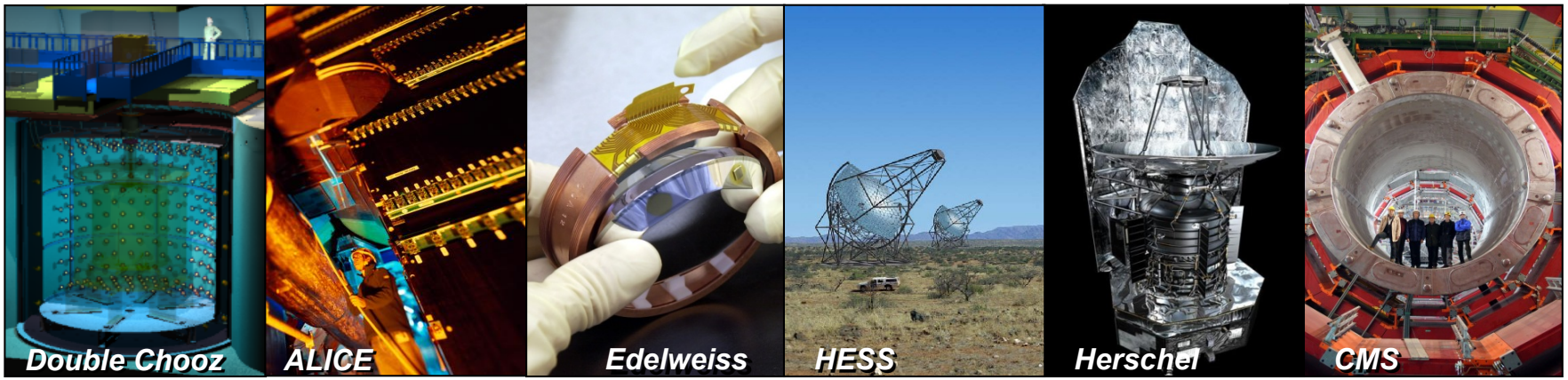
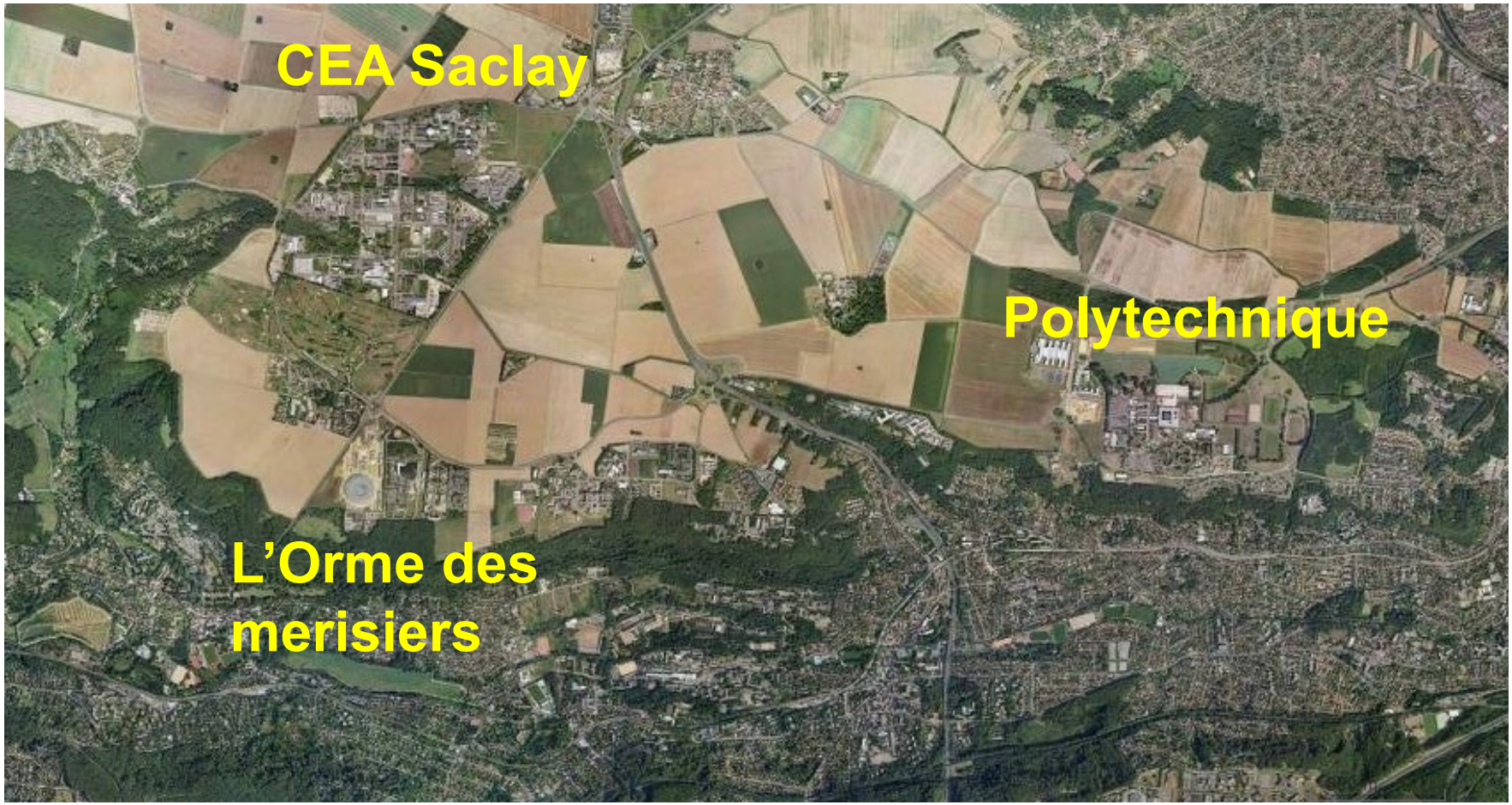
Saclay accelerator R&D platform
building accelerators at the technology frontier

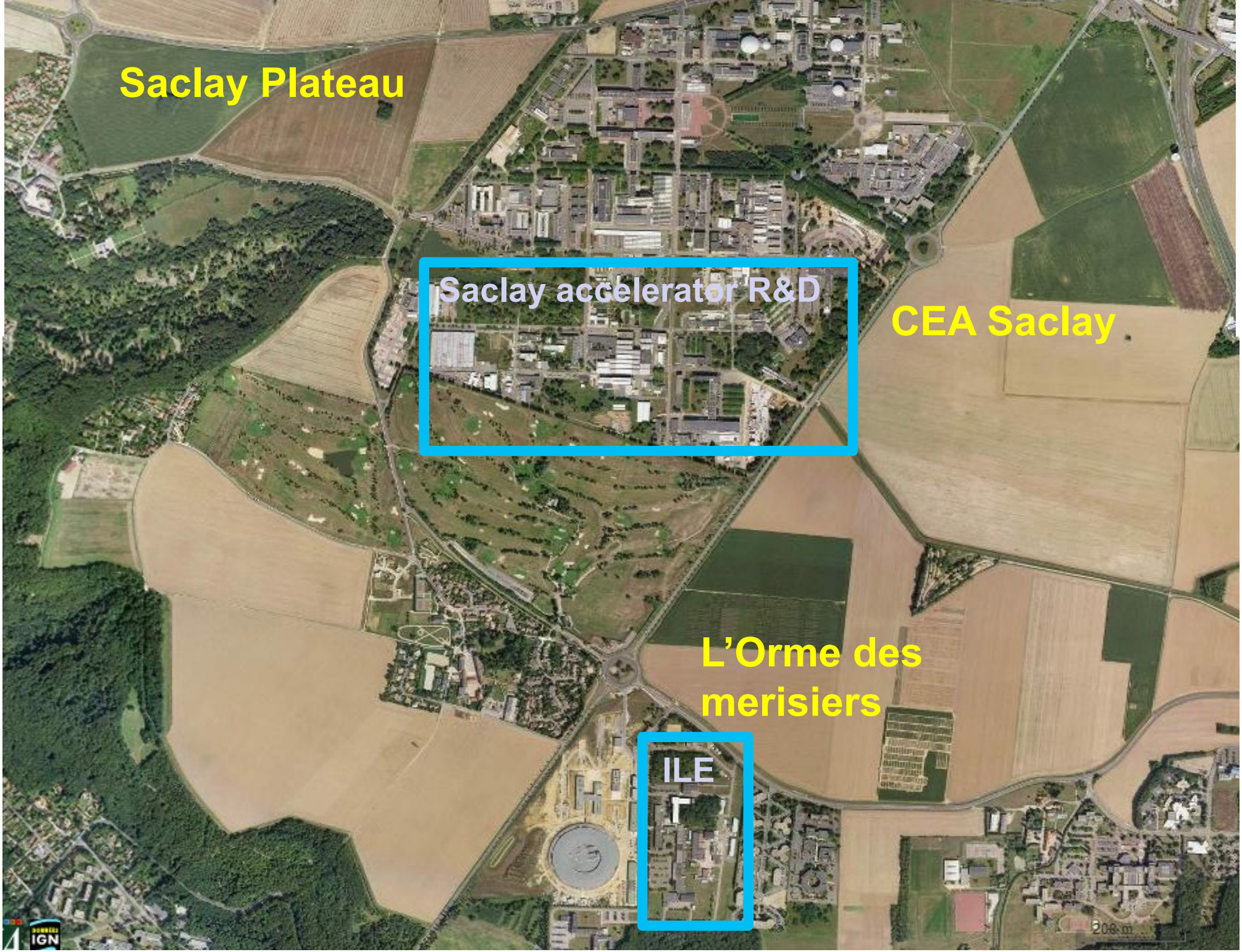
Philippe CHOMAZ



Interpréter les radiations de l'Univers.

