EuroFEL Collaboration

David Holder
ASTeC, Daresbury Laboratory

CCLRC
Daresbury Laboratory

Contents

- What is it?
- Who is involved?
- How much money?
- Workpackage Leaders
- Overall Objectives.
- Workpackage 2 (Beam Dynamics) details.
- Conclusion.

What is it?

- Full name: European FEL Design Study
- Acronym: EuroFEL
- European Union "*Sixth Framework Programme*";
  - Sub-programme: "*Structuring the European Research Area*", "*Research Infrastructures Action*",
  - "*Design Studies*", implemented as a "*Specific Support Action*"
- Start date *1st January 2005*; duration *3 years*.

Who is involved? (1 of 2)

- Laboratories, universities and research institutes from countries within the EU, co-ordinated by DESY Hamburg;
- Other participants:
  - BESSY - Berlin, Germany
  - CCLRC - Daresbury & Rutherford Appleton Labs, UK
  - CEA – France
  - CNRS – France
  - DESY - Zeuthen, Germany
  - ELETTRA - Trieste, Italy
  - ENEA - Rome, Italy

Who is involved? (2 of 2)

- ENEA - Rome, Italy
- FZ Rossendorf - Dresden, Germany
- INFN - Frascati, Italy
- MAX-lab - Lund, Sweden
- Max Born Institute - Berlin, Germany
- SOLEIL – Paris, France
- Technical University of Darmstadt - Germany
- University of Hamburg - Germany
- University of Rome “La Sapienza” - Italy
- University Strathclyde - Glasgow, UK.

How Much Money?

€9M, split into 6 workpackages:

- DS 1 Photo-Guns & Injectors (26%);
- DS 2 Beam Dynamics (12%);
- DS 3 Synchronisation (13%);
- DS 4 Seeding and Harmonic Generation (18%);
- DS 5 Superconducting CW and Near-CW Linacs (14%);
- DS 6 Cryomodules Technology Transfer (14%);

Workpackage Leaders

- DS 1 Photo-Guns & Injectors (Massimo Ferrario, INFN);
- DS 2 Beam Dynamics (Hywel Owen, CCLRC);
- DS 3 Synchronisation (Mario Ferianis, ELETTRA);
- DS 4 Seeding and Harmonic Generation (Sverker Werin, MAX-lab);
- DS 5 Superconducting CW and Near-CW Linacs (Jens Knobloch, BESSY);
- DS 6 Cryomodules Technology Transfer (Bernd Petersen, DESY);

Overall Objectives (1 of 2)

- Develop proven designs for critical components such as:
  - Electron gun;
  - Complete injection system;
  - Optical system;
  - Electron bunch compressor.
- Improvement of the electron beam parameters;
- Development of seeding and harmonic generation techniques;

Overall Objectives (2 of 2)

- Ensure flexible FEL pulse time distribution by:
  - Qualification of superconducting structures for high duty-cycle (CW) operation;
  - Studies of synchronisation of the electron beam;
- Move from prototyping to industrial production of complete superconducting accelerator modules.

Workpackage DS 2 Objectives - Beam Dynamics

- Start-to-end simulation code development;
- CSR simulation and observation;
- Optimised bunch compression schemes;
- Beam break-up and recirculation limitations at high current;
- Wakefields and impedances;
- Photoinjector dynamics.

DS2 Topic 1: Start-to-End Code and Repository

- Establish a common repository (and comparison data) for beam dynamics codes, specifically those for start-to-end (S2E) simulation of high charge, low emittance bunches that is easily-accessible;
- Provide a parallel-computing resource for the European community;
- Provide the code TREDI to the partners;
- Develop the codes HOMDYN, RETAR and make them available to the partners .

DS2 Topic 2: CSR/LSC Simulation and Observation

- Develop simulation capability to accurately model CSR microbunching, systematic studies of simulation validity;
- Validate these simulations on planned facilities and study their impact on future facilities;
- Develop the code CSRtrack to model complete beam transport systems and provide a robust and simple user interface;
- Study proposed bunch compression designs for XFEL, 4GLS and FERMI using CSRtrack.

DS2 Topic 3: Optimised Bunch Compression Schemes

- Examine alternatives to the standard schemes to explore which method is best suited to each of the various future European FEL sources;
- Study non-linear optics effects in bunch compression;
- Validation of schemes on test facilities;
- Modelling of (non-magnetic) bunch compressor schemes in TREDI.

DS2 Topic 4: BBU and Recirculation at High Currents

- A systematic study of recirculation dynamics is needed to determine the required performance of the accelerating cavities and recirculation system for future European FEL sources:
  - Evaluate the limitations on high current operation for 4GLS and Arc-en-Ciel operation;
  - Evaluate the limitations for a possible future ERL option with counter-moving beams in the main linac of the XFEL project (DESY).

DS2 Topic 5: Wakefields and Impedances

- Developed existing and well-proven computer codes to produce a seamless impedance model for an entire accelerator:
  - Development of the code ECHO to fully model 3D wakefields and to include an integrated IO interface;
  - Validation of ECHO and comparison with experiments;
  - Wakefield and impedance analysis for FERMI, 4GLS and XFEL;
  - Longitudinal and transverse wakefield effects in the presence of space charge.

DS2 Topic 6: Photoinjector Dynamics

- Develop HOMDYN and apply to photo-injectors like SPARC and PITZ, with comparisons to measurements;
- Develop RETAR code, for fully self-consistent 3D treatment of beams including radiation effects, laser and cathode inhomogeneity;
- Use of the code TREDI on a parallel platform to perform large-scale simulations of injector designs for individual projects;
- Design study of high-current photoinjector for 4GLS.

Conclusion

- Europe-wide programme to develop accelerator technology for FEL-based light sources;
- Part of a new effort to co-ordinate accelerator R & D within Europe;
- Sharing codes, knowledge and expertise;
- *Not in it for the money!*