

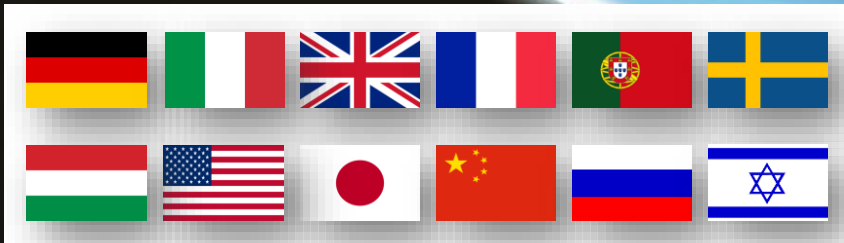
EUROPEAN
PLASMA RESEARCH
ACCELERATOR WITH
EXCELLENCE IN
APPLICATIONS



Electron Beam Design and Optimization (WP5)

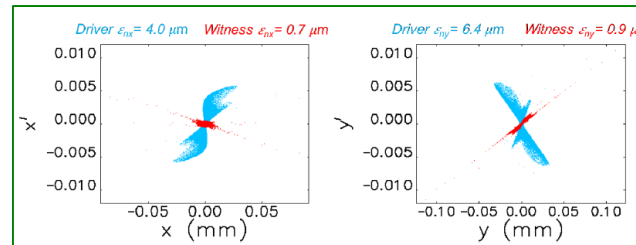
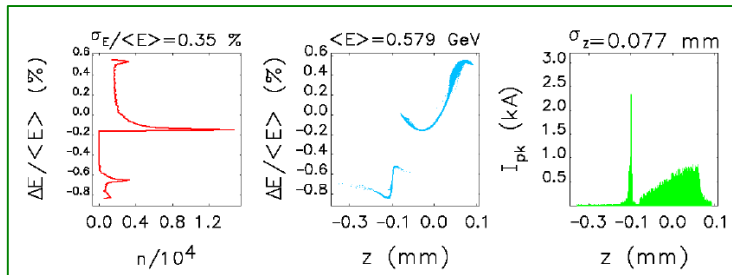
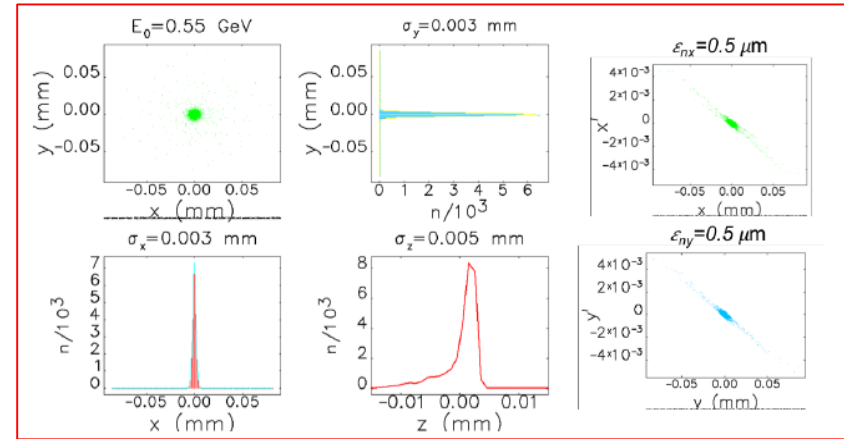
Antoine Chance on behalf of WP5 collaboration

Thanks to E. Chiadroni and A. Cianchi for providing slides



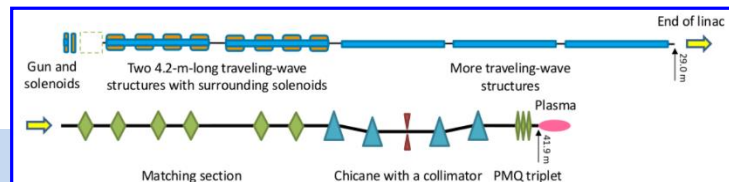
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 653782.

- Start-to-End simulations from the cathode to the plasma module
 - Full RF compression for LWFA external injection (INFN)
 - 3 S-band TW sections and X-band booster
 - Full RF compression for PWFA (INFN)
 - 3 S-band TW sections and X-band booster



Transverse phase space at the plasma entrance

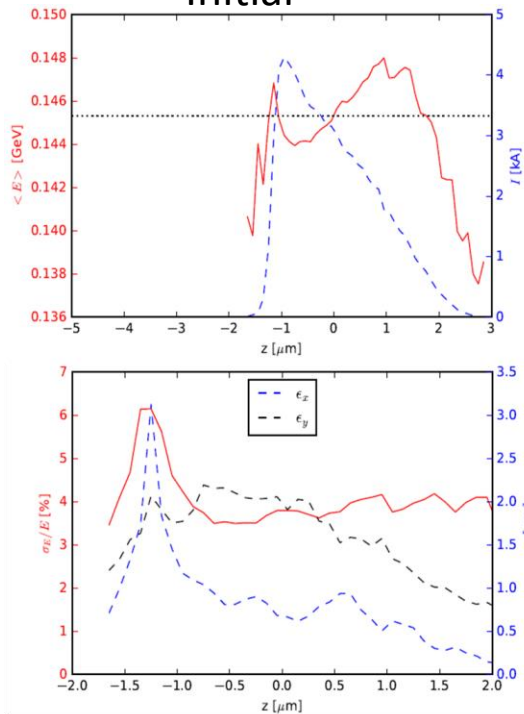
- Hybrid compression (DESY)



