European Laser Electron controlled Acceleration in Plasmas to GeV energy range

NEST ADVENTURE STREP Proposal
Coordinator: Brigitte CROS (CNRS- LPGP)

Approved January, 2006

euro LEAP

History

- This NEST STREP Adventure project started in January 2005
- First step approved in June 2005
- Full project approved in January 2006
- CPF signed by partners
- Contract signature ???
- Consortium Agreement : second draft
- First fund transfer expected in September 2006

Objectives

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

Participants

- 1 - Centre National de la Recherche Scientifique : LPGP, LOA, LLR, LAL
- 2 - CCLRC-RAL, U STRATHCLYDE, Imperial College, U OXFORD
- 3 - Universiteit Twente, UT
- 4 - Eindhoven U. of Technology, TUE
- 5 - Instituto Superior Técnico, IST-GOLP

Research activities

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

WP1: Laser Injector Development

- Demonstrate all-optical injection (AOI) and acceleration of ultra-short (10 fs) electron bunches by
  - colliding laser pulses (CDP)
  - 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

- Improve existing technology in order to build 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

- 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

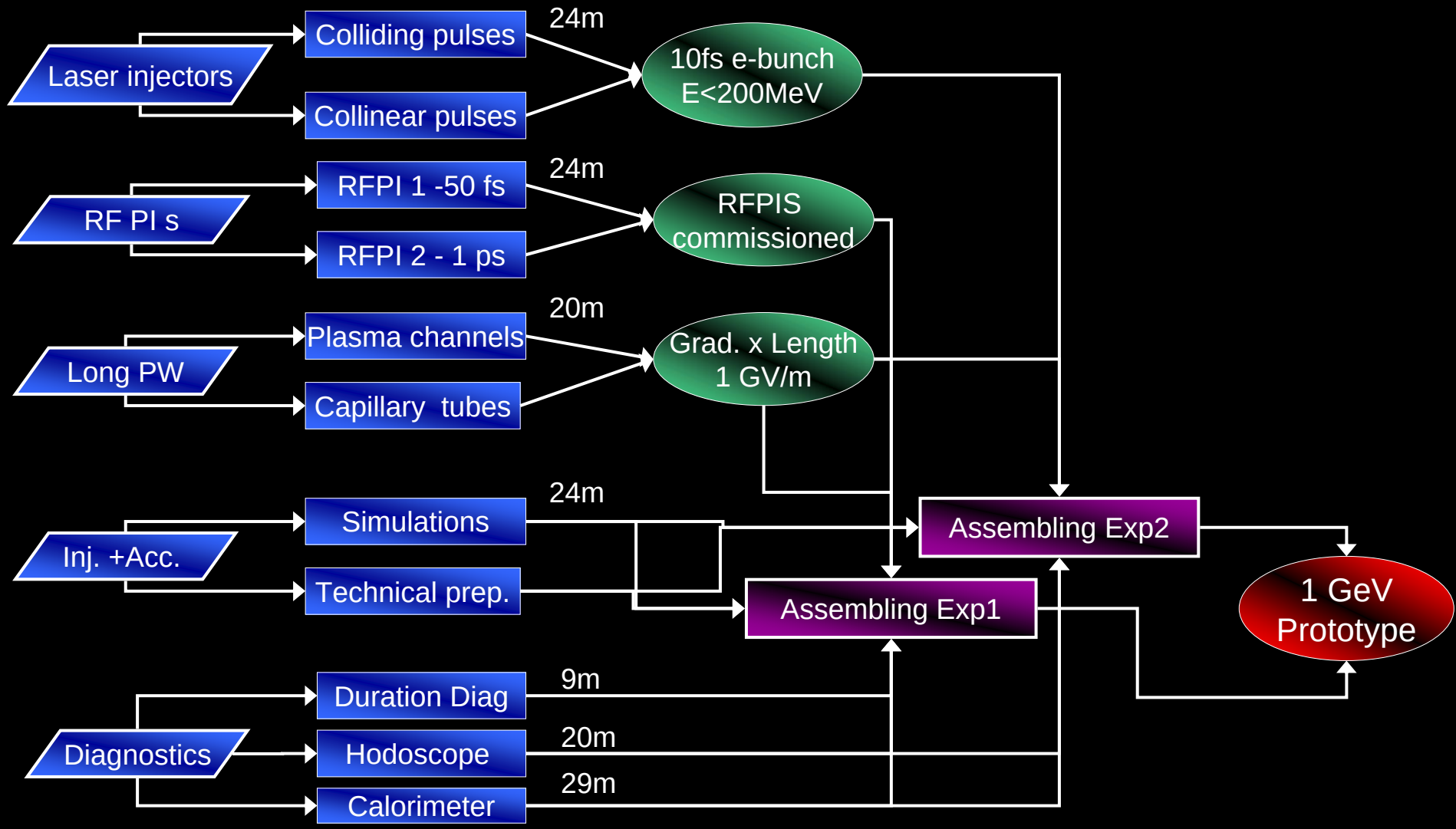
WP4: Injection & Controlled Acceleration

