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New challenges in FEL modeling and consequences for OPAL

OPAL Developer Meeting - 1 - 2022

Andeas Adelmann

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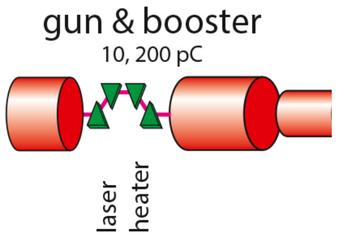
Energy Spread Values before First Compression Stage

Measurement	15 keV
Design	2.3 keV
Astra+Elegant	< 1 keV



Inconsistency between Modeling and Observation

e) over the years,
erical tools cannot
sFEL injector by
ication S. Reiche)

– 5 nm, 100 Hz
3.4 GeV

.08) – 0.7 nm
5.8 GeV
) fs, 100 Hz

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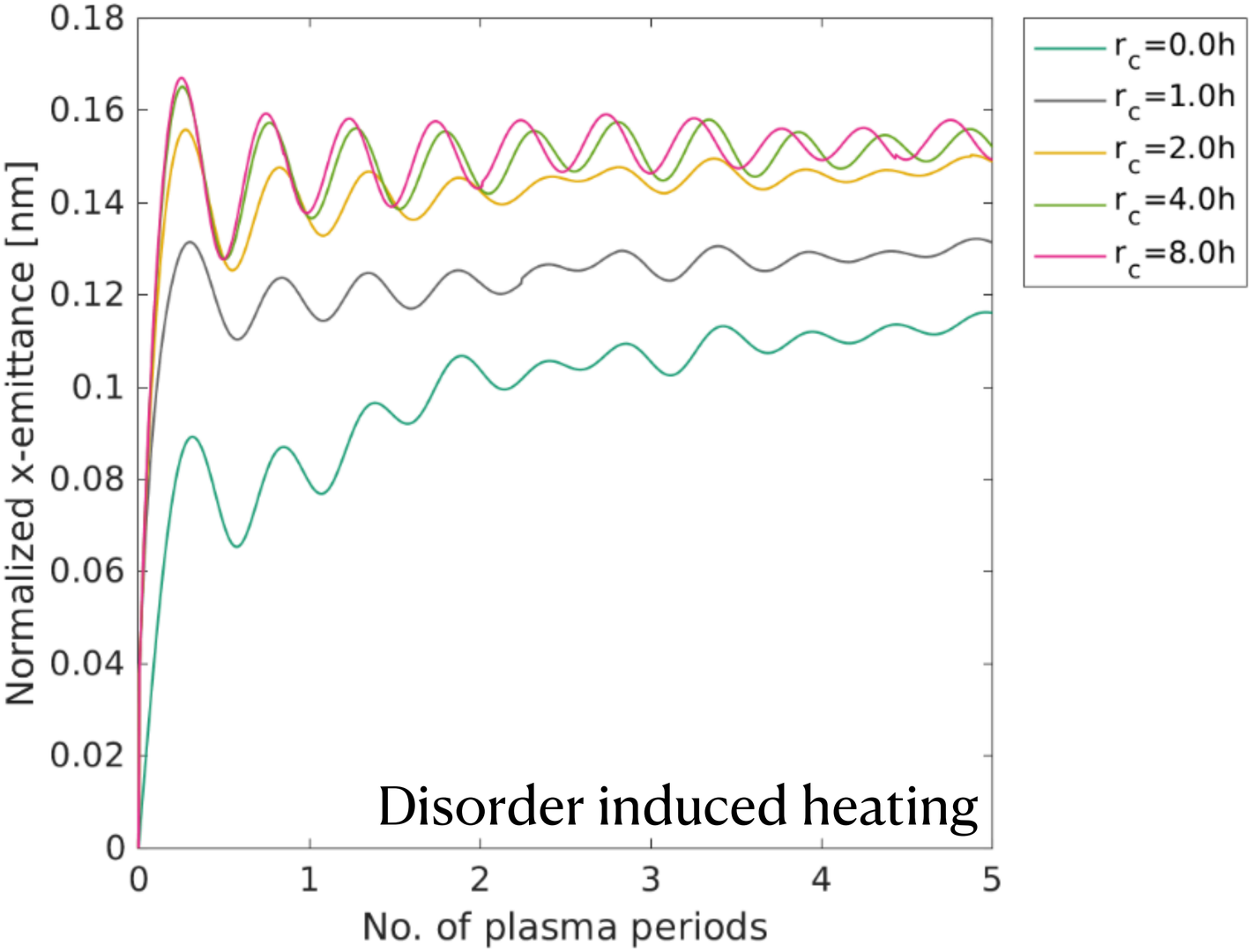
SwissFEL: Parameters from Sven Reiche

