

OPEN SYMPOSIUM European Strategy for Particle Physics



23-27 JUNE 2025



Role of national labs, strategy implementation

Members of WG3 :

Jim Clarke (STFC Daresbury), Beate Heinemann (DESY), Jorgen D'Hondt (Nikhef), Klaus Kirch (PSI), Ben Kilminster (CH), Achille Stocchi (IJClab)

With an important contribution from all the directors of the large “national” laboratories LDG chaired by Mike Seidel

Previously : some words about the recommendations at ESPPU 2020

B. The European organisational model centred on close collaboration between CERN and the national institutes, laboratories and universities in its Member and Associate Member States is essential to the enduring success of the field. This has proven highly effective in harnessing the collective resources and expertise of the particle, astroparticle and nuclear physics communities, and of many interdisciplinary research fields. Another manifestation of the success of this model is the collaboration with non-Member States and their substantial contribution. ***The particle physics***

community must further strengthen the unique ecosystem of research centres in Europe. In particular, cooperative programmes between CERN and these research centres should be expanded and sustained with adequate resources in order to address the objectives set out in the Strategy update.

As main results of these recommendations we can mention :

- The definition and the execution of the **Accelerator Roadmap** under the responsibility of the **LDG**
- The creation of the **DRD groups** under the responsibility of the ECFA

Relevant Input papers submitted to ESPPU 2026

Input papers relevant to WG3 have been submitted by :

- Individually by the Large Particle Physics Laboratories (LPPL)
- A common input from Large Particle Physics Laboratories (LPPL) and CERN
- From members/Pis from Experiments running or in program in LPPL

• Laboratori Nazionali di Frascati of INFN
• Search for the electric dipole moment of the neutron with the n2EDM experiment
• Early Career Researcher Input to the European Strategy for Particle Physics Update
• PERLE : an ERL facility for future sustainable colliders (LHeC, FCC)
• DESY's role in Europe: A Contribution to the European Particle Physics Strategy Update Process
• INFN - Gran Sasso National Laboratory - Input for the European Particles Physics Strategy
• The LUXE Experiment
• PSI European Strategy Input
• ESSnuSB (European Spallation Source neutrino Super Beam)
• The HIBEAM/NNBAR program
• The NEXT Search for Neutrinoless Double Beta Decay in Xe-136
• Charged Lepton Flavour Violations searches with muons: present and future
• Future perspectives for mu to e gamma searches
• PIONEER: a next generation rare pion decay experiment
• The International Axion Observatory (IAXO): case, status and plans.
• Community input to the European Strategy on particle physics: Searches for Permanent Electric Dipole Moments
• The Importance of Test Beams for Particle Physics worldwide
• MUonE Contribution to the European Strategy: status of the project
• RF developments for future colliders
• Advanced Accelerator and HEP Developments through Networking between the Large Particle Physics Laboratories and CERN

National laboratories contributions to strategy implementation

National laboratories could contribute successfully and coherently to strategy implementation thanks to the fact that they are hosting :

- accelerator-based experiments
- non-collider experiments
- test beam or irradiation facilities
- detector R&D facilities (possibly including computing infrastructure)
- accelerator R&D facilities

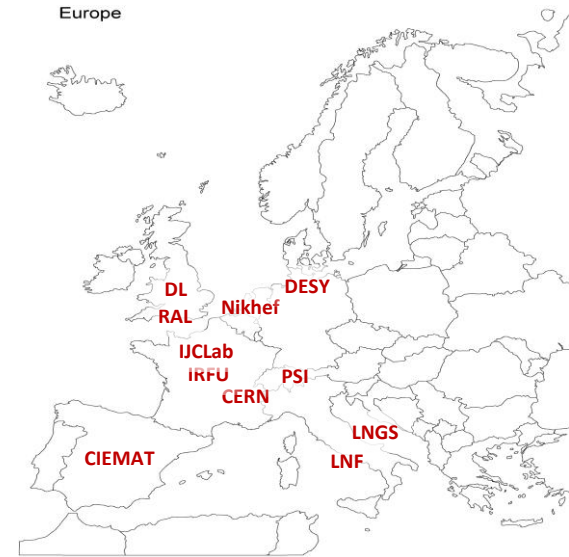
Large Particle Physics Laboratories (LPPL) and LDG

11 Large Particle Physics Laboratories (LPPL) :

CIEMAT, DESY, Daresbury, IJCLAB, IRFU, LNF, LNGS, Nikhef, PSI, RAL and CERN

are grouped in the Large Particle Physics Laboratory Directors Group : LDG

- LDG groups laboratories which have infrastructures and technical capabilities necessary for the implementation of most large-scale projects in the field.
- The LDG provides a forum to synchronize the laboratories' respective strategies, projects and priorities, with the aim of maximising cooperation in the planning, preparation and execution of future projects.
- LDG meets regularly and since ESPPU 2020 is in charge the Accelerator RoadMap.
- The chair of the LDG is one of the members of Strategy Secretariat and all the directors are represented in the European Strategy Group



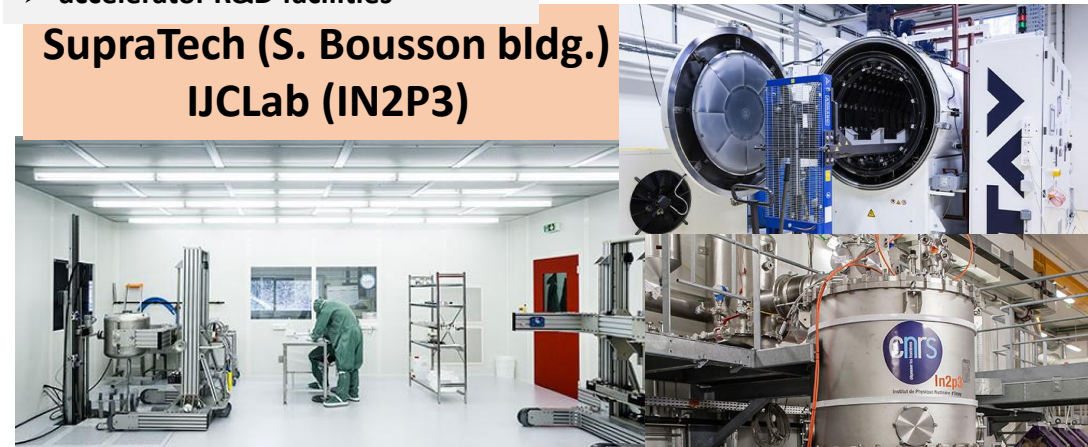
LDG membership criteria:

- 1) **National role**
- 2) **Strong participation in particle physics research**
- 3) **Accelerator or particle physics facility R&D and construction activities and infrastructures**
- 4) **Detector R&D and construction activities and infrastructures**

- accelerator-based experiments
- non-collider experiments
- test beam or irradiation facilities
- detector R&D facilities
- accelerator R&D facilities

Example of the LPPL strengths

SupraTech (S. Bousson bldg.) IJCLab (IN2P3)