- 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

- Develop and implement diagnostics to characterize
  - beam profile,
  - charge,
  - energy,
  - time duration

Work plan synoptic view



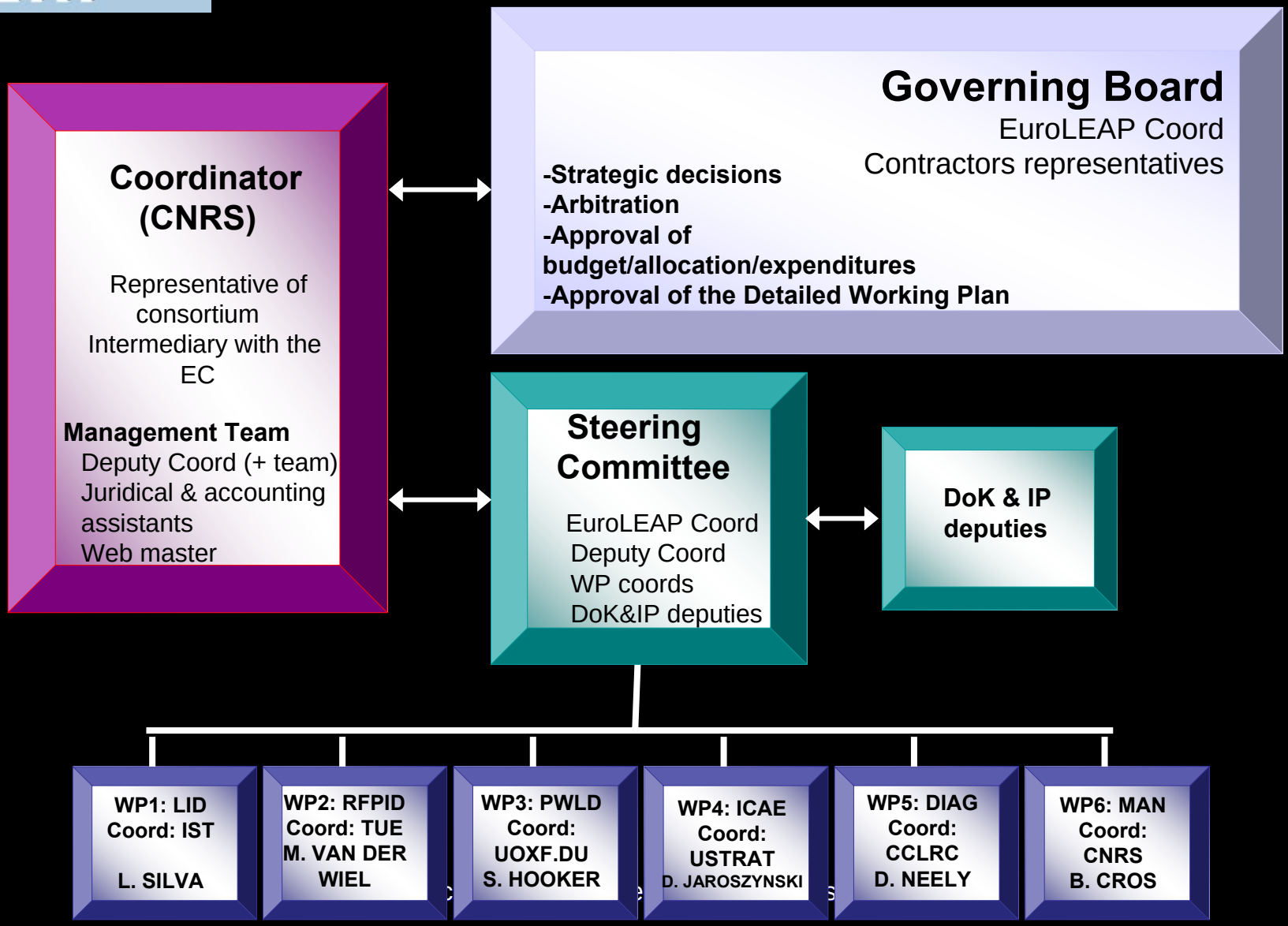
Resources

- 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
- Requested funds: 2M Euros are for
  - Post-doc or PhD
  - Consumables, transfer of equipment, missions for collaborative experiments, collaboration meetings, management

