

WP2, WP3

Electron beam

Modeling Tools

Analytical
PIC
Calder-PIC (CNRS -LOA)
other WP

LPA electron beam parameter sets
from MS4 : baseline parameter sets

Technological constraints

bunch to bunch reliability
repetition rate

WP2, WP5

Transfer / manipulation line

Modeling Tools

Analytical
modified BETA
ASTRA
....

Schemes : demixing chicane,
chromatic matching, TGU, new
concepts ?

Technological constraints

focusing with permanent
magnet quadrupoles

Radiation

Modeling Tools

Analytical
spontaneous emission : SRW ...
FEL :
GENESIS
PLARES
PROMETEO

Technological constraints

undulator technology

Introduction on undulators
In each case, provide period, field, gap / achieved / prospects

- 1) Cryogenic undulators (ME Couprie, M.Valléau SOLEIL)
- 2) Superconducting undulators (J. Clarck)
- 3) More exotic undulators :
RF undulators, Micromachined undulators, Plasma undulators (I. Andryash, SOLEIL), other ideas ...
- 4) Transverse gradient undulators

=> one presently operational set of undulator parameters, and two sets of optimistic parameter set, or define a parameter range.

MS5 /
D6.1

WP6 effort

- CNRS-LOA (4) : 24 months : Francesco Massimo start: 4/1/16, LPA calculations so far
- SOLEIL (8) : 24 months (not 30) : Eléonore Roussel : end of the year
- ENEA (11) : 36 months
- UHH (14) : 24 months : starting Jan. 2017

MS4 : Electron beam baseline parameter for FEL application (SOLEIL) M6, published on intranet

Resonance wavelength depends on the electron beam energy;

several MeV : UV-VUV, 1 GeV range : few nm radiation, several GeV : Angstrom region. Gain is getting smaller at short wavelength.

it makes no sense to target directly 1 Å without intermediate steps in wavelength! => Need of different energy ranges

Electron beam parameters: Energy, energy spread, slice energy spread, emittance, size, divergence, charge, bunch length, peak current + possibly the distribution

• Cases of test experiment under investigation

For example, COXINEL 200-400 MeV, 1 %, 1 mrad RMS .../ X-Five, UHH for benchmarking with experiment in progress

• Prospective cases

- 1-1.5 GeV case (it can be one stage LPA)
- 3 GeV case
- 5 GeV case

-Electron acceleration with PW laser results:

Texas PW (150 J, 150 fs): energies up to 2 GeV, energy spread ~6 %, ~400 pC, 0.5 mrad

Berkeley PW (30 J, 30 fs): best beam 4 GeV, energy spread 6%, 6 pC, 0.3 mrad

Korea PW (30 J, 30 fs): energies up to 3 GeV, large spectrum including several peaks, ~70 pC, ~1.4 mrad

-Expected LPA performance from PIC code (+ distribution giving the correlations in phase space)

Preliminary simulations with Korea PW specs (30 J, 30 fs chirped to 60 fs, non-ideal laser spectrum), using self-injection and no-guiding: 3 GeV in one stage, spectrum large, 500 pC. Strong spectral phase variations (chirp and third-order terms).

- For reference, approaching parameters on existing FELs (such as FLASH, FERMI, LCLS, E-XFEL)

=> reasonable LPA parameter specification for the FEL application, providing the requirements to the other WP.

- Setting “directly” the undulator after the electron source, i.e. with e beam specifications approaching what presently exist on FELs on conventional accelerators
- Setting a “manipulation transfer line” or “TGU” or other ideas (to be proposed, impact from WP2 / WP5) for intermediate e beam specifications.

Tasks, Milestones, Deliverables

Tasks

- WP6.1 : Coordination and Communication (SOLEIL, ENEA)
- WP6.2 : FEL baseline cases (SOLEIL, ENEA, CNRS-LOA, UHH, Lille Univ.)
- WP6.3 : Undulator and technological development of equipments (SOLEIL, UHH, INFN, DESY, STFC)
- WP6.4 : Towards scientific applications (SOLEIL, ENEA, STFC, DESY)
- WP6.5 : Operational model (SOLEIL, DESY, INFN)

Milestones

- MS4 : Electron beam baseline parameter for FEL application (SOLEIL) M6, published on intranet
- MS5 : State-of-the-art of short period undulator (SOLEIL) M7, Activity report
- MS17 : Models and scaling laws for plasma FEL dynamics (SOLEIL) M 20, Activity report

Deliverables

- D6.1 : Report on state-of-the-art of short period undulators, Report, Public, M12
- D6.2 : Models, scaling laws plasma FEL dynamics, Report, Public, M24
- D6.3 : Diagnostic requirements and technical approaches, Report, Public, M24
- D6.4 : Specific magnetic elements, Report, Public, M32
- D6.5 : FEL Scientific user workshop, Report, Public, M24

WP6 effort

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MS5 : State-of-the-art of short period undulator (SOLEIL) M7, Activity report

D6.1 : Report on state-of-the-art of short period undulators, Report, Public, M12

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