Saclay Plateau



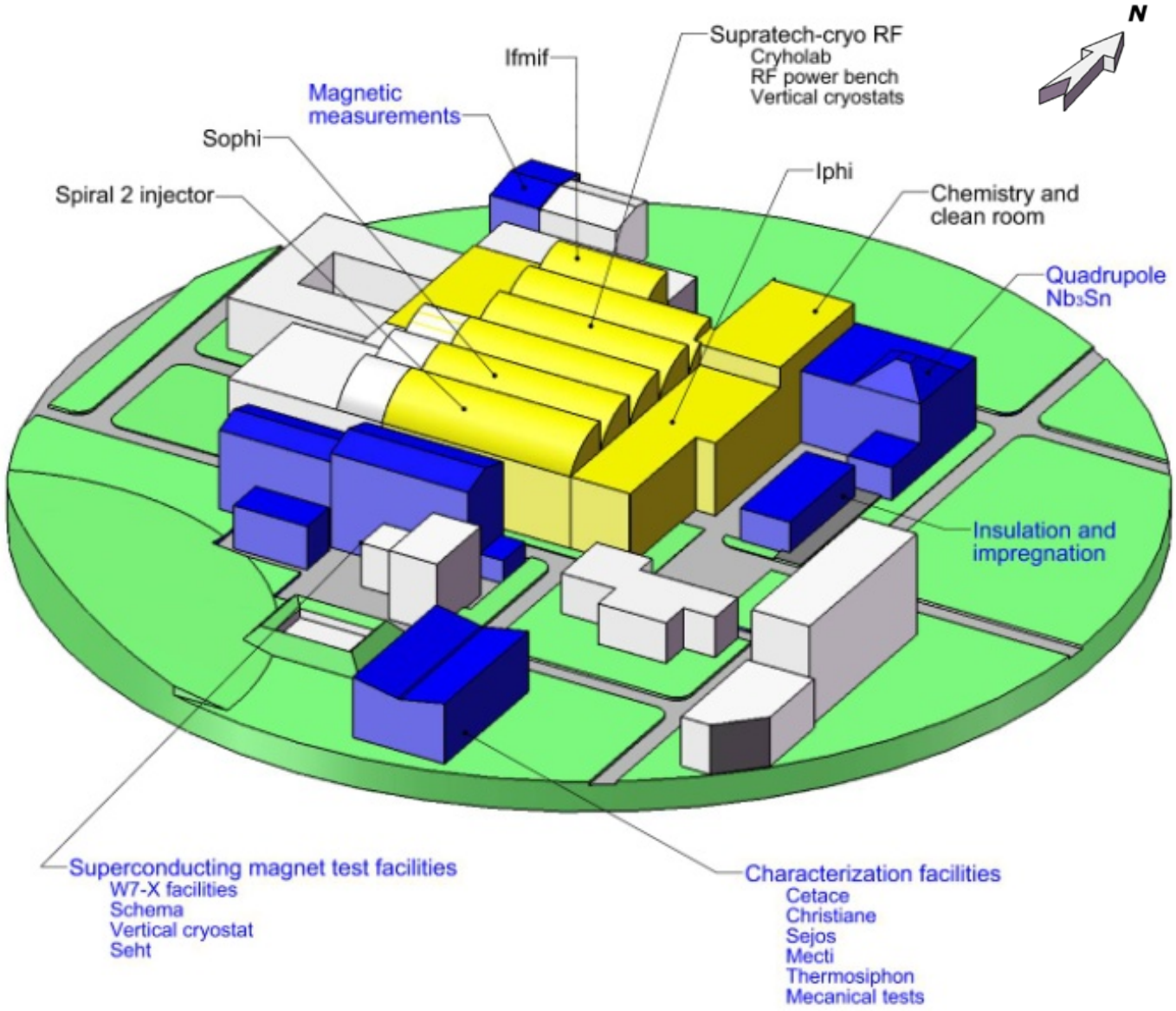

Saclay Plateau
Saclay accelerator R&D
CEA Saclay
L'Orme des merisiers
ILE
IGN

CEA-Irfu : Saclay Accelerator R&D Plateforme

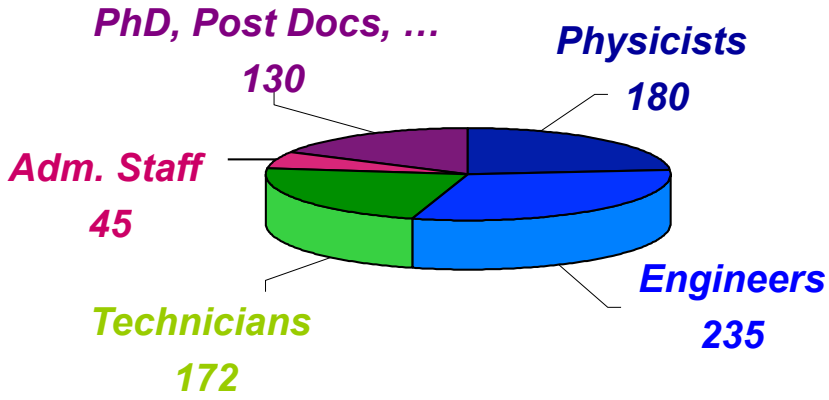
CEA-Irfu : Saclay Accelerator R&D Plateform

CEA-Irfu : Saclay Accelerator R&D Plateform

CEA-Irfu – Accelerator Installations 25 000 m²

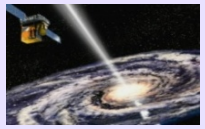


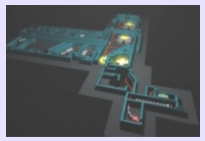
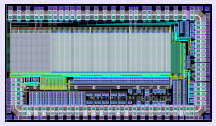
CEA-Irfu : The largest institute of CEA

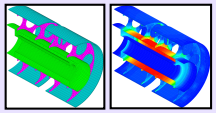
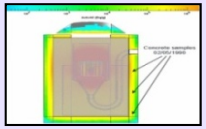
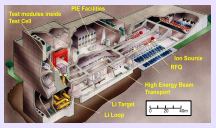


800 Employees

Institute of Research into the Fundamental laws of Universe


Astrophysics
Space technologies
Accelerators,
Supra. Magnets


Nuclear Physics
Detectors, electronic,
computing


Particle Physics
Systems engineering


Nuclear expertise
IFMIF EVEDA


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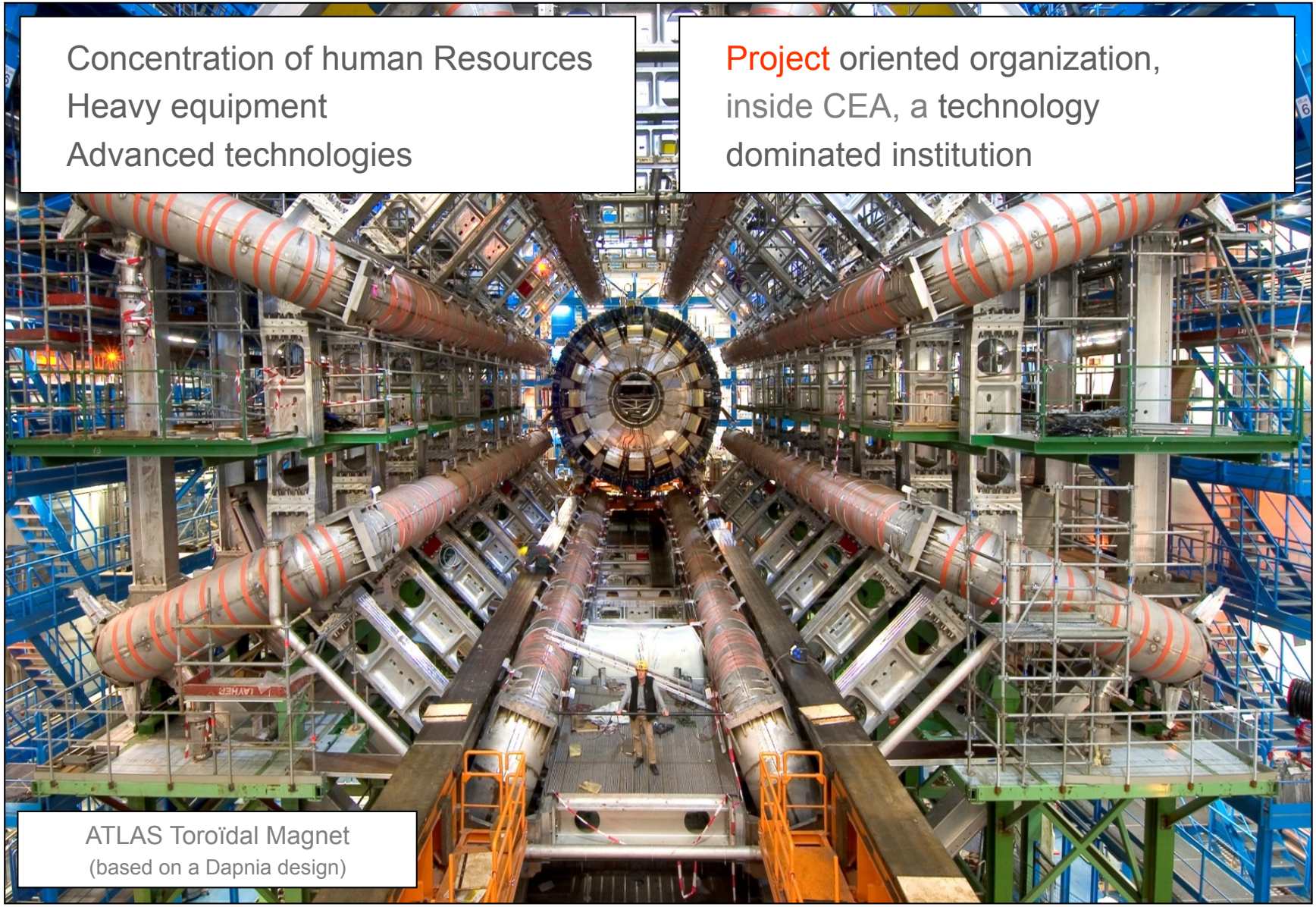
Institute of research into the fundamental laws of the universe

