High Gradient Laser Plasma Accelerating Structure

WP3: B. Cros, Z. Najmudin

Objectives of WP3

- **Design plasma accelerating structures and elements linked to laser plasma coupling issues:**

  (i) to achieve **an injector (reliable,** short **duration e- bunch)**

  (ii) to achieve **a high gradient accelerating structure** with controllable plasma parameters **scalable to high electron energy** requirements.

Starting point for plasma structures design

- **Plasma based injector:** The best method of injection should be determined for **bunch charge in the range 10-20 pC, and 50-100 pC at the output of the injector,** allowing the achievement of other parameters:
  - Energy spread ≤ 5% at the injector exit
  - Normalized emittance ≤ 1 mm mrad
  - Repetition rate 10 Hz or more (if useful for beam steering, positioning with feed back loop, switching between two beam lines - to be discussed)
- **Plasma based acceleration structure**
  - **Define regime of acceleration**: non-linear with self-focusing versus quasi-linear with external guiding. The two options should be studied in a preliminary phase.
  - **For each option describe** plasma creation, guiding, depletion and dephasing, acceleration distance. Evaluate reliability at 10Hz and scalability.

Tasks definition

- **Task 3.2. Design plasma structures** (injector & accelerator)

Define the regimes of operation.

Study plasma creation, laser confinement, and injection techniques Evaluate their sensitivity to stability.

- **Task 3.3. Design plasma chamber & environement** (beam coupling…)
- **Task 3.4. Diagnostics** for plasma, wakefield and electron parameters
- **Task 3.5. Staging plasma structures**

Study compact laser-plasma coupling, e.g plasma mirror

Study engineering issues for stability: laser/electron synchronisation and superposition at the entrance of the plasma.

Tasks were distributed

Task	Description	Contributing institutions	people
3.2.1	Define the regime of operation	ICL, U. Lancaster, CNRS	K Poder, Z Najmudin; A Thomas, B Cros
3.2.2	Plasma creation	JAI, ICL, CNR, CNRS	S Hooker, N Lopes, L Gabate, B Cros
	Laser confinement	JAI, ICL, CNRS	S Hooker, K Poder, B Cros
	Injection techniques	ICL, CNRS	K Poder, M Streeter, P Koester, B Cros
3.3.1	Determine reqiurements for plasma structure along with beam combining	ICL, DESY	N Lopes, A Walker
3.3.2	Study specific tasks		
	Laser focussing	RAL, CNR, CNRS	R Pattathil, L Gizzi, F Matthieu
	Laser plasma alignment and control	CNR, CNRS	L Gizzi, B Cros
	Vacuum system (gas load, sputtering)	CNRS, DESY	F Matthieu, A Walker
	Activation (chamber, local shielding)	RAL	R Pattathil
	Laser beam dumping	RAL, CNRS	D Symes, B. Cros
3.4	Diagnostics for plasma, electrons, wakefield	CNR, ICL,	Giuletti, Gurcio, Giove, Brandi, Filippi, Poder
3.5.1	Designing staging, identifying scalability parameters	ICL, U Lancaster, CNRS	K Poder, A Thomas, B Cros
3.5.2	Laser plasma coupling, eg plasma mirrors	ICL, LBNL	N Lopes, W Leemans?
	Laser plasma coupling, othoer options	CNRS	F Matthieu
3.5.3	Engineering issues for stability, timing and overlap	CNRS, INFN, ICL	L Gizzi, Anania, K Poder

What we do next

- **Define in detail each contribution and refine the definition of tasks**
- **The list of people identified in this table is now the mailing list for WP3 (contributors only, opened to additional contributors):** if your name is missing, please contact B. Cros!
- **WP3 meeting in october before the yearly meeting**
- **Reminder of milestones**
  - **MS14: M3.1 Design for an electron injector and a laser plasma stage proposed**
    - **Due date: m18 (April 2017)**
  - MS20: M3.2 Design for interaction chambers proposed
    - Due date: m24 (October 2017)
  - MS21: M3.3 Design for implementation of proposed diagnostics
    - Due date: m24 (October 2017)
  - MS26: M3.2 Design for multi-stage coupling proposed
    - Due date: m33 (July 2018)

  - D3.1: Report on the design of plasma structures
    - Due date: m36 (October 2018)