Milestone reports

Done

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

Based on these references, we recommend the following prospective scenarios for the EuPRAXIA FEL design:

- 1-1.5 GeV case, starting with one stage, 0.1 % energy spread, 1 mm.mrad emittance. Advanced beam manipulation to prepare the electron beam for the undulator section is advised. This can relax the requirements on the plasma acceleration stage.
- 3 GeV case , 0.1 % energy spread, 1 mm.mrad emittance
- 5 GeV case, 0.1 % energy spread, 1 mm.mrad emittance

The targeted current value (or charge) has still to be investigated. From these three series of data, one could define reasonable LPA parameter specification for the FEL application, providing the requirements to the other WP.

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

Milestone reports

Done

MS5 : State-of-the-art of short period undulator (SOLEIL) M7, Activity report
preparation for D6.1 : Report on state-of-the-art of short period undulators, Report, Public, M12

1. Undulator technologies will be reviewed and summarized by the WP members.
2. The WP members will report on the developments and state-of-the art of cryogenics undulators (this part will be mainly handled by SOLEIL and University of Hamburg).
3. The WP members will analyze the progress of superconducting undulators (this part will be managed by STFC).
4. Subsequently, even when unlikely to be used for the baseline case, the study and the report will include advanced and novel undulators, such as bi-harmonic undulators, RF undulators, micro-machined undulators and plasma undulators. Contributions will come from the different participants.
5. Finally, the last part of the work will deal with technical issues associated with transverse gradient undulators, which are considered to be a possible solution for handling the large energy spread provided by laser plasma accelerators (if this energy spread cannot be solved by other measures). This part will cover both the conceptual approach and the technological issues related to transverse gradient undulators. This part will be completed by different participants in WP6.

From this one should propose one presently operational set of undulator parameters, and two sets of optimistic parameter set, or define a parameter range.

To be done next

Next deliverables, milestone report

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
D6.2 : Models, scaling laws plasma FEL dynamics, Report, Public, M24
D6.3 : Diagnostic requirements and technical approaches, Report, Public, M24

Useful information from other WP

- Detailed review of achieved LPA performance experimentally, and from simulations
- Report on the comparisons between the different configurations and their adavantges in terms of electron beam performance
- ...

back up

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

CNRS-LOA (4) : 24 months	Francesco Massimo started the 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

WP6 : FEL Pilot application

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

MS5 / D6.1

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.

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
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WP6 : FEL Pilot application

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 : Angstroem 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.