The Accelerator Research and Development Laboratory (LEDA) at CEA Saclay

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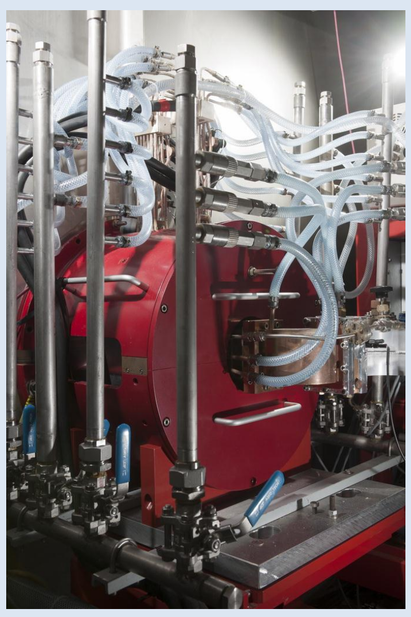
The Accelerator Research and Development Laboratory (LEDA) is part of the Accelerator, Cryogenics and Magnetism Department (SACM) of the Institute of Research into the Fundamental Laws of the Universe (IRFU). We design, build and operate ion sources, injectors and diagnostics for high intensity proton or deuteron accelerators for nuclear physics, material studies or accelerator driven systems. Several home-made simulation codes are used to design and understand the beam dynamics. We also work on the accelerators for high energy physics, and on R&D for laser-plasma acceleration.

Light ion ECR sources



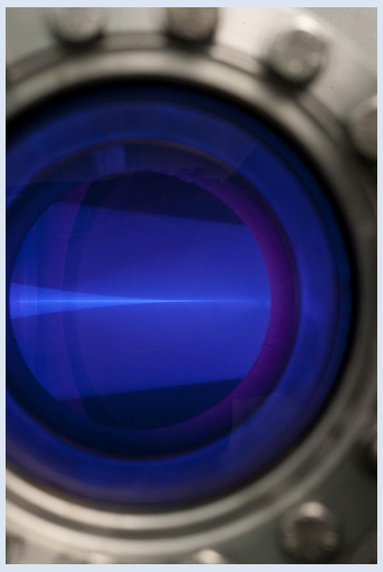
We design, build and operate **electron cyclotron resonance (ECR) ion sources** to produce beams of protons or deuterons with intensities up to ~100 mA.

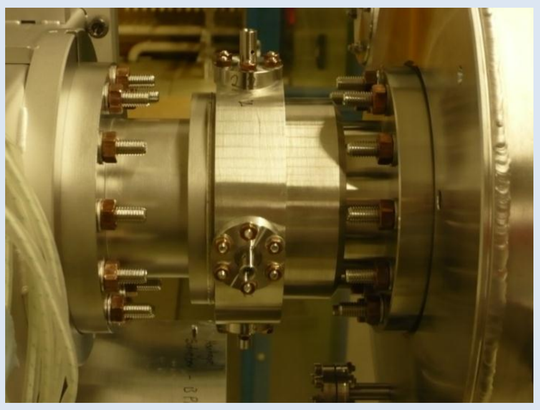
This includes:
- Magnetic simulation and design
- Compact mechanical solutions
- Optimisation of the extraction electrodes
- High voltage and cooling systems
- Gaz injection in the plasma chamber
- Command Control and saftey systems

Beam diagnostics

Together with standard diagnostics, such as Allison scanners, Wien filters or ACCTs, we design non-interceptive **optical diagnostics** for H^+, H_2^+, H_3^+ species fraction measurement, 1d beam profiling or 2d tomography.

We also design the data acquisition systems and processing softwares.



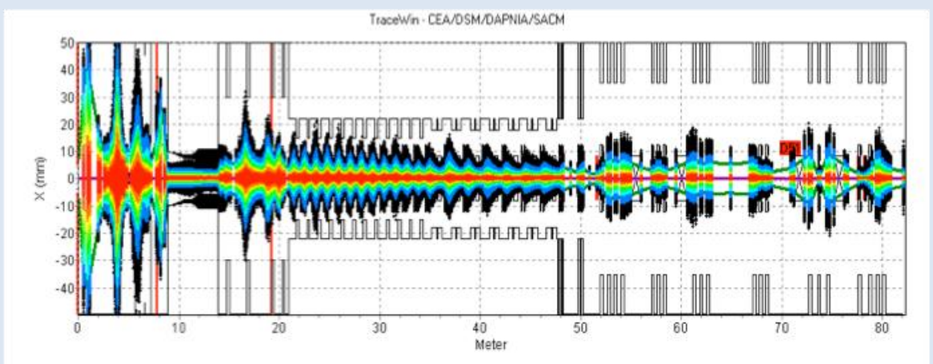


We simulate, design and build reentrant cavity **Beam Position Monitors** (BPMs) for the XFEL project, or button BPMs for the FAIR proton Linac project, together with their associated analog electronics and test benches.

Simulations

Home-made Particle in Cell (PIC) codes(*) such as **TraceWin**, **Toutatis** or **SolMaxP** are used to simulate the beam transport from the ion source to the target, or laser – plasma interactions, taking into account non-linear effects such as space charge, wake fields or beam – gas interaction.

