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EuroLEAP Kick-off meeting, May 2006

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Abstract

The EuroLEAP Kick-off meeting took place in Orsay, the 16th of May 2006. The general presentation of the EuroLEAP project was followed by presentations from the work package leaders and a general discussion of the different aspects of the project organisation.

Introduction

The EuroLEAP (European Laser Electron controlled Acceleration in Plasmas to GeV energy range) is a NEST STREP Adventure project coordinated by B. Cros (CNRS-LPGP) which has been approved for funding in January 2006. The project starting date is September 2006.

The objectives of this project are:

- To build a laser-plasma accelerator in order to accelerate electrons to the GeV energy range in a energy range in a plasma wave.
- To test the issues related to the control of the properties of the electron beam properties of the electron beam

It is thus expected to produce an accelerated e-beam with beam with

- energy in the GeV range,
- energy spread of the order of 1%,
- pulse duration of the order of 100 fs, ,
- charge in the range 10 pC to 100 pC.

The participants are from 4 European countries,

- France : Centre National de la Recherche entre National de la Recherche

Scientifique : LPGP, LOA, LLR, LAL

- UK : CCLRC CCLRC-RAL, University of STRATHCLYDE USTRAT, Imperial College IC, University of OXFORD UOXF
- The Netherlands: Universiteit Universiteit Twente Twente, UT, U. Eindhoven U. of Technology, TUE , TUE
- Instituto Superior Técnico, IST , IST-GOLP

Research activities are broken down into 5 work packages (WP):

- WP1: Laser Injector Development
- WP2: RF Photo-Injector Development
- WP3: Production of a plasma wave over a long distance over a long distance
- WP4: Injection & Controlled Acceleration
- WP5: Diagnostics

Objectives of the WPs

WP1: Laser Injector Development objectives are

- To demonstrate all-optical injection (AOI) and acceleration of ultra-short (10 fs) electron bunches by
  - colliding laser pulses (CDP)
  - collinear pulses (CLP) collinear pulses (CLP)
- Characterize and optimize the spectrum of electrons
- Achieve mono-energetic, low emittance electron beams at a few tens of MeV to 200 MeV

WP2: RF Photo-Injector Development objectives are to

- Improve existing technology in order to build Radio-Frequency Photo-Injectors (RFPIs) to produce e- bunches with:
  - 50 to 100 pC charge,

  - 50 fs to 1ps duration,
  - energy 3- 4 MeV, energy spread 2% ,
- Transport and focus the electron beam at the entrance of the plasma
- Commission RFPIs for acceleration experiment

WP3:Production of a plasma wave over a long distance objectives are to

- Develop plasma media allowing to achieve a plasma wave over several centimetres
- Study the propagation of intense laser pulses ($\geq 10^{17} W.cm^{-2}$) in the waveguides
- Control the plasma wave stability, repeatability and lifetime
- Achieve a product of gradient and length of 1 GV

WP4: Injection & Controlled Acceleration objectives are to

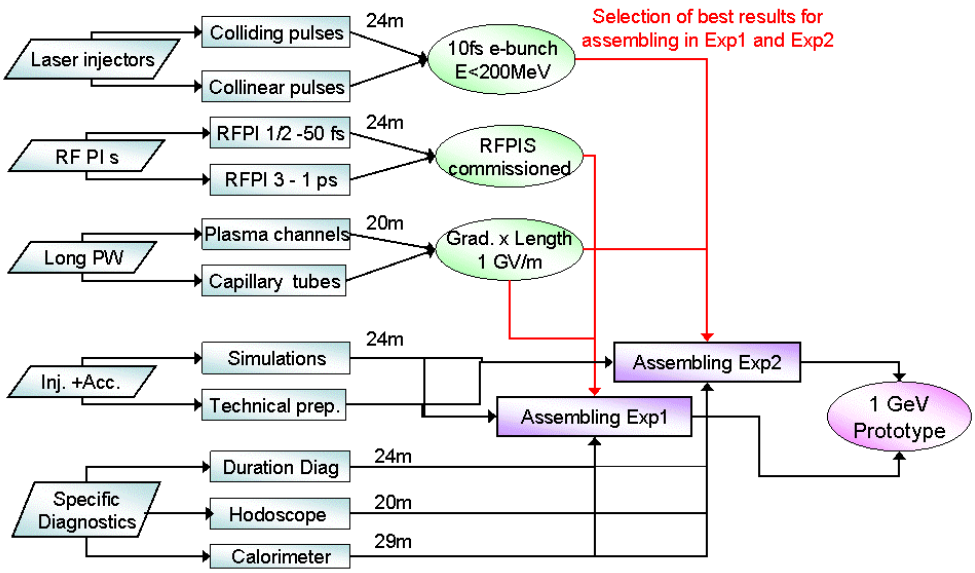
- Inject and accelerate electrons in a linear plasma wave over a long distance (several centimetres)
- Achieve a precise theoretical modelling and control the different elements of the acceleration process
- Build a prototype to achieve accelerated electron beams with
  - energy in the GeV range,
  - energy spread of the order of 1%,
  - pulse duration of the order of 100 fs,
  - charge in the range 10 pC to 100 pC.

WP5: Diagnostics Development objectives are to
Develop and implement diagnostics to characterize the accelerated electron bunches

- beam profile,
- charge,
- energy,
- time duration

Organisation of the work

The following diagram summarizes the organisation of the works. Several options for



laser injectors, RFPIS, and guiding media will be studied in parallel. At the end of the second year of the project, the option giving the best results will be selected and brought together to achieve an "optimized" injection experiment.

Resources

This project brings together several groups with complementary resources and expertise.

- Accelerator laboratories and laser facilities: TUE, UT, LAL, RAL, LOA, USTRAT, IST
- Waveguide development labs: OXFORD, IST, LPGP
- Diagnostics development labs: LLR, USTRAT, TUE, UT
- Modeling and simulation infrastructures

The funds from the EU (2M Euros) are for

- Post-doc or PhD
- Consumables, transfer of equipment, missions for collaborative experiments, collaboration meetings, management

Conclusion

The output of this project will be a compact controllable e-source in the GeV range. This technology will allow dissemination to university size labs for applications or further developments. Several industrial spin-offs in laser, photo-injector technology, synchronization, are expected, as well as applications to femtosecond X-ray generation, femtochemistry, radiobiology, …
This prototype, as the first stage of a laser plasma accelerator, will allow to evaluate the feasibility of building a multi-stages accelerator for higher energy electron beam production and is thus the basis for a larger scale project at the European level.

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