Concentration of human Resources
Heavy equipment
Advanced technologies

Project oriented organization,
inside CEA, a technology
dominated institution



ATLAS Toroïdal Magnet
(based on a Dapnia design)

CEA-Irfu Accelerator Activities

-

CEA-Irfu Accelerator Activities

1. **Building accelerators**
   - SPIRAL2
   - IFMIF
   - XFeL
   - ESS
   - FAIR

2. **Accelerator R&D**
   - Intensity frontier
   - Energy frontier
   - Laser acceleration

Collaborations and construction

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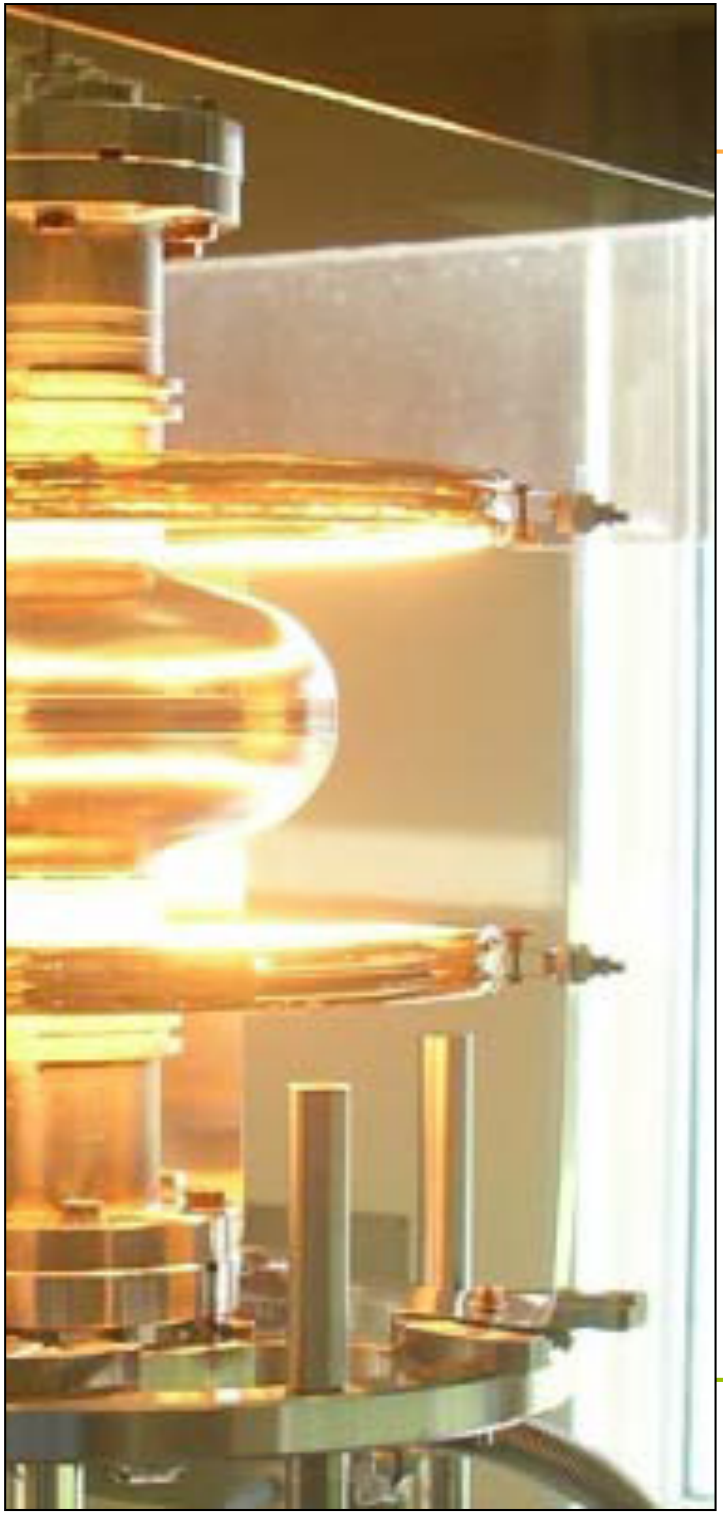
The Quest for High Gradients in RF Accelerators



Superconducting RF Technology

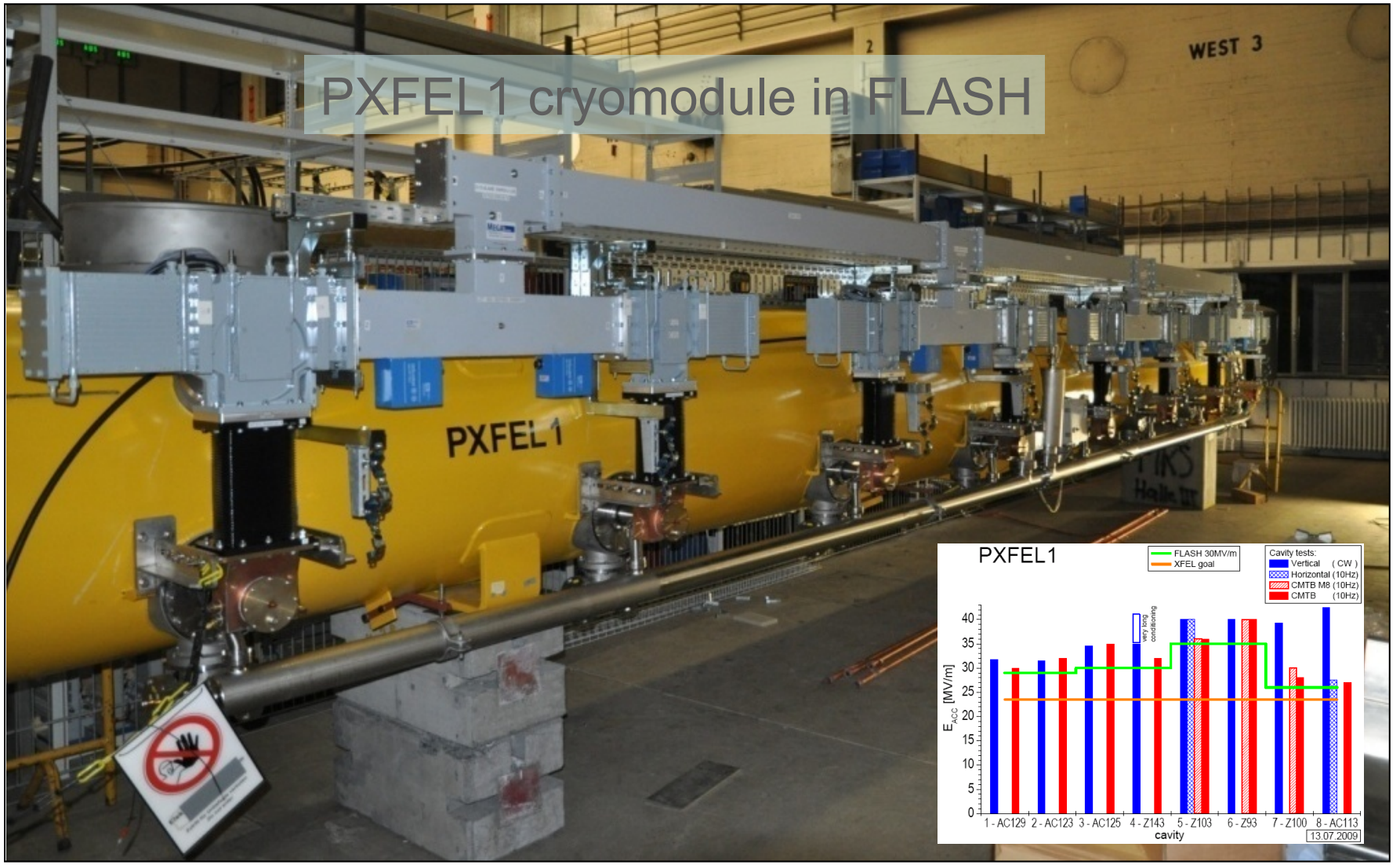
- Based on bulk Niobium since 2000 :
  SNS, XFEL, ESS, FRIB, CEBAF upgrade

- Motivated by the XFEL and ILC, accelerating gradients of 30 MV/m produced reliably.

Electron single cell cavity under baking

XFEL Cryomodules

World record for long RF accelerating structures: Eacc = 30 MV/m



XFEL Module Assembly at Saclay

The 83 XFEL cryomodules of the XFEL 14 GeV Cold Linac will be assembled at Irfu-Saclay.

