WP14 Hybrid Laser-Electron-Beam Driven Acceleration

Manpower (Name / Position)	Email	Institute	WPs	Fraction available	Start Date	End Date	Funded with EU Money*	Not funded with EU Money*
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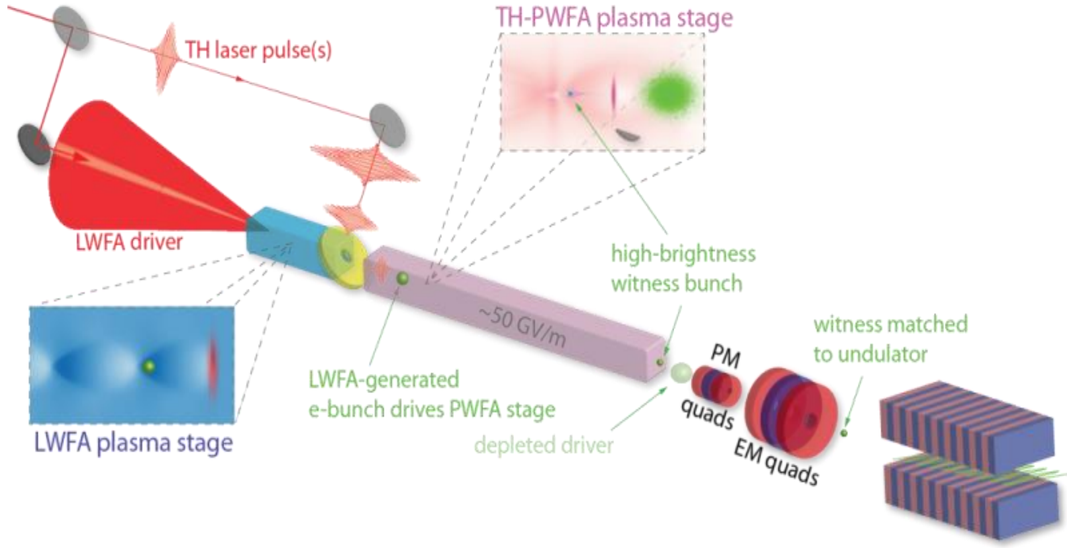
* please declare the amount of funding								

- Tight interaction between Hamburg and Glasgow:

- Task 14.1. Selective ionization of plasma components
- Task 14.2. Trojan Horse underdense photocathode witness bunch generation
- Task 14.3. Wakefield-Induced ionisation injection
- Task 14.4. Exploiting LWFA-generated electron bunches as drivers for PWFA

e.g. Dr. Manahan to visit HH via PIER fellowship



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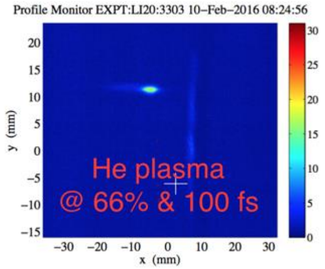
EuPRAXIA

- **Task 14.1. Selective ionization of plasma components**
  - ↳ Experimental determination of ionisation rates triggered by a laser.
  - ↳ Selection of most promising species for internal injection in both LWFA and PWFA modules
  - ↳ Deliverable 14.1. Design of an optimized plasma ionization module.



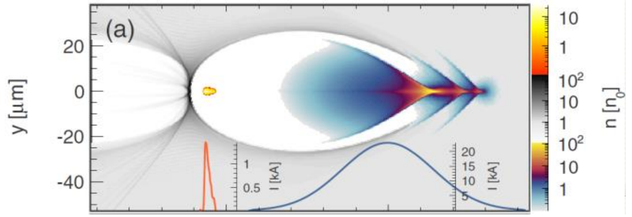
- **Task 14.2. Trojan Horse underdense photocathode witness bunch generation**
  - ↳ Deliverable 14.2: Underdense plasma photocathode design report.
    - *B. Hidding et al., Phys. Rev. Lett. 108, 035001 (2012).*
    - *A. Knetsch et al., arXiv:1412.4844v1 [physics.acc-ph].*
  - ↳ *G. G. Manahan et al. (PRAB 19, 011303 (2016)*

FACET

radiabeam TECHNOLOGIES

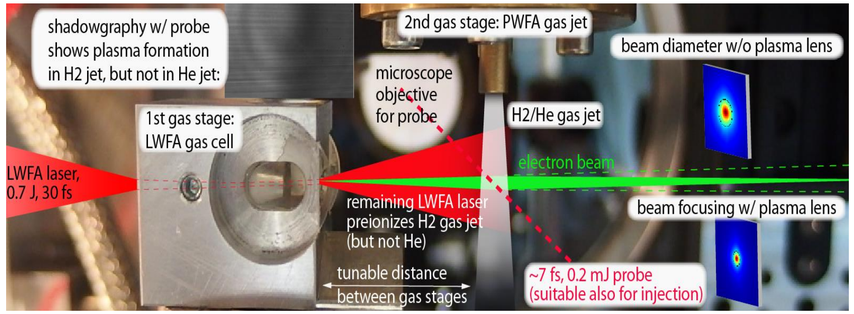
Breakthrough results recently obtained at SLAC FACET (associate intn'l partner) in E210 „Trojan Horse PWFA" programme, supported by RBT (industrial partner)