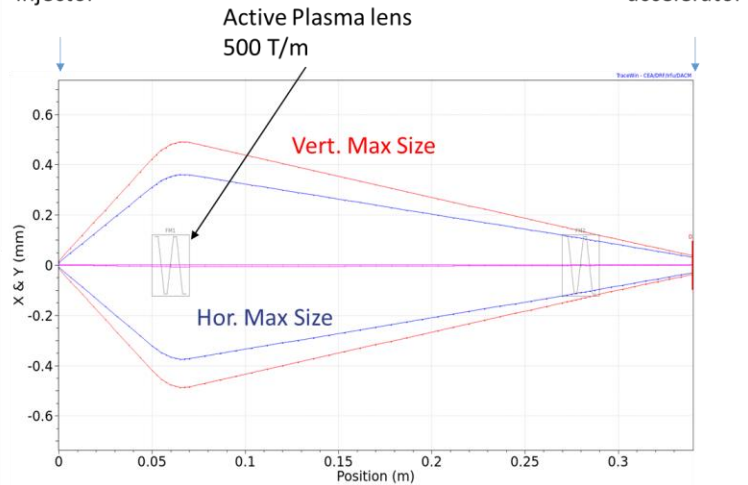
	Linac exit	Injection point
Energy (MeV)	242.0	240.8
Bunch charge (pC)	50.0	29.8
RMS bunch length (fs)	160.0	7.5
Peak current (kA)	0.13	4.0
Projected ϵ_x / ϵ_y (μm)	0.30 / 0.30	0.81 / 0.46
Slice ϵ_x / ϵ_y (μm)	0.28 / 0.28	0.59 / 0.34
β_x / β_y (mm)		3.1 / 3.0
RMS energy spread (%)	0.50	0.27
Slice RMS energy spread (%)	0.05	0.23

- Distributions from ReMPI schemes and ionization schemes have been transported. Exploration of a parameter set (total length and number of quadrupoles).
- No good solution was found with permanent quadrupoles (because of large initial $\gamma_{x,y}$).
- Plasma lenses are the most promising.