Roll-in of cavity string in IS04 Area Clean Room

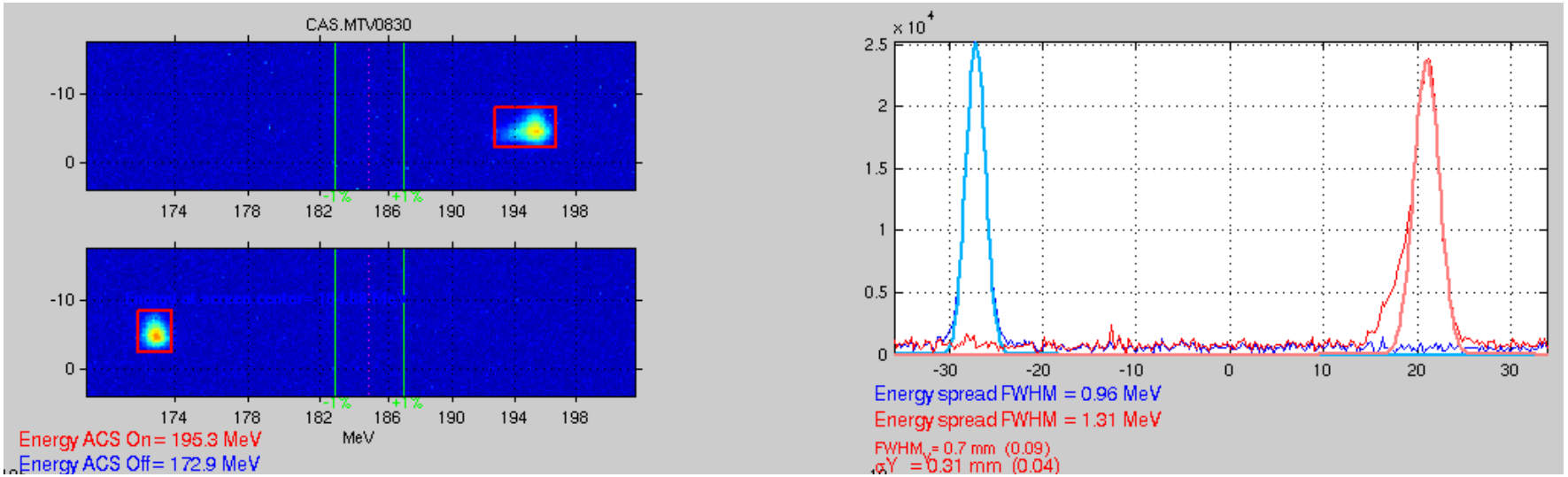
XFEL Module Assembly at Saclay

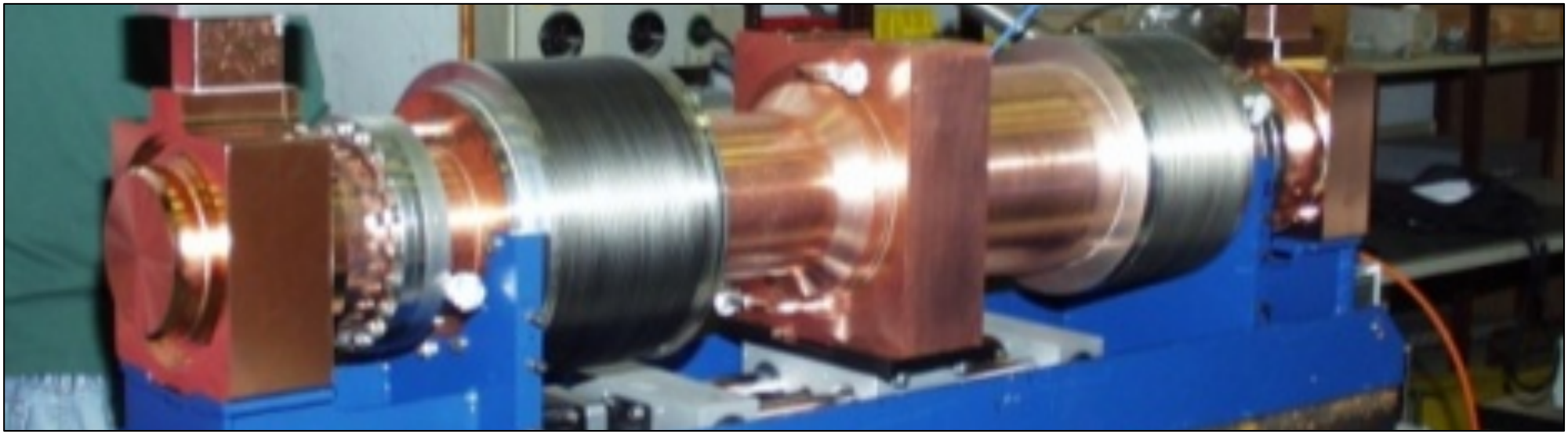
Transfer of cryomodule in Clean Room roll-out Area

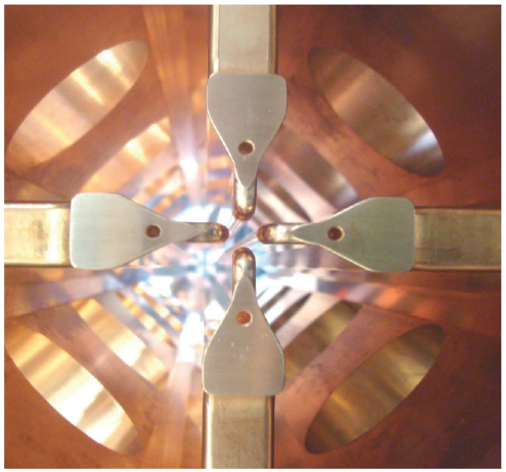
XFEL Module Assembly at Saclay

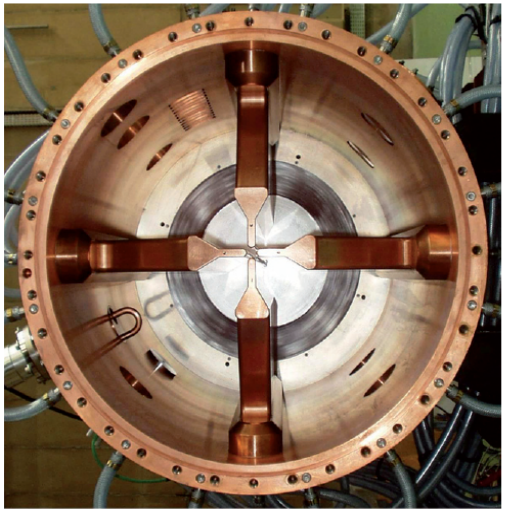
Transfer of cryomodule in RF Coupler assembly area

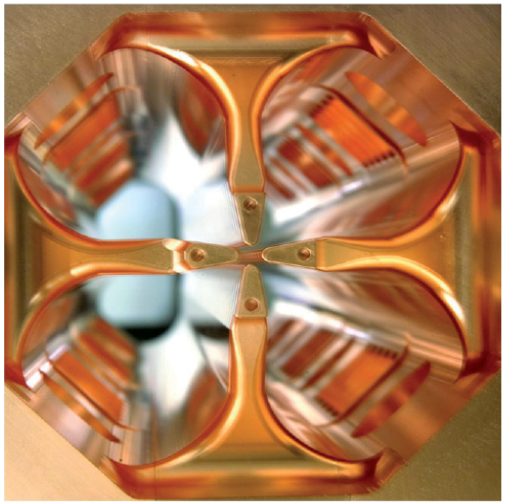
CLIC: First Accelerating Gradient at CERN: 112 MeV/m





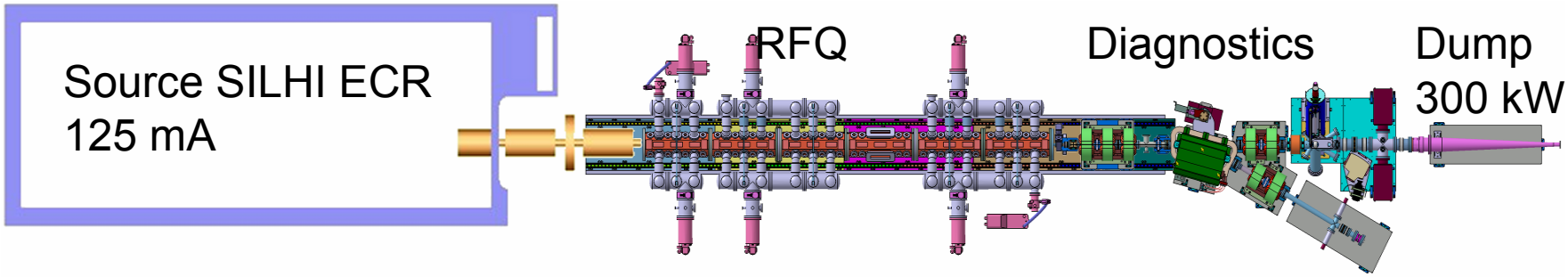


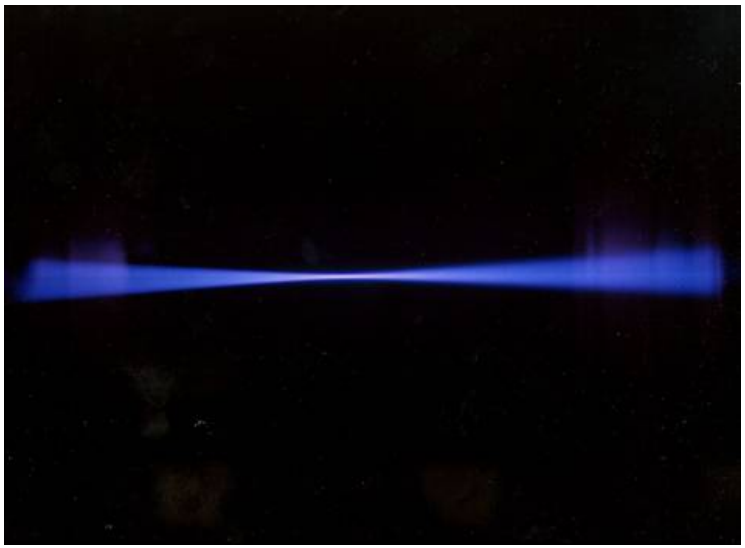


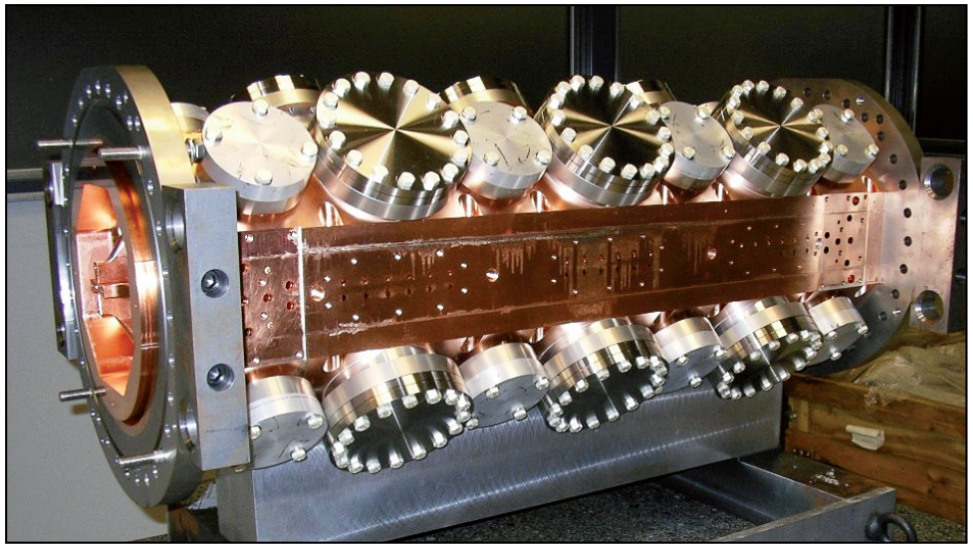


The Quest for High Intensities

IPHI (High Intensity Proton Injector)