- **Task 14.3. Wakefield-Induced ionisation injection**
  - ↳ Deliverable 14.3: Report on wakefield ionization and trapping requirement and technique
    - *A. Martinez de la Ossa et al., Phys. Rev. Lett. 111, 245003 (2013).*
    - *A. Martinez de la Ossa et al., Phys. Plasmas 22, 093107 (2015).*

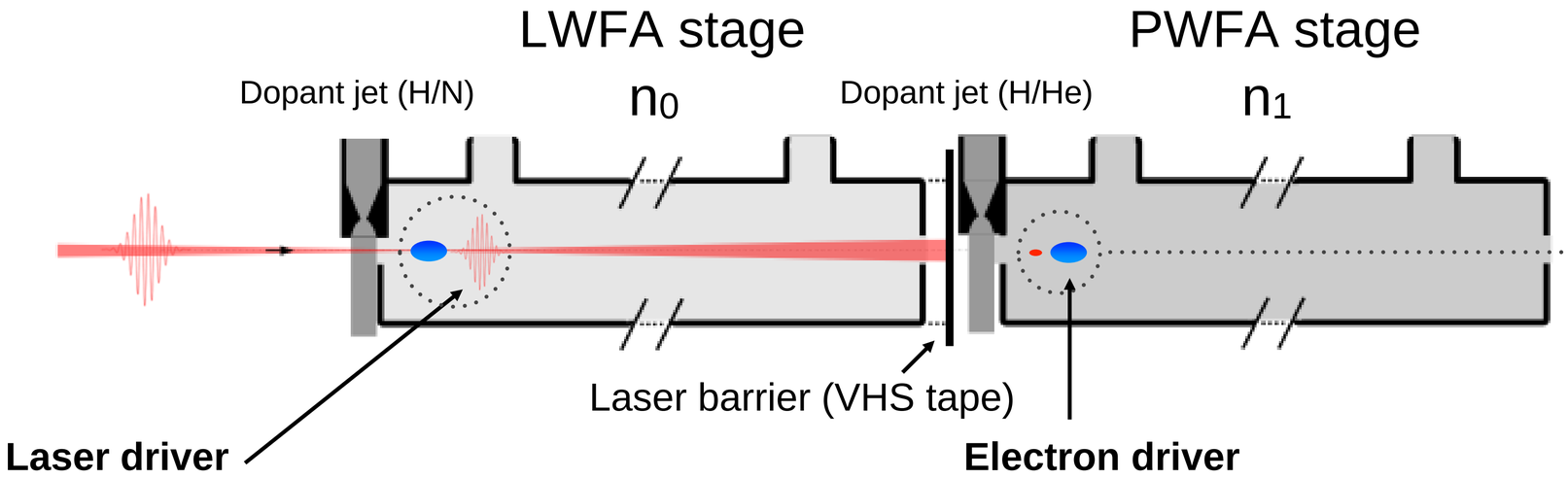


- **Task 14.4. Exploiting LWFA-generated electron bunches as drivers for PWFA**
  - ↳ *B. Hidding et al., PRL 104. 195002 (2010)*
  - ↳ Determination of a working point to enable internal injection in PWFA stage with LWFA produced beams.
  - ↳ Estimation of experimental tolerances: Laser jitter, laser asymmetries, bunch asymmetries, plasma fluctuations, dark current suppression, hosing mitigation, etc.
  - ↳ Deliverable 14.4. Conceptual design of optimized LWFA-source for PWFA-driver electron bunches.

Plasma lensing with e-beams from LWFA stage shown in PWFA stage (collab. with FSU Jena, S. Kuschel et al., submitted)



Conceptual design: 2 plasma stages, laser-driven (LWFA) + beam driven (PWFA)



Second witness internally injected by means of ionisation injection: laser or wakefield triggered. (require high-current drivers).

Laser driver

High-power lasers (~ 1 PW) can operate at low densities $n_0 \lesssim 10^{17}\,\mathrm{cm}^{-3}$

Electron driver

The witness e- bunch is now the driver in a higher plasma density scale $n_1 \lesssim 10^{19}\,\mathrm{cm}^{-3}$

Electrons beams from LWFA can do PWFA!

e.g. ionisation-induced injection enables direct control over the amount of injected charge for the production of **high-current beams.**

Witness from PWFA stage

- 10 times shorter and lower emittance.
- 10^2 times brighter!
- “Doubles” the energy per electron.

A. Martinez de la Ossa *et al.,* Phys. Plasmas **22**, 093107 (2015)