EuPRAXIA

EuroNNAc and EuPRAXIA Workshop on a European Plasma Accelerator
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WP5: Electron Beam Design and Optimization

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CEA (antoine.chance@cea.fr),
UROM, DESY, ULIV, USTRATH, SOLEIL, UHH

INFN People

- **Enrica Chiadroni**: **WP5 Leader**
  - Accelerator physicist, expert in high brightness photo-injectors and electron beam diagnostics, both transverse and longitudinal
    - **Responsible for the machine operation at SPARC_LAB** (Laboratori Nazionali di Frascati, INFN)
  - **Principal Investigator** of the "FIRB 2012" grant, funded by the Italian Minister of Research, for the development of experiments to be performed at SPARC_LAB on the **acceleration of high brightness electron beams in a plasma-based accelerator**
- **INFN Team**: Massimo Ferrario (WP9), Enrica Chiadroni, Alberto Marocchino (WP5 and WP2)

CEA/IRFU People

- **Antoine Chance: WP5 co-Leader**
  - Accelerator physicist, expert in beam dynamics, storage rings and colliders (design)
  - Transfer line @200 MeV between both acceleration stages for CILEX WP2 leader (« arc design ») for EuroCirCol
  - Interests: beam dynamics and simulations for plasma acceleration of electrons
- **CEA/Irfu Team:** Olivier Delferrière, Claire Simon, Antoine Chance, Phi Nghiem (WP2), Alban Mosnier (WP2), Xiangkun Li (post-doc, WP2 & WP5) + PhD student (WP2,not yet selected)

WP5 Description

- In **external injection schemes**, the optimum performance of a plasma accelerator is set by the **quality of the injected electron beam**
- **High brightness bunches** have to be generated directly at the cathode and transported without losses and with minimum quality degradation down to the plasma entrance
  - **Mitigation of sources of emittance degradation**
    - Proper choice of the electron injector
    - Emittance compensation schemes to assure an optimized matching to the plasma
  - **Longitudinal compression techniques** to provide bunch lengths << plasma wavelength
- **Optimization of**
  - witness bunch parameters
    - at the *entrance of the plasma* accelerating structure
      - matching studies both for the LWFA and PWFA performances
    - at the *plasma exit* to fit user needs
  - driver bunch parameters
    - at the *entrance of the plasma* accelerating structure
      - matching tolerance studies for alternative electron beam driven plasma structures
- Design of **electron beam diagnostics** before and after the plasma channel, taking profit from both standard and novel techniques

- **Task 5.1**: Coordination and Communication (INFN, CEA)
- **Task 5.2**: Electron Beam for *external* injection (RF injector) (UROM, DESY, ULIV, USTRATH)
- **Task 5.3**: Electron Beam Manipulation (INFN, CEA,UROM, DESY, ULIV, USTRATH, SOLEIL)
- **Task 5.4**: Electron Beam Diagnostics and Practical Issue (INFN, CEA,UROM, DESY, ULIV, USTRATH, UHH)

Milestones and Deliverables

- **M 5.1**: Personell recruitment [M12]
  - ✓ INFN-LNF Post-doc assigned
    - Alberto Marocchino: 50% to WP5, 50% to WP9
  - ✓ CEA Post-doc assigned
    - Xiangkun Li: WP5 and WP2
- **M 5.2**: Preliminary RF accelerator specifications [M12]
  - Project report (WPs involved: 5,2,3,6,7,9,12,14)
    - *Charge, average and peak current, energy, both for laser and particle driven plasma acceleration* to drive the choice of the most suitable injector
- **M 5.3**: Specification of the transfer line from the RF injector to the plasma [M24]
  - Project report
- **M 5.4**: Definition of diagnostics before and after the plasma channel [M40]
  - Project report

- **D 5.1**: Design report photo injector recruitment [M30]
  - Definition of laser, photocathode, cavities, emittance compensation schemes and tools for the diagnostics of the required electron beam parameters for both laser and particle driven schemes
- **D 5.2**: Report on optimal beam handling [M42]
  - Beam matching to the plasma and transport beam lines to users
- **D 5.3**: Full design report EuPRAXIA, WP5 contribution [M48]
  - Section 12 of the Conceptual Design Report (CDR)