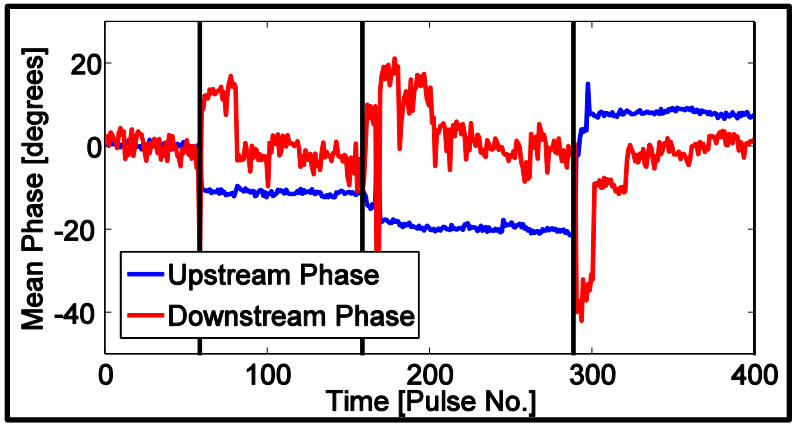
Convergence of dispersion and wakefield correction

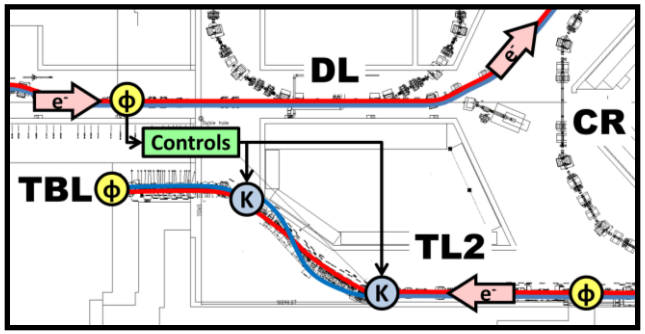
Makes BBA “easy”
Tested at SLAC and at Fermi
Now being considered for routine operation

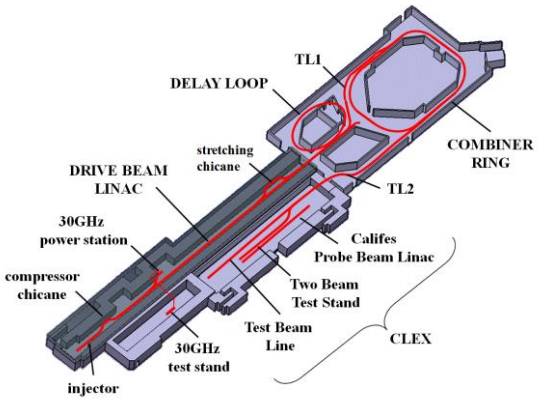
System tests

J. Roberts, “Phase Feed-Forward experiment at CTF3”

- Phase stabilization tests
- Current status: all hardware tested, phase feedforward tests to commence soon.
- Phase after chicane (downstream monitor) is brought back to nominal after the (20 pulse) averaging time of the slow feedback.
- Mean downstream phase offset of 13.0° ± 2.0° reduced to
  −0.2° ± 0.8°







First look on photon effects

V. Telnov, "Effects in high energy colliders due to particle fields"

The above consideration assumes that electron collides with photons created in the cavities by one preceding bunch. If damping time correspond to storage of photons from N_b bunches one should multiply the probability of collisions by N_b.

ILC,

For E_0=500 GeV, N=2·10^{10}, a~3.5 cm, b~10 cm, l=15 km, σ_z=0.03 cm and N_b~100 ? we get

$$p \sim 0.2 \qquad \frac{E_{\gamma,\max}}{E_0} \approx 0.005, \qquad \frac{\bar{E}_\gamma}{E_0} \approx 0.0005$$

CLIC

For E_0=1500 GeV, N=3.8·10^9, a~0.3 cm, b~1.5 cm, l=15 km, σ_z=0.0045 cm and N_b~1 ? we get

$$p \sim 0.05 \qquad \frac{E_{\gamma,\max}}{E_0} \approx 0.1, \qquad \frac{\bar{E}_\gamma}{E_0} \approx 0.01$$

CLIC has very strong damping of high modes and effective N_b<1

Conclusions

Progress

- From pure simulation studies we are moving toward more experimental studies, including diagnostics, machine protection, and system tests at ATF2, CTF3, FACET, Fermi@Elettra
- Simulation codes in continue development

Issues

- More studies are required for the RTML and bunch compressor (emittance target still not met)
- Integrated start-to-end simulations are needed
- Pursue more realistic assumptions about errors, possibly coming from hardware tests (LWS, measurement stations, wakefields, couplers, …)
- More resources are needed