Calculating the Electric Field of Coherent THz Pulses

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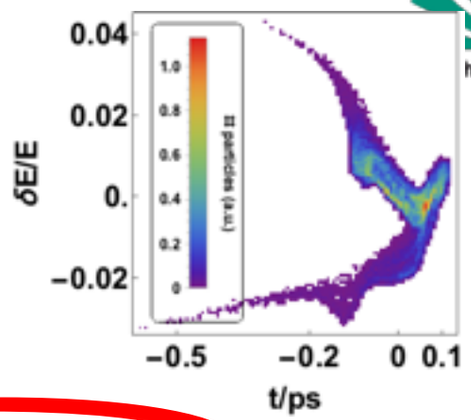
3rd ARD ST3 Workshop

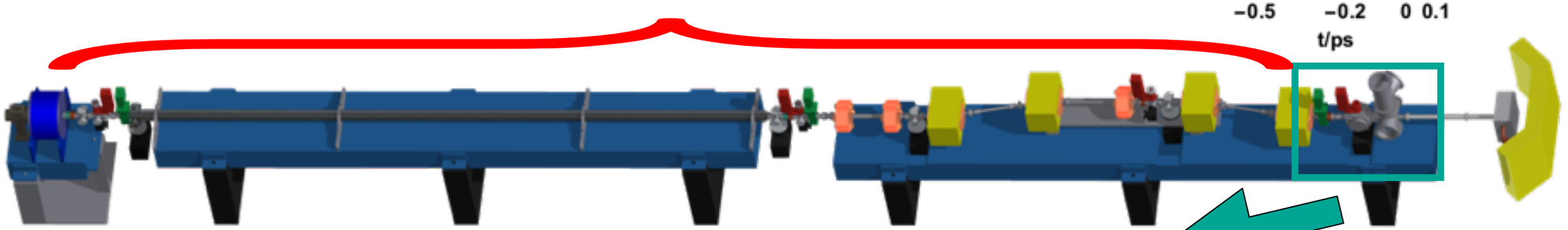
Laboratory for applications of synchrotron radiation (LAS)

Simulation Chain for FLUTE

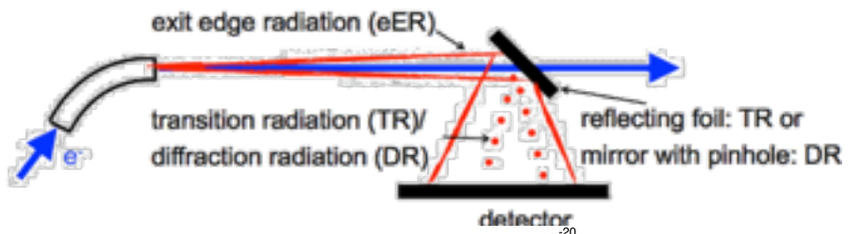
- Particle tracking from gun to end of chicane with ASTRA & CSRtrack (includes SC and CSR)

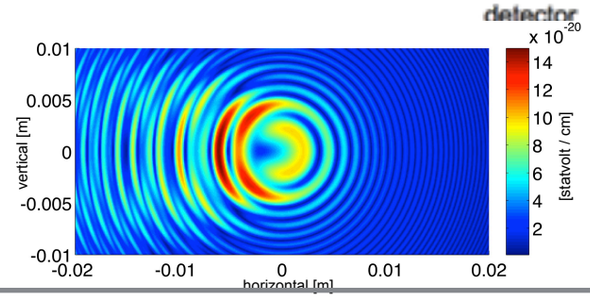
  S. Naknaimueang et al., FEL 2012, WEPD59





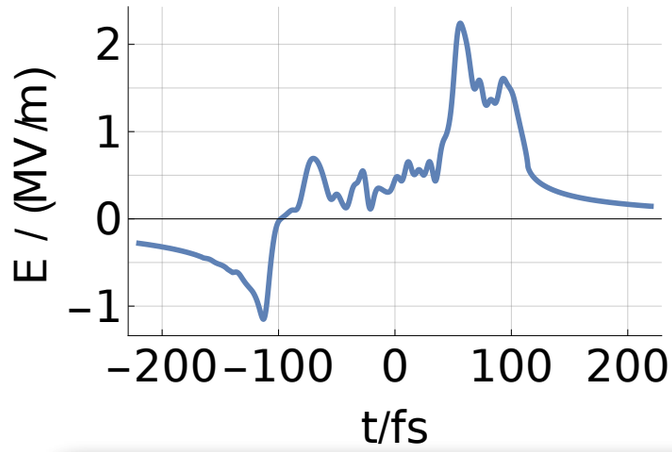
- Own methods for calculations of emitted THz pulse
  - First principle numeric calculations of THz pulse
    - no code available for near-field THz synchrotron radiation
    - include interference of radiation sources