Parameters

- $R = 2\mu m$
- Q=20fC
- $N_e = 124,844$
- $T_{end} = 9.1ps$
- 256^3 grid
- $h = 0.08\mu m$



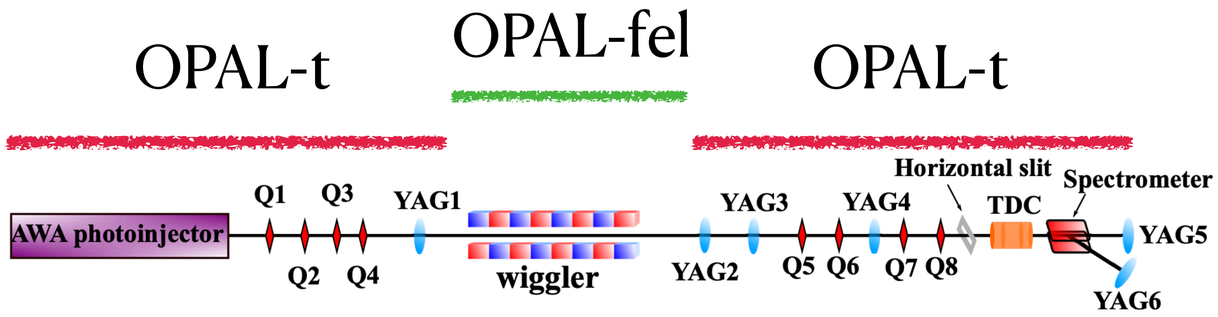
S. Muralikrishnan and A. Adelmann

From the 2021 UC-XFEL workshop

Sven Reiche :: Paul Scherrer Institute

Computational Challenges for Compact FELs

Ultra-Compact XFEL Workshop, July 2021



Alaba A et al. https://arxiv.org/pdf/2112.02316.pdf

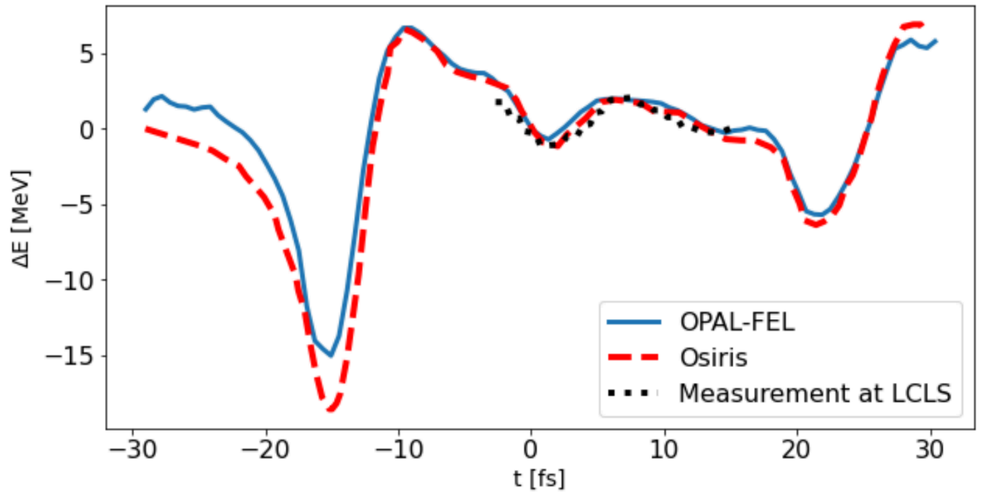


Figure 3: Comparison of the final slice-averaged energy between the OPAL-FEL simulation, and the OSIRIS simulation and measurement by MacArthur et al. [13].

Angle of Attack: SwissFEL & future compact FELs

- ☑ resolution (thanks to IPPL 1.0 & 2.x)

- collisions
  - will have P3M available soon in electrostatic OPAL (work of Sri)

- full electromagnetic PIC (PhD project)
  - first approximation is MITHRA
  - FEM ?
  - + collisions (discretisation of collision operator)