Initial

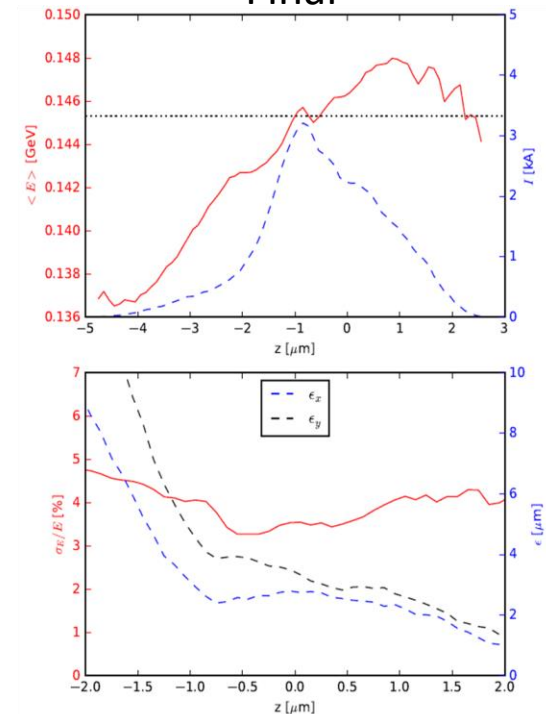


Exit of the plasma injector



Entrance of the plasma accelerator

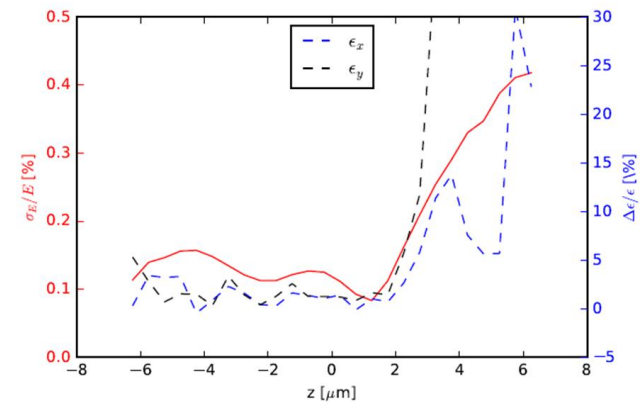
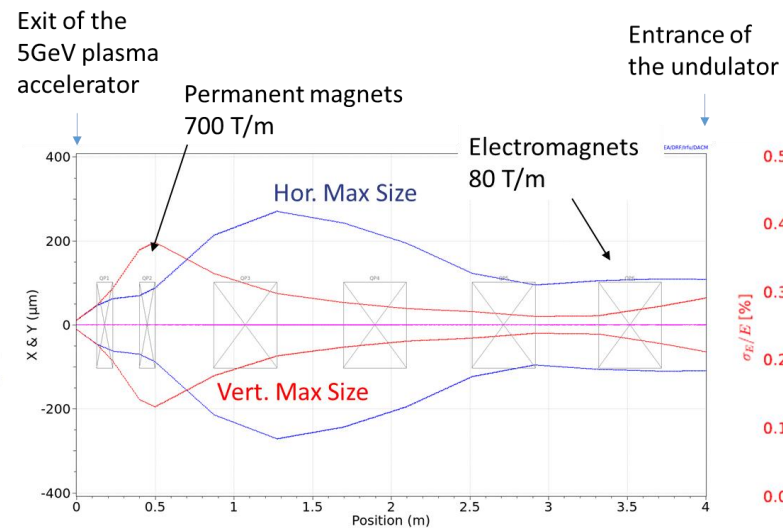
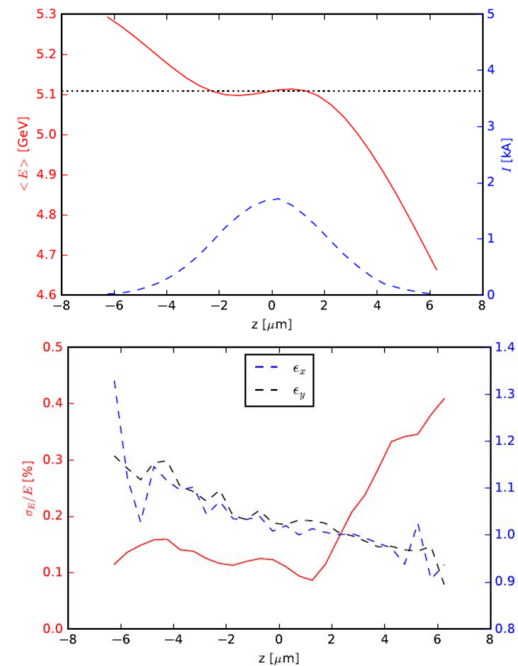
Final



- Only beam lines to FEL users have been investigated.
- Different distributions have been investigated. Exploration of a parameter set (total length and number of quadrupoles).
- Solutions were found with a very small emittance growth: only a growth of a few percents for the slice emittance.
- PWFA was investigated for EuPRAXIA@SPARC_LAB CDR.

Initial

Final



- Studies were initially done with no space charge. First studies were performed with SC effects. Currently under validation.
- Studies will focus on 2-stage-line: currently the hot topic. We need a convenient solution for start-to-end simulations.
- Dogleg will be realised for transfer lines to users of WP7.
- Transfer lines will be modified a bit to ensure feasibility of magnets and allocated space.
- Impact of misalignment errors and correction should be investigated.
- Discussions with WP5.3 to locate diagnostics.

- Eli-Beamlines:
 - setup for longitudinal diagnostics in single shot. Collaboration between ELI-Beamlines and the **SPARC_LAB** to test this device in Frascati in the fourth week of October.
- LAL
 - Nicolas will test his device, based on Smith-Purcell, for single shot not intercepting longitudinal diagnostics at **SPARC_LAB** in September-October.
- Cockroft Institute:
 - We agreed that the group at Cockroft Institute will be focused on um beam size measurement (based on OTR) and BLM
- DESY:
 - TDS in X band. The study of the tolerances has been completed, the mechanical design is ready and the prototype cavity is under procurement (PSI). As soon as the prototype is available, it will be characterized at low power at PSI. The test of the prototype with beam is foreseen to happen next year (2019) at the FLASHForward beamline (DESY). Meanwhile the procurement of the RF station and waveguide components (CERN design) for the prototype cavity at DESY are ongoing.

- During a workshop in Barcelona in January, about emittance measurements, in a talk given by M. Bergamaschi **the use of Diffraction Cherenkov radiation as a single shot non-intercepting beam profile monitor has been introduced.** It is an important topics that deserves our investigation. Maybe it can open interesting possibilities in emittance measurement.
- **No solution found** so far on the problem of the **betatron radiation spectrum overlap between driver and witness** in beam driven scheme.
- **EuPRAXIA@SPARC_LAB CDR has been released.** There is a **chapter dedicated to the diagnostics** that can be the starting point to write our CDR on this topic.
- New dedicated WP: WP15(diagnostics). WP leader: A. Cianchi

- start-to-end simulations for the transfer line design in case of LPI and multi-stage plasma accelerator (WP5, WP2, WP3)
- real plasma density profile for plasma capillaries and plasma cells (WP5, WP2, WP3)
- preliminary machine layout for electron beam diagnostic design (WP5)
- driver removal (WP5, WP4, WP9)