P. Rieger et al., Vib. Spec. **75**, 196 (2014)

  - Analytic calculation of coherent THz pulse

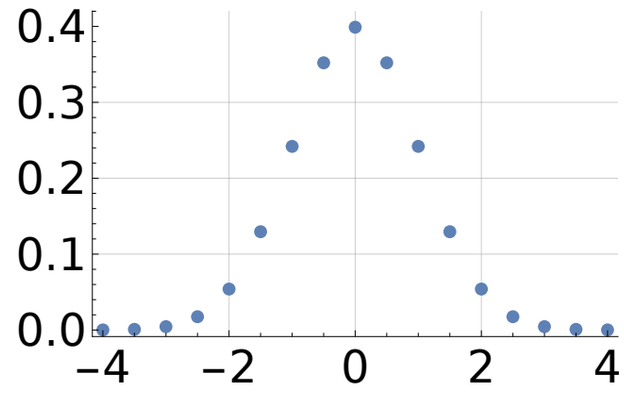


M. Schwarz et al., Phys. Rev. ST - Accl. Beam **17**, 050701 (2014)

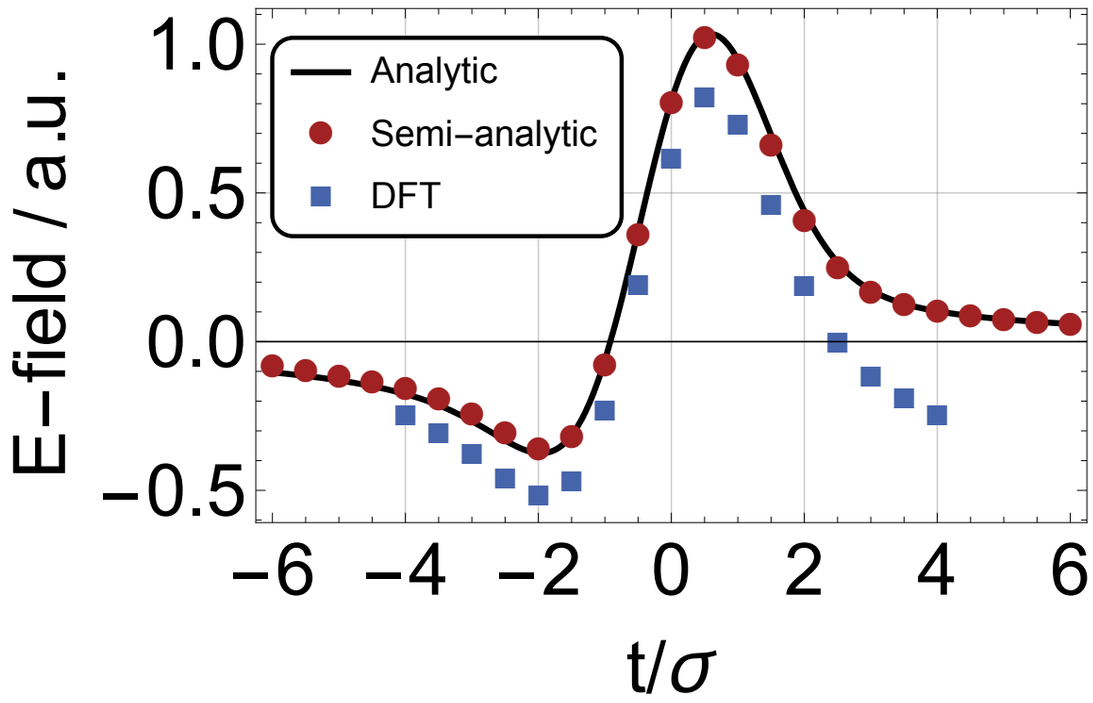
Goal:
Full simulation chain to optimise THz field streng and pulse shape

Electric Field of Pulse: Gaussian Bunch

- E-Field given by $E(t) = 2\,\mathrm{Re}\int_0^\infty \tilde{E}_0(\omega)\tilde{\rho}(\omega)\mathrm{e}^{-\mathrm{i}\omega t}\,\mathrm{d}\omega$
- Input:
  - Gaussian bunch profile
    17 data points in interval
    containing >99.9% of charge
  - low-frequency synchrotron
    spectrum $\tilde{E}_0(\omega) = \omega^{1/6}$



- Result



- References
  - M. Schwarz et al.
    PRSTAB, **17**, 050701 (2014)
  - M. Schwarz et al.
    IPAC'14, MOPRO067
  - M. Schwarz et al.
    IPAC'15, MOPHA043

Method/ Property	DFT	Analytic Gauss Profile	Analytic Interpolation	Semi-analytic
General bunch profile	✔	✘	✔	✔
General spectra	✔	✘	✘	✔
Δ peak field	✘ (22%)	✔ (exact)	✔ (1permille)	✔ (1%)