



EUROPEAN PLASMA RESEARCH ACCELERATOR WITH EXCELLENCE IN APPLICATIONS

High Gradient Laser Plasma Accelerating Structure WP3

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Within EuPRAXIA laser plasma accelerating structures shall be used for two different purposes:

1. As versatile injector platform that can produce high quality electron bunches of short duration;
2. As high gradient accelerating structure with controllable plasma parameters, compatible with laser propagation over the acceleration length, and scalable to high electron energy requirements.

This work package aims at identifying a reliable and stable solution to build an injector and an accelerator corresponding to the requirements identified in WP2 and in relation to the targeted range of applications. It will design the plasma structures required for both tasks and define optimum regimes of operation.

The work package will also study the diagnostics required to monitor the shot-to-shot operation of plasma structures for both scenarios and propose a design for the implementation of this instrumentation of an electron injector and a laser plasma stage. Finally, the partners will also investigate into the requirements for building a scalable accelerator by staging successive laser plasma structures.

Task	Description	Milestone	Due Date	Status
3.2	Design plasma structures (injector & accelerator)	MS14	April 2017	Completed
3.4	Diagnostics for plasma, wakefield and electron parameters	MS21	October 2017	Completed
3.3	Design plasma chamber & environment (beam coupling...)	MS20	July 2018	In progress
3.5	Staging plasma structures	MS26	July 2018	In progress
All	Final Delivery Report	D3.1	October 2018	

Task 3.2. Design plasma structures (injector & accelerator)

3.2.1: Define the regime of operation: Identify laser intensity, plasma density range and volume (effective acceleration length and transverse structure), repetition rate, ...

3.2.2 : Plasma creation

3.2.3: Laser confinement

MS14: M3.1 REPORT Design for an electron injector and a laser plasma stage proposed,

Task 3.3: Design plasma structure

3.3.1 : Determine requirements for plasma structure along with beam combining

3.3.2 : Study specific tasks

3.3.2a : Laser focussing

3.3.2b: Laser plasma alignment and control

3.3.2c: Vacuum system (gas load, sputtering)

3.3.2d: Activation (chamber, local shielding)

3.3.2e: Laser beam removal from electron axis

MS20: M3.2 REPORT Design for interaction chambers proposed

Task 3.4: Diagnostics

3.4.1: plasma diagnostics

3.4.2: plasma wave diagnostics

3.4.3: diagnostics of electrons in the plasma

3.4.4: laser diagnostics around focus, in/out plasma

MS21: M3.3 REPORT Design for implementation of proposed diagnostics

Task 3.5: design multistage LPA

3.5.1: Designing successive plasma structures, identifying scalability parameters

3.5.2: Laser plasma coupling

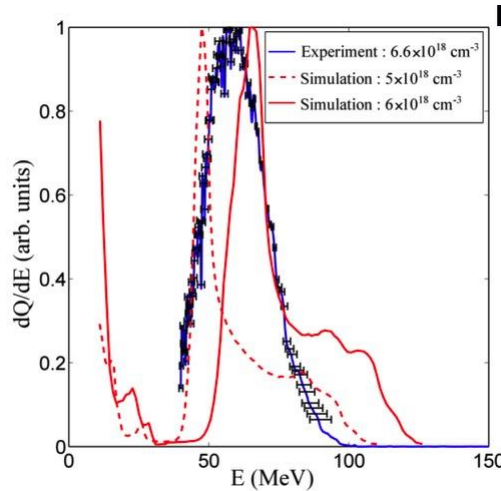
3.5.2a: Plasma mirrors

3.5.2b: other options

3.5.3: Engineering issues for stability, timing and overlap

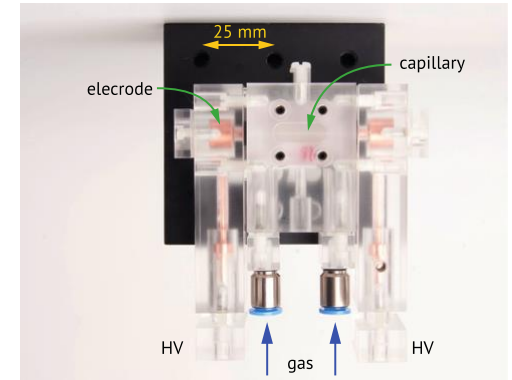
MS26: M3.2 REPORT Design for multi-stage coupling proposed

Injector



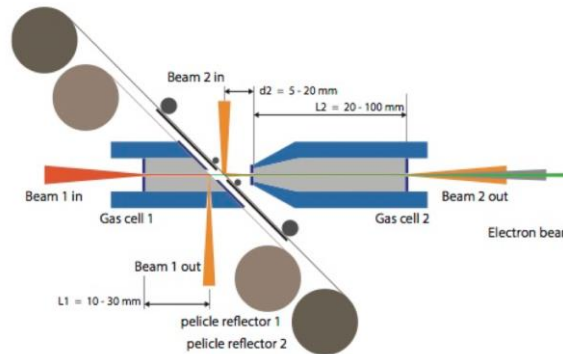
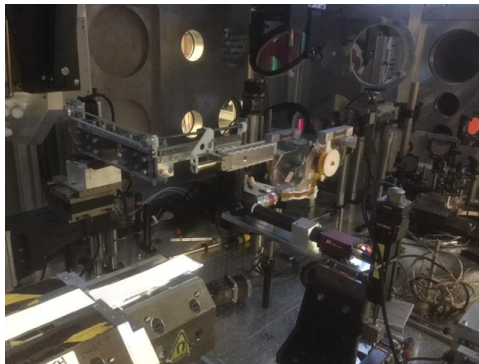
Gas cell development – experiments at UHI100

Accelerating structure

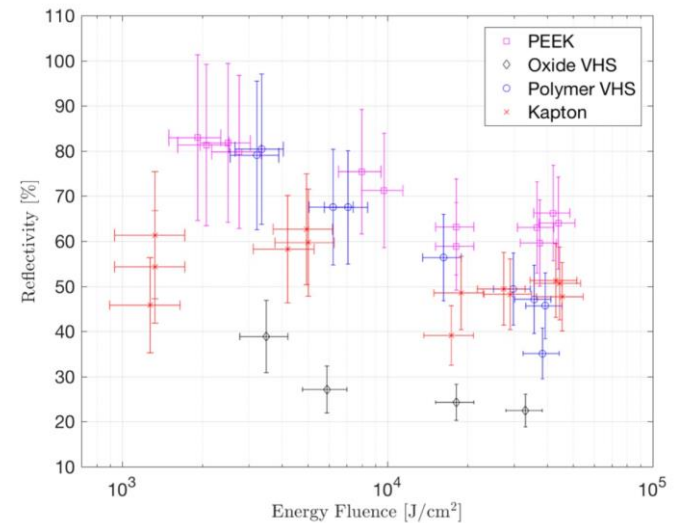


Capillary discharges main candidates for accelerator structures

Staging structure



Apparatus constructed for testing staged acceleration



Schedule for this week:

- **WP3 meeting : finalise M26 report**
- **WP3 meeting : discuss prototyping / testing experiments**
- **WP3 / WP 12 meeting : discuss requirements for plasma stages for wakefield based FELs (Thursday 13:15-14:30)**

Contributors

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