Start to end simulations of beam lines are compared to the measured characteristics and can be used to operate the injectors.



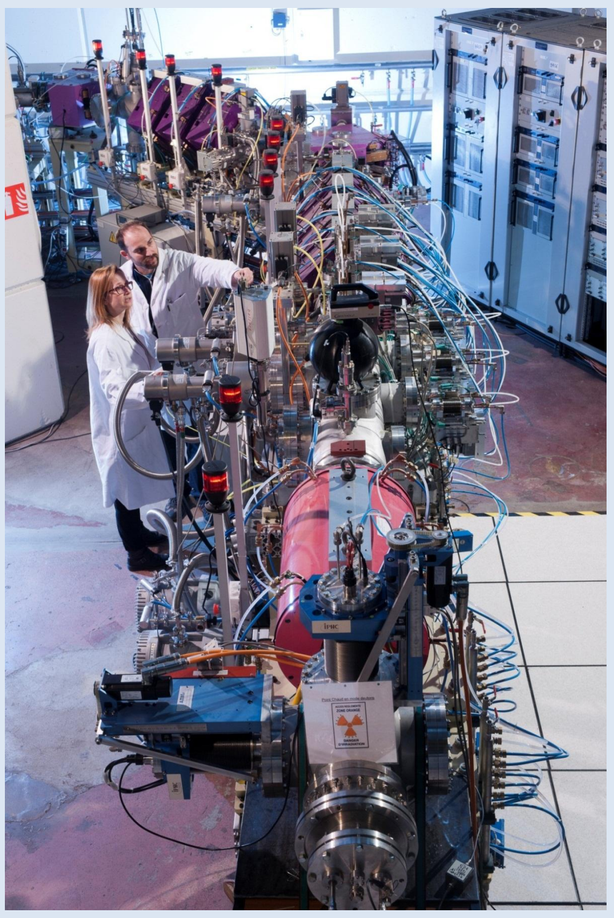
(*) available at http://irfu.cea.fr/Sacm/logiciels/

High intensity injectors

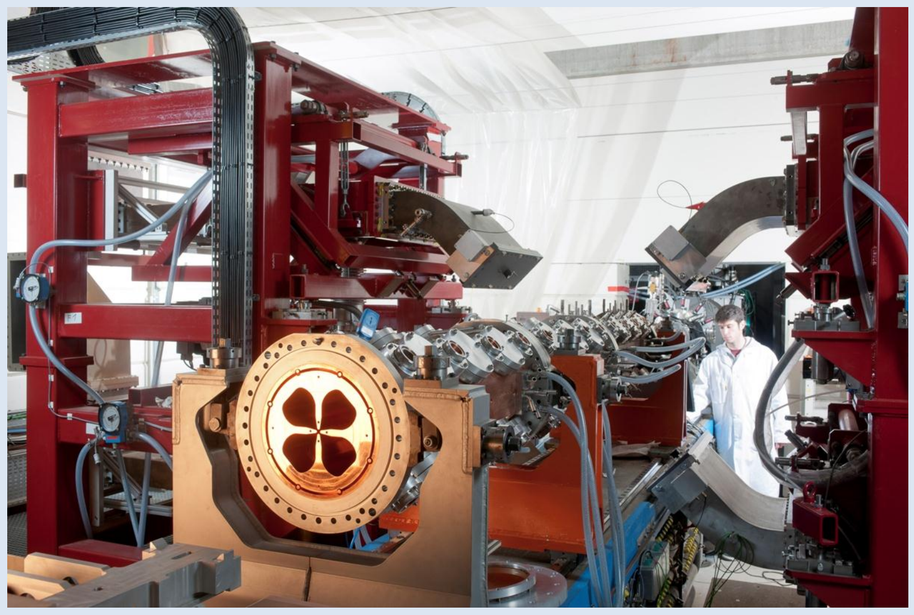
Beams extracted from the ECR sources (at 20 – 100 keV) are transported by **low energy beam lines** which can include:

- Focusing dipoles or quadrupoles
- Dipoles
- Correction magnets
- Faraday cups, choppers…
- Diagnostics: wire scanners, emittance-meters, Wien filters…
- Measurements of space-charge effects
- Beam stops

We assemble and operate low energy beam lines, including the vacuum, cooling and safety systems. Beam characteristics are measured and compared to the results of simulations.



We are currently working on the **SPIRAL2**, **IFMIF** and **FAIR** injectors for nuclear physics or material studies.
IPHI (High Intensity Proton Injector) is located at CEA Saclay and will accelerate a 100 mA continuous proton beam to 3 MeV by using a 6 m long Radio-Frequency Quadrupole (RFQ)



Accelerators for High Energy Physics

We participate to studies for the future High Energy Physics accelerators:

- Study of the **beta-beam** decay ring or the **ILC** interaction region
- Optimisation of the optics of the interaction regions for **HL-LHC**
- Participation in the **CLIC** Test Facility

We are also partner of the **CILEX** project which brings together laser and accelerator experts to study laser – plasma acceleration, and participate to the integration of the cryomodules for the **XFEL** project.

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