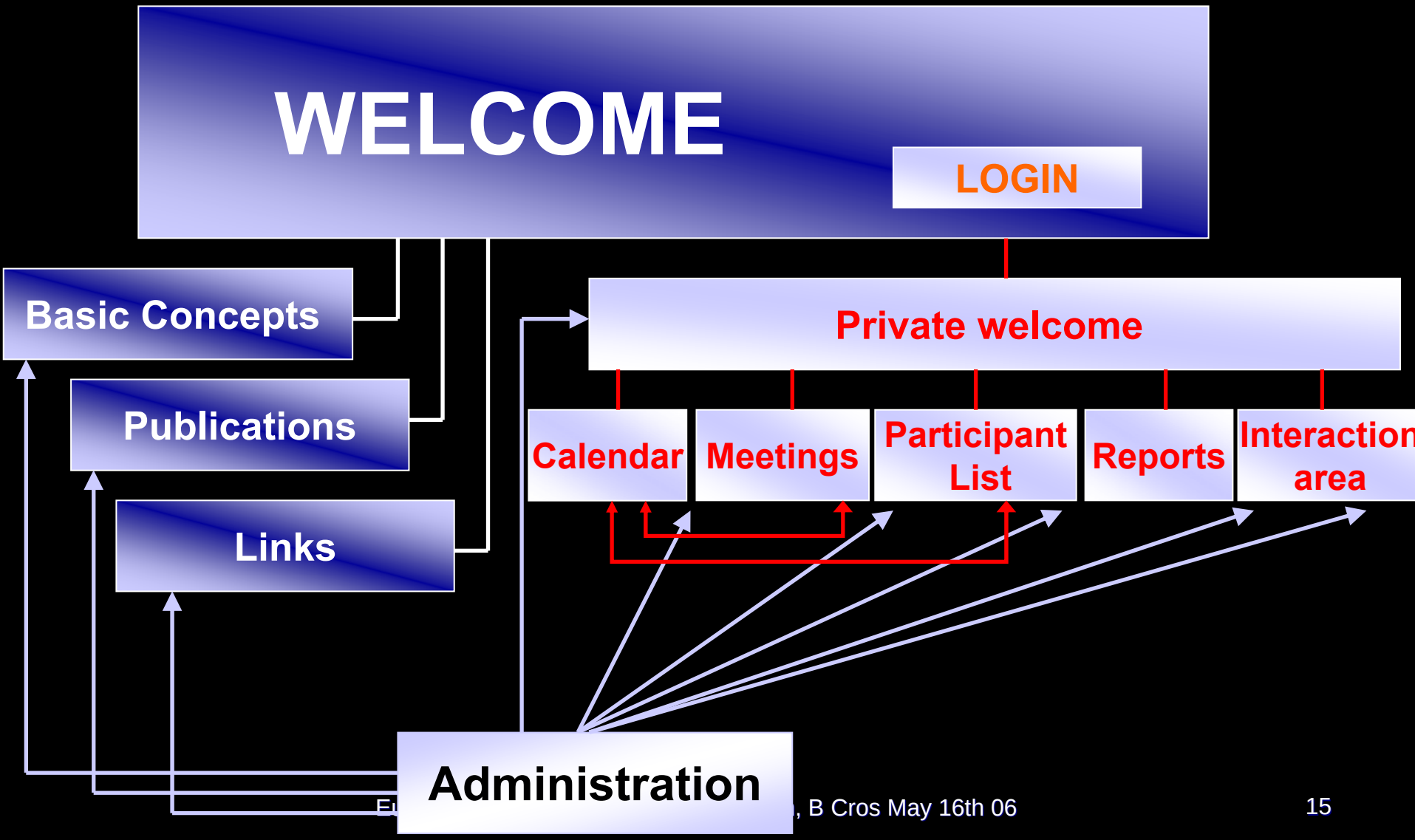
Impact

- Compact controllable e-source in the GeV range
  - Dissemination to University size labs
  - Industrial spin-offs (laser, photo-injector technology, synchronisation)
  - Applications to femtosecond X-ray generation, femtochemistry, radiobiology, …
- First stage of a laser plasma accelerator
  - Will allow to evaluate the feasibility of building a multi-stages accelerator for high energy
  - Basis for a larger scale project at the European level.

Management structure



Website


WELCOME
LOGIN
Basic Concepts
Publications
Links
Private welcome
Calendar
Meetings
Participant List
Reports
Interaction area
Administration

Questions to be discussed

- Organisation of the work in the WP
- Publications: authorship rules, reviewing, preprint diffusion
- Dok and IP deputies: volunteers ?
- Use of the website (workflow, sharing of information)
- Budget rules and calendar
- Recruitment issues

Today's Agenda

- **9h15- 9h45General presentation of EuroLEAP** B. Cros
- **9h45-11h30Présentation of WP objectives**
  - 9h45 WP1 L. Silva
  - 10h00 WP2 M. van der Wiel
  - 10h15 WP3 S. Hooker
- 10h30-11h00*Coffee Break*
  - 11h00WP4D. Jaroszynski
  - 11h15WP5D. Neely
- **11h30-15h00Discussion of work coordination : plan for 06/07**
  - 11h30WP1 L. Silva
  - 12h00WP2M. van der Wiel
- 12h30–13h30 *Lunch break*
  - 13h30WP3S. Hooker
  - 14h00WP4D. Jaroszynski
  - 14h30WP5D. Neely
- 15h00-15h30 *Coffee break*
- **15h30-16h45 Discussion of organisation : IP, publication, communication, budget rules, …** B. Cros
  - 16h45-17h00Summing-upB. Cros
  - 17h00*End of kick-off meeting*
- 17h15-18h00 Steering board meeting
- 18h00-18h45 Governing board meeting