WP6 : FEL Pilot application

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Partners

SOLEIL (24), ENEA (36), LOA (24), UHH (24), DESY, STFC, INFN, Lille Univ.

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)	mid-April 2017
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 / Labview tool by ENEA
spontaneous emission : SRW ...
FEL :
GENESIS
PLARES
PROMETEO

Technological constraints

undulator technology

WP11 : FEL Pilot application

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

- Parameter sets of existing FELs
- Parameter set of test experiments under investigations
- LWFA typical parameters
- Prospective cases

- 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, several dizains of pC. 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 % slice energy spread, 1 mm.mrad emittance, charge : several dizains of pC
- 5 GeV case, 0.1 % slice energy spread, 1 mm.mrad emittance, several dizains of pC

MS5 : State-of-the-art of short period undulator (SOLEIL) M7, published on intranet

Proposed workplan
- developments and state-of-the art of cryogenics undulators (this part will be mainly handled by SOLEIL and University of Hamburg).
- progresses of superconducting undulators (this part will be managed by STFC).
- even unlikely to be used for the baseline case, the report will include more exotic undulators, such as bi-harmonic undulators, RF undulators, micro-machined undulators, plasma undulators. Contributions from the different participants.
- technical issues associated with transverse gradient undulators

The feasibility of undulator schemes (transverse gradient/or other improvements) capable of ensuring FEL will be investigated within MS17 : Models and scaling laws for plasma FEL dynamics (SOLEIL coordination) M 20, Activity report and D6.2 : Models, scaling laws plasma FEL dynamics, Report, Public, M24.

Expected outcome

The working group participants will pick out from the technologically feasible undulator parameters the most appropriate characteristics for FEL operation in different spectral ranges.

=> Robust undulator choice as a baseline

Challenged by ImPACT : 4 mm period undulator

WP6 : FEL Pilot application

MS17 (M20) / D6.2 (M24) : Models and scaling laws for plasma FEL dynamics

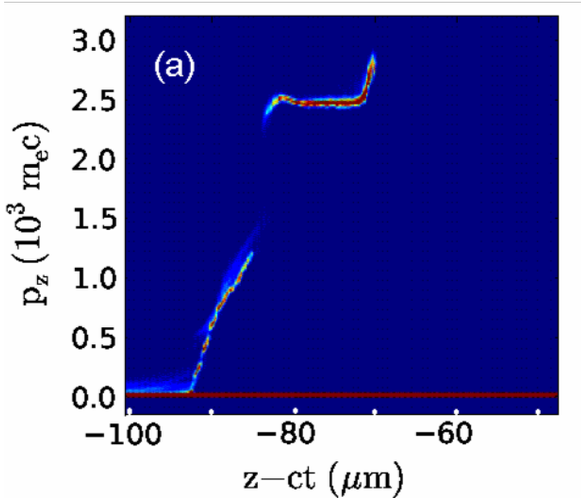
Tool :

Virtual lab. and computor aided for FEL outline and simulation, presented by C Dattoli et al.

Then, simulations in different cases : PROMETEO, GENESIS, CHIMERA (I. Andriyash)

=> Start with some existing parameter set (WP11)

evaluate the differences between a parameter set and a distribution



S Y Kalmykov et al New Journal of Physics 12 (2010) 045019

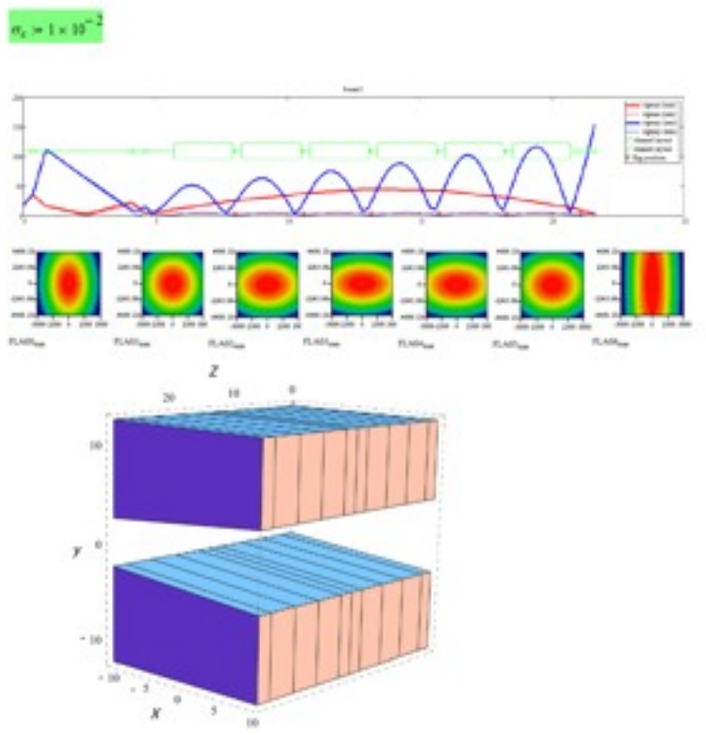
Parameter range :

- REQUEST TO WP2-3 :get a set of relaible scaling LPA parameters for FEL optimisation? => guide for parameter range

- REQUEST TO WP2-3 :set of 6D-distribution for our baseline cases (even if deviations, at least in Energy) : It is not enough to have only a list of parameters (slice characteristics, correlations ...) , common platform (Matematica) ? Dattoli?

=> REQUEST TO WP2-3 :compare in a detailed report the codes used or to be used with the experimental data obtained for experimental set of data to evaluate the degree of confidence in the electron beam, including the phase space portraits

look for existing measured data in one single experiment : what can we reach now for an FEL on paper ?



- manipulation line (decompression , TGU...) required or not? Issues with beam transport

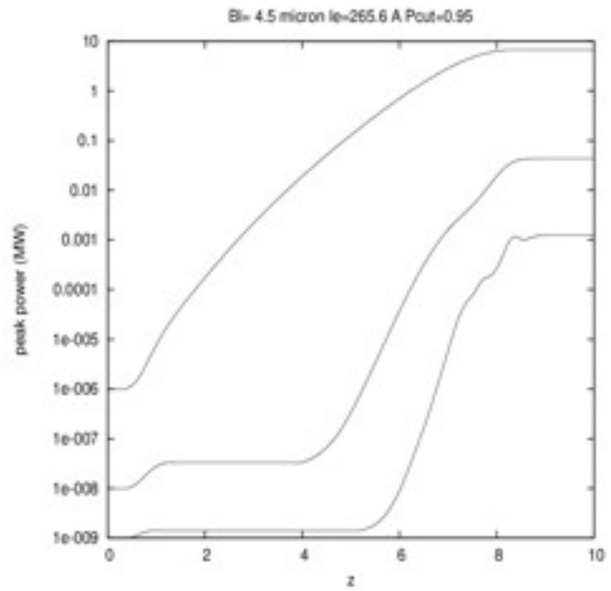
question of modelling and higher order field components to be taken into account

- are there several LPA configurations? Do we need to have multi-staging at once?

D6.3 : Diagnostic requirements and technical approaches, Report, Public, M24
issues with the diagnostics, cf WP5

D6.4 : Specific magnetic elements, Report, Public, M32
Issues with the focusing (permanent magnet quadrupole with variable strength : still R&D in the conventional accelerator community)

issues with the short pulse



$$P_{SP} = \left[1. - exp\left(-1.7\frac{\pi}{\mu_c}\right)\right] P_F$$

Dattoli et al.

D6.5 : FEL Scientific user workshop, Report, Public, M24
as Ralph said, if we can afready reach what FLASH is offering...
already a problem of repetition rate