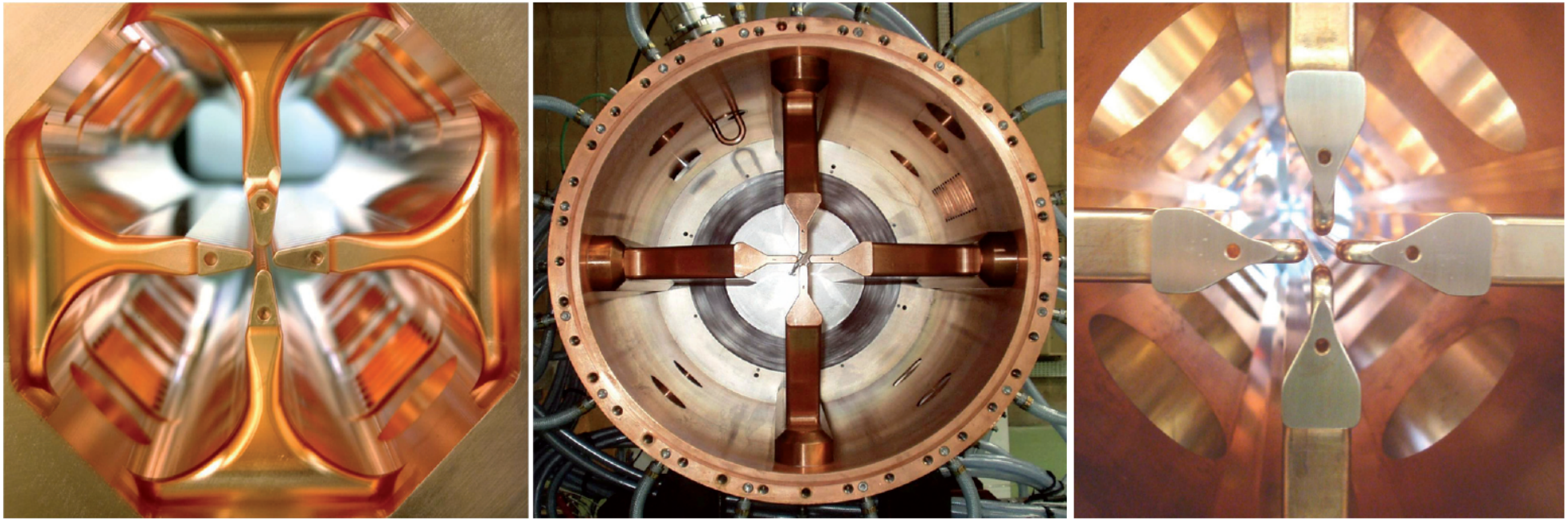




IPHI is a front-end demonstrator for future applications:

- Waste Transmutation (ADS)
- Spallation Neutrons Sources (ESS)
- Neutrino Factories (NuFact)
- Material Irradation (IFMIF)

Radio Frequency Quadrupoles



The three RFQs under construction. From left to right: IPHI section no. 2, Spiral 2 prototype, Linac 4 section no. 1.

SPIRAL2 Project

Irfu is in charge of the construction of :

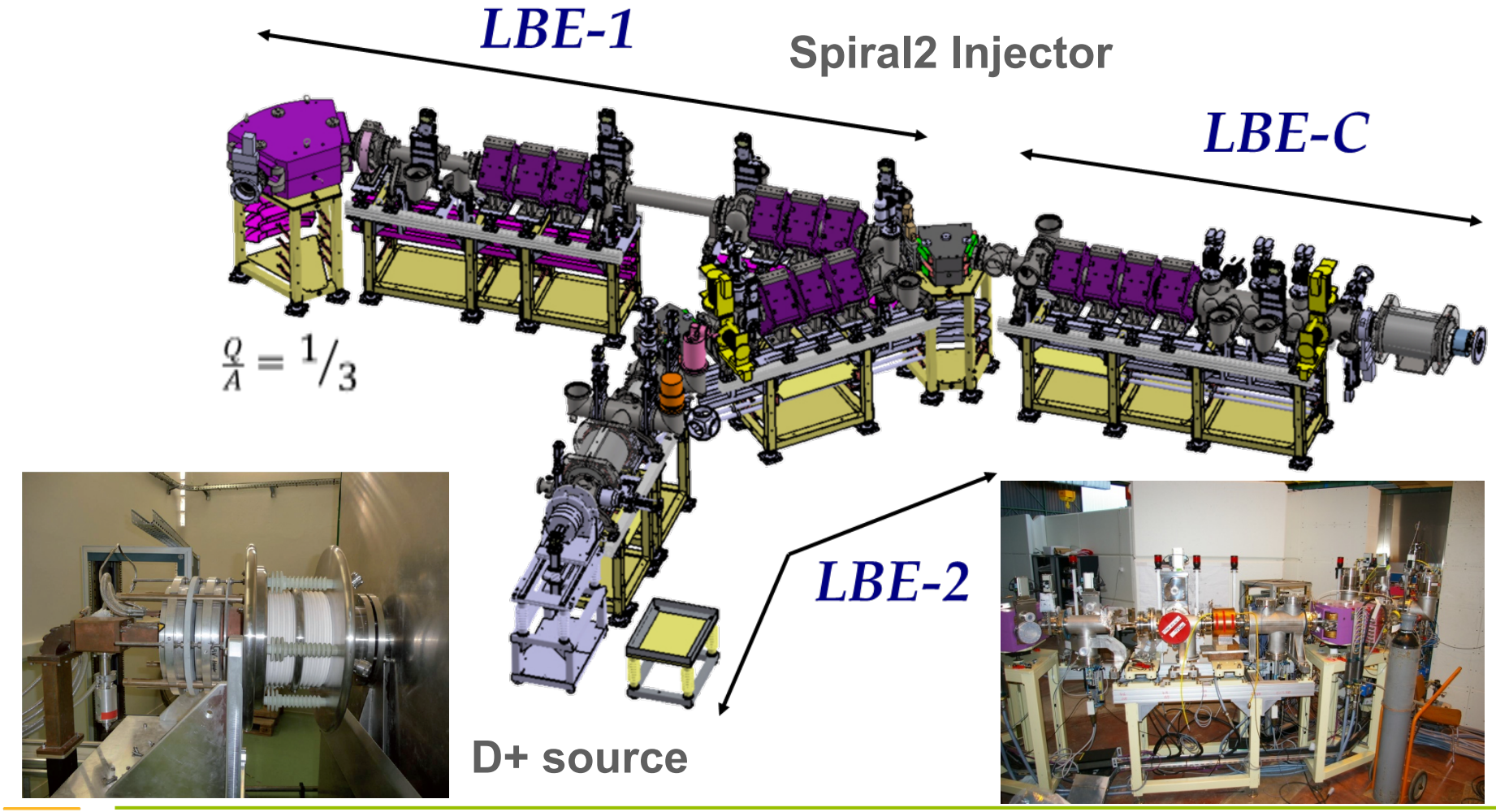
a) the D+ ion source

b) the ion injectors (D+ and Q/A=1/3)

c) the RFQ (see above)

d) the low energy supeconducting linac,

e) the linac LLRF



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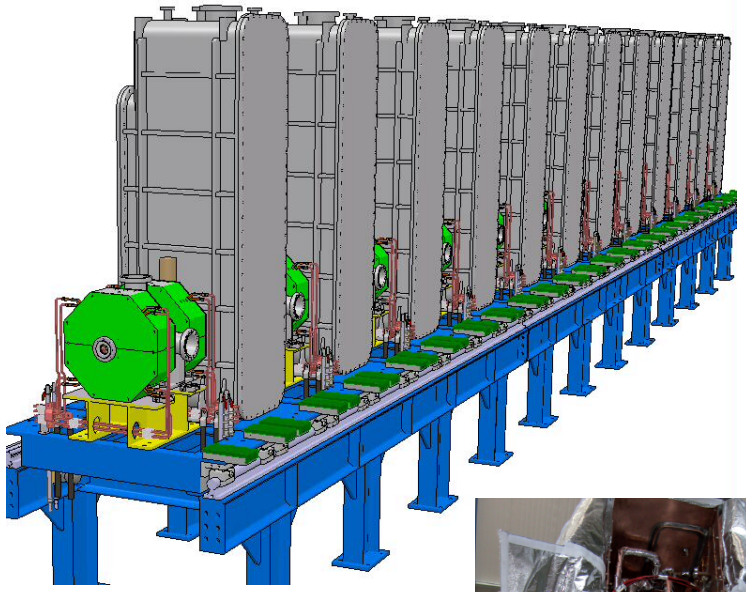
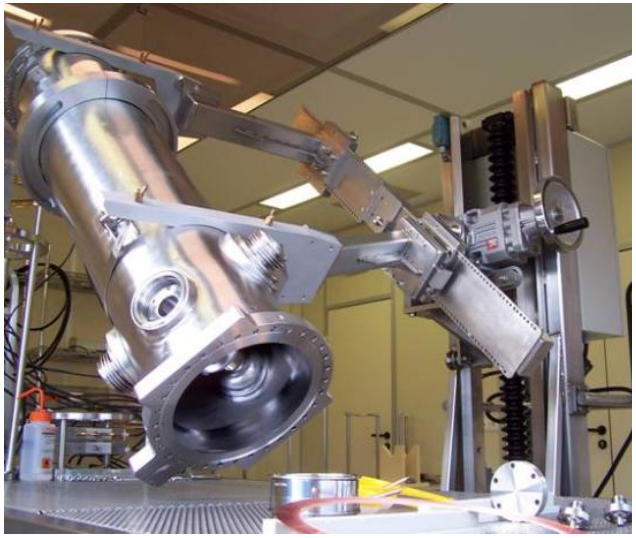
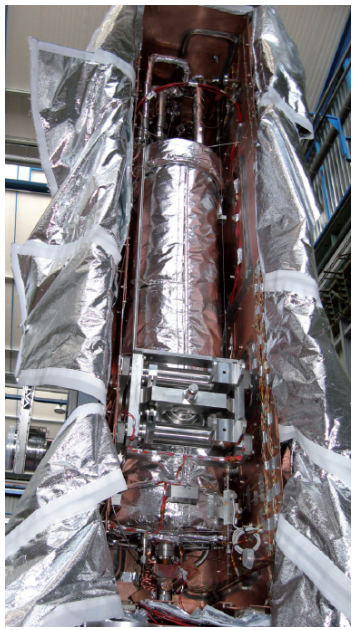
SPIRAL2 Project

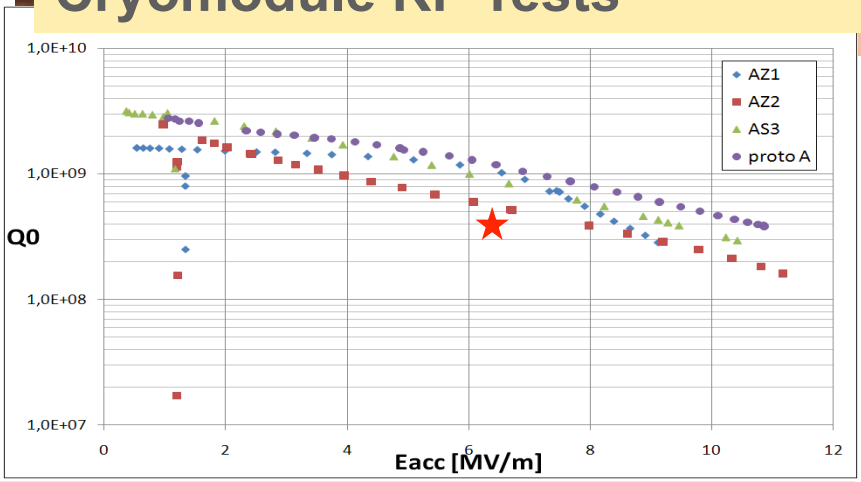
Low energy (β=0.12) SC Linac







Cryomodule RF Tests



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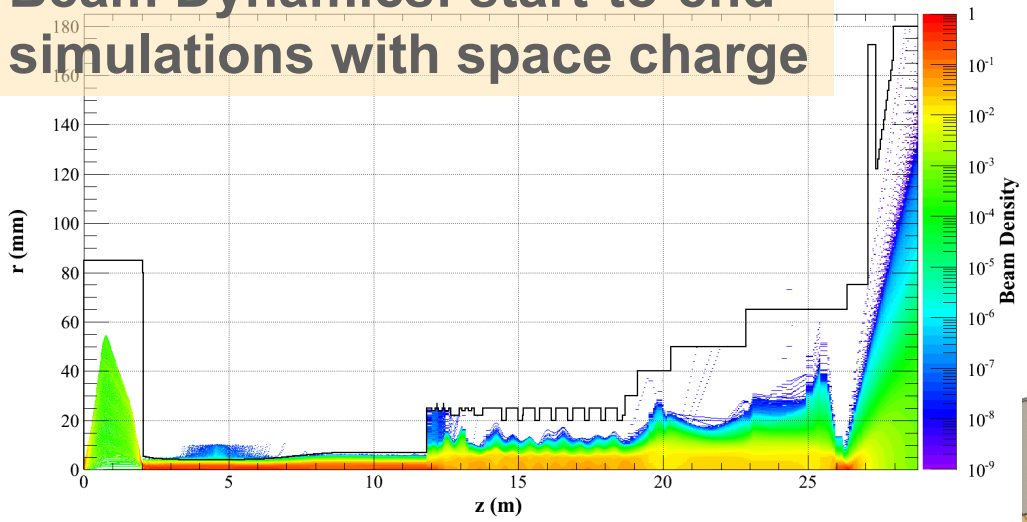
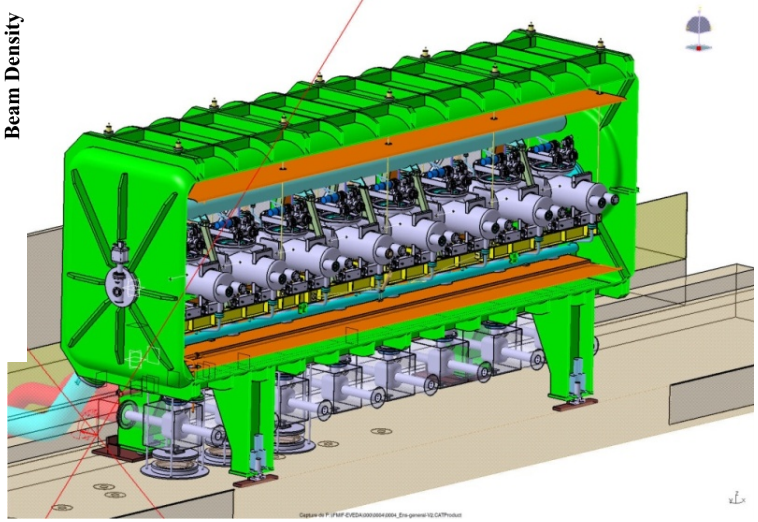
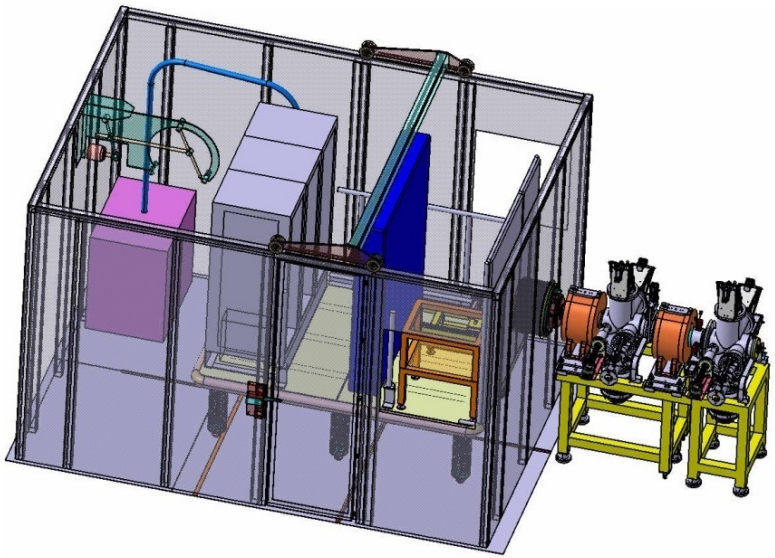
IFMIF-EVEDA Project

Beam Dynamics: start-to-end simulations with space charge



Cryomodule





D+ injector

First cavity prototype under RF measurements

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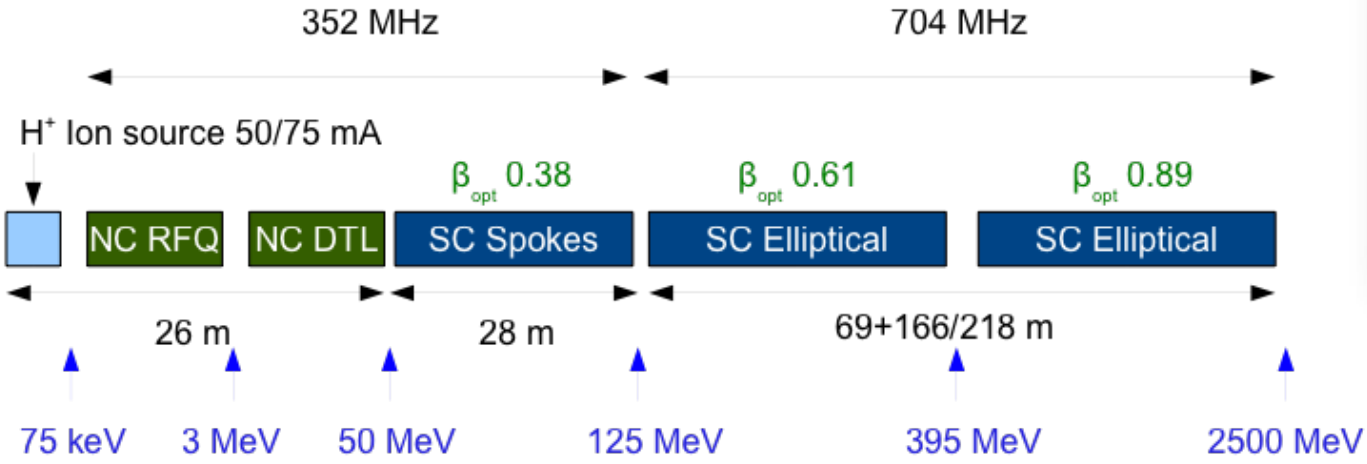
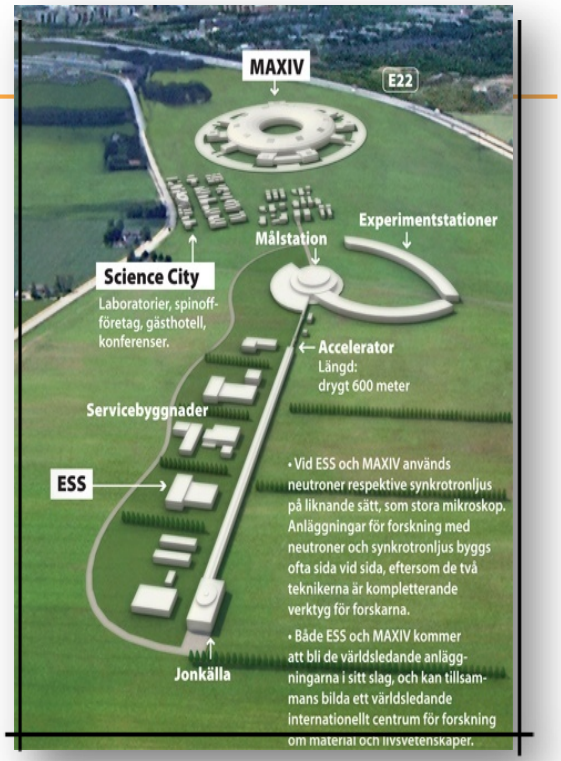
European Spallation Source

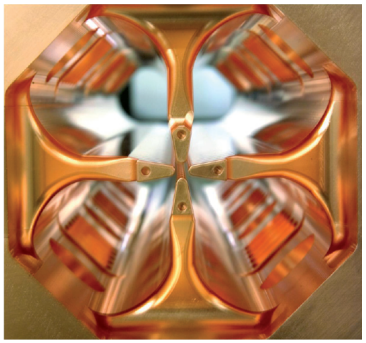
Proton Beam of 2.5 GeV and 5MW

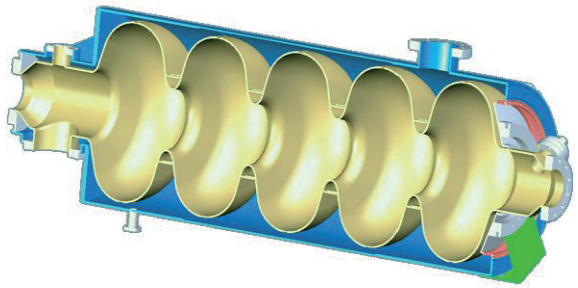
Design Phase: 2010-2015.

Construction Phase: 2015-2025.

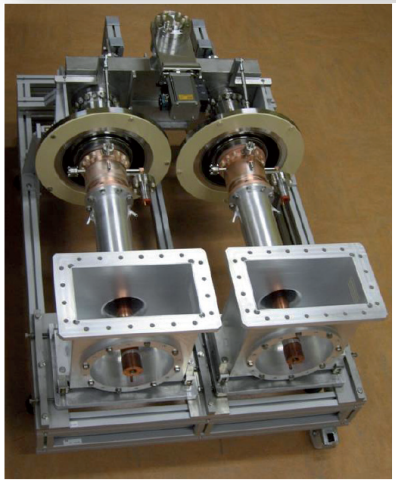






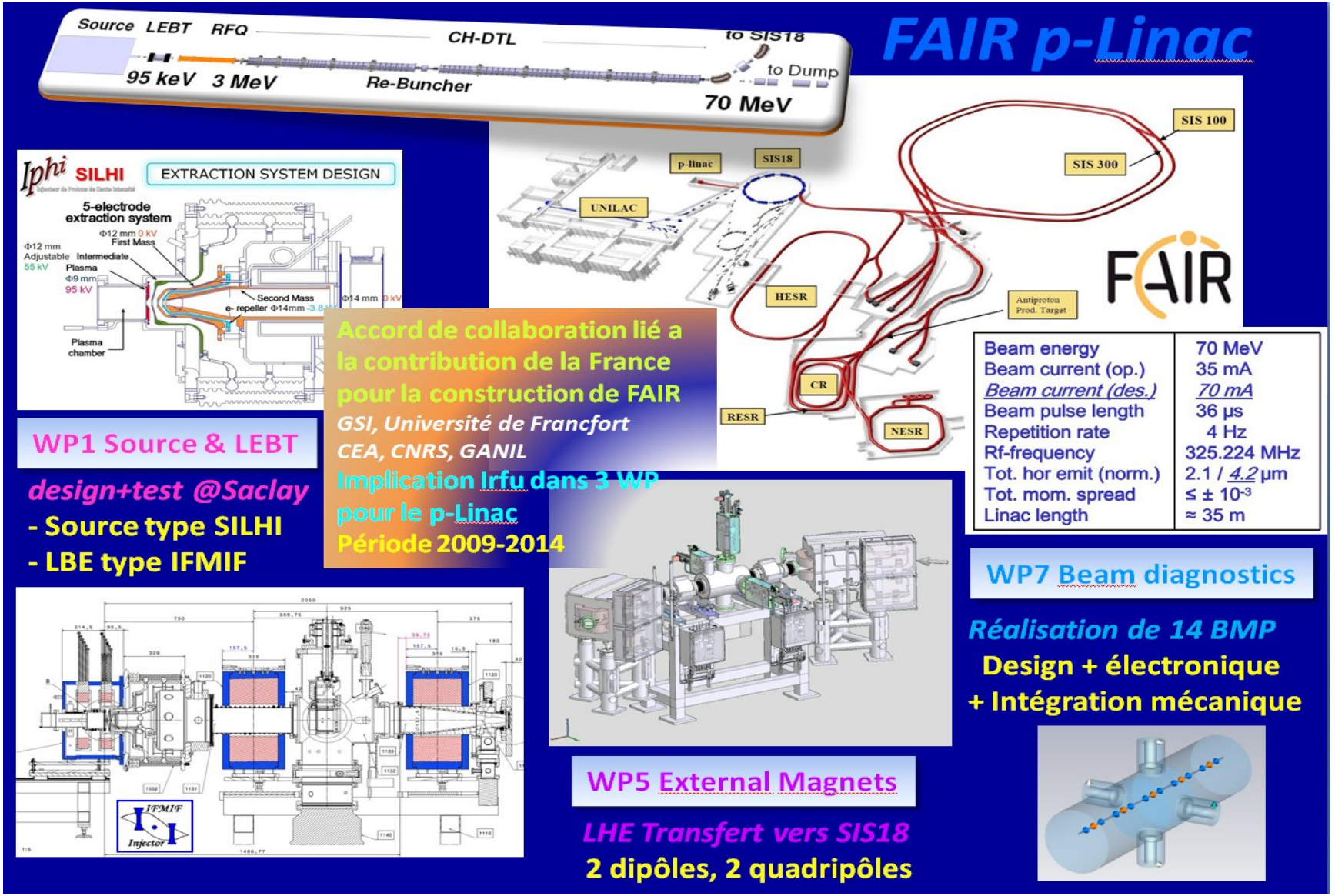


Mockup of the β = 1 cavity developed for the EuCARD

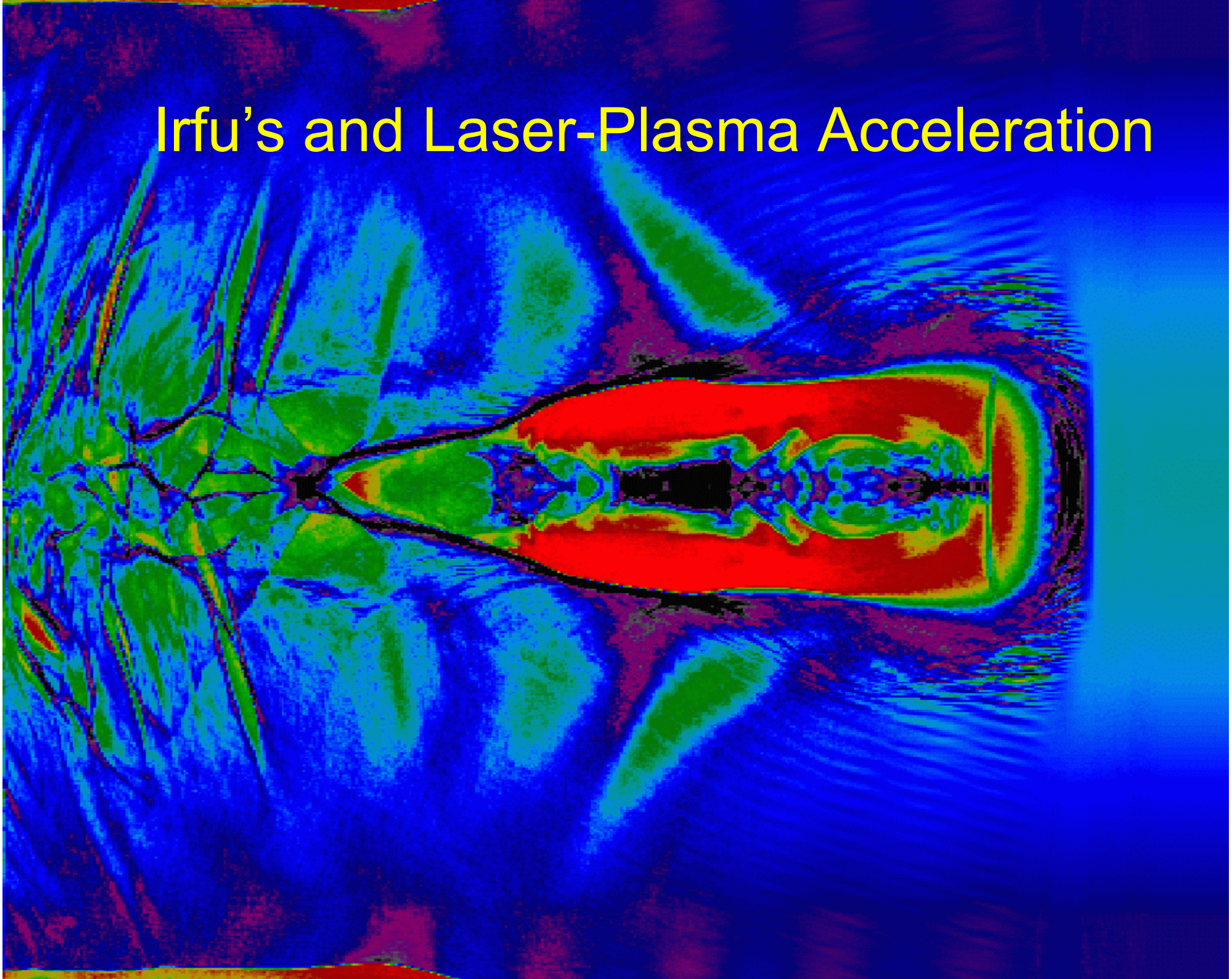


Two prototype couplers assembled on the 704 MHz coupler conditioning test bench.

FAIR Proton Linac



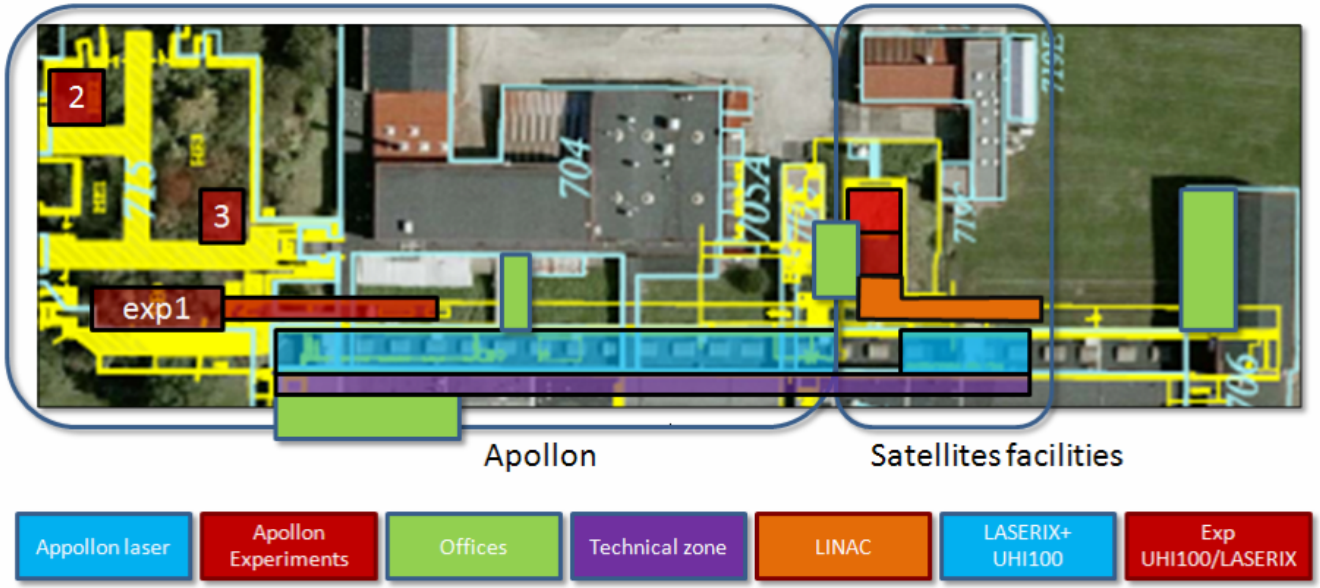
Irfu's and Laser-Plasma Acceleration



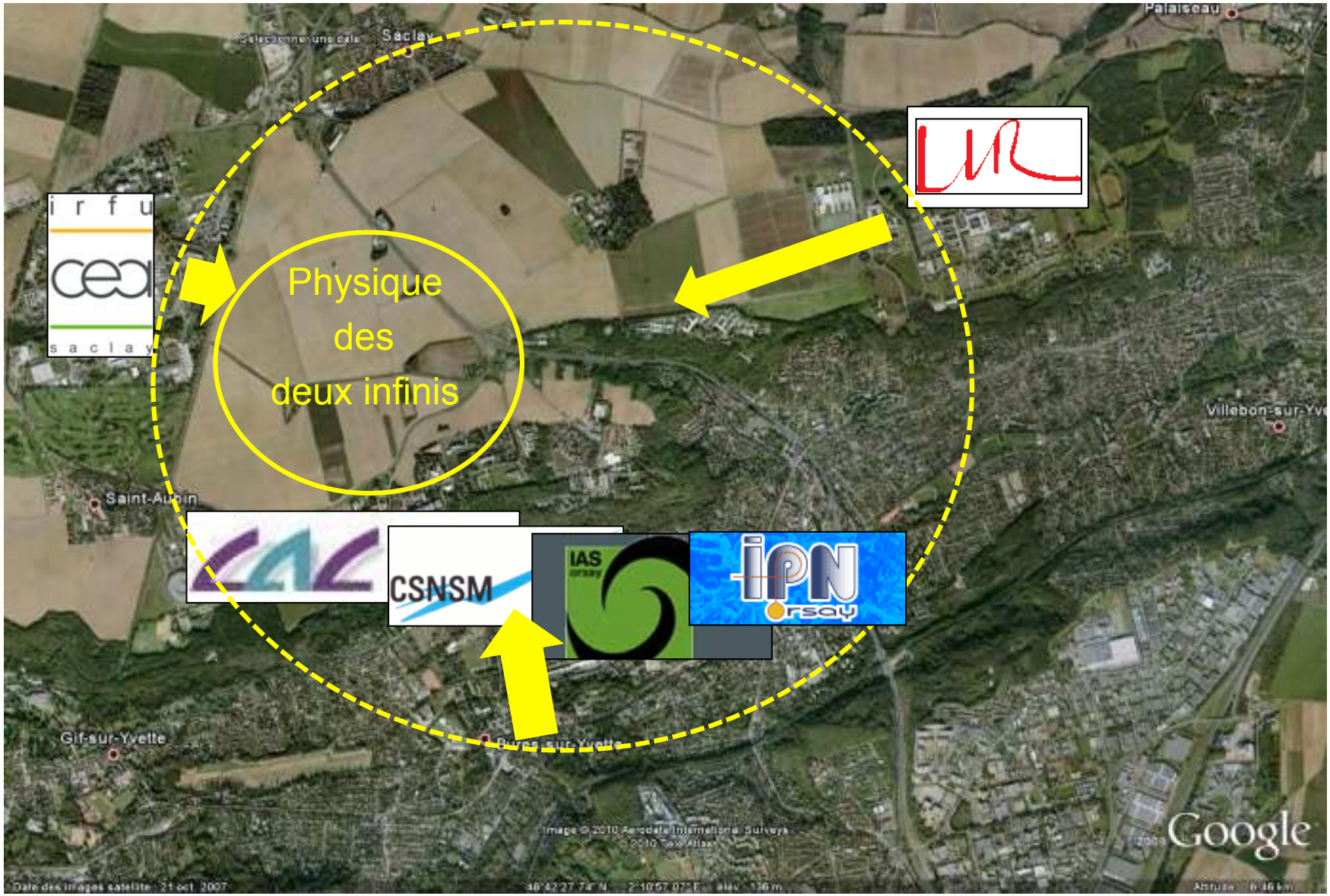
Irfu collaborates on WakeField Acceleration

- Ongoing collaboration with CEA/Iramis upon the upgrade of the diagnostics beam line.
- Start of modelisation of the acceleration process.
- First studies of the electron injection schemes.
- First studies of proton source, using a solid target.
- **Contribution to Cilex**: cooling infrastructure, experimental beam line, beam instrumentation, experimental program.

Centre Interdisciplinaire de Lumière EXtrême (EquipEX)



A priority of the P2IO campus

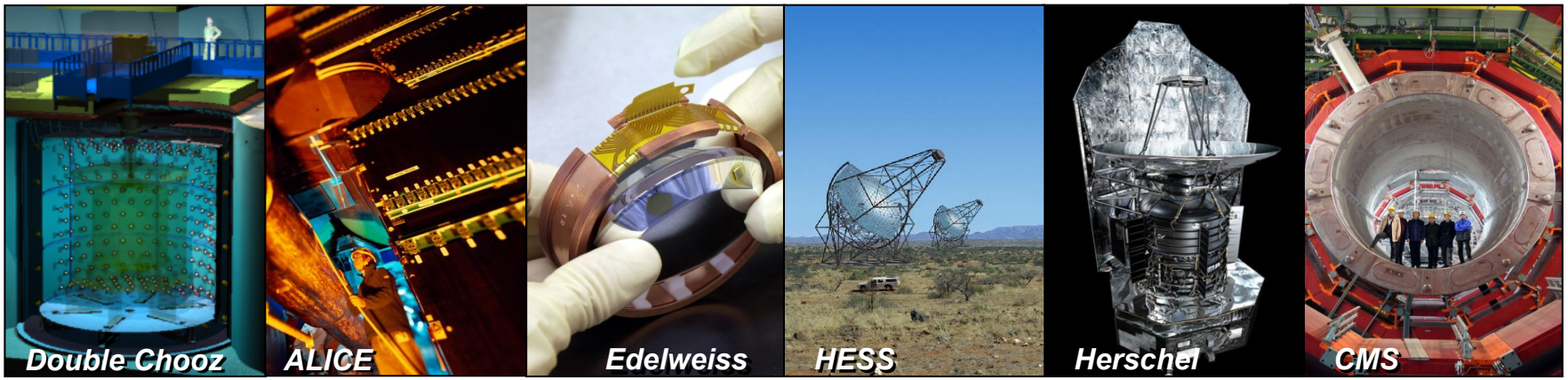


Conclusions

- We need a dedicated facility to new laser acceleration technique
- We should concentrate efforts on 1 or 2 specific applications in order to focus the efforts
- We need a strong interdisciplinary effort including laser and accelerator experts

Saclay accelerator R&D platform
building accelerators at the technology frontier

Philippe CHOMAZ



Interpréter les radiations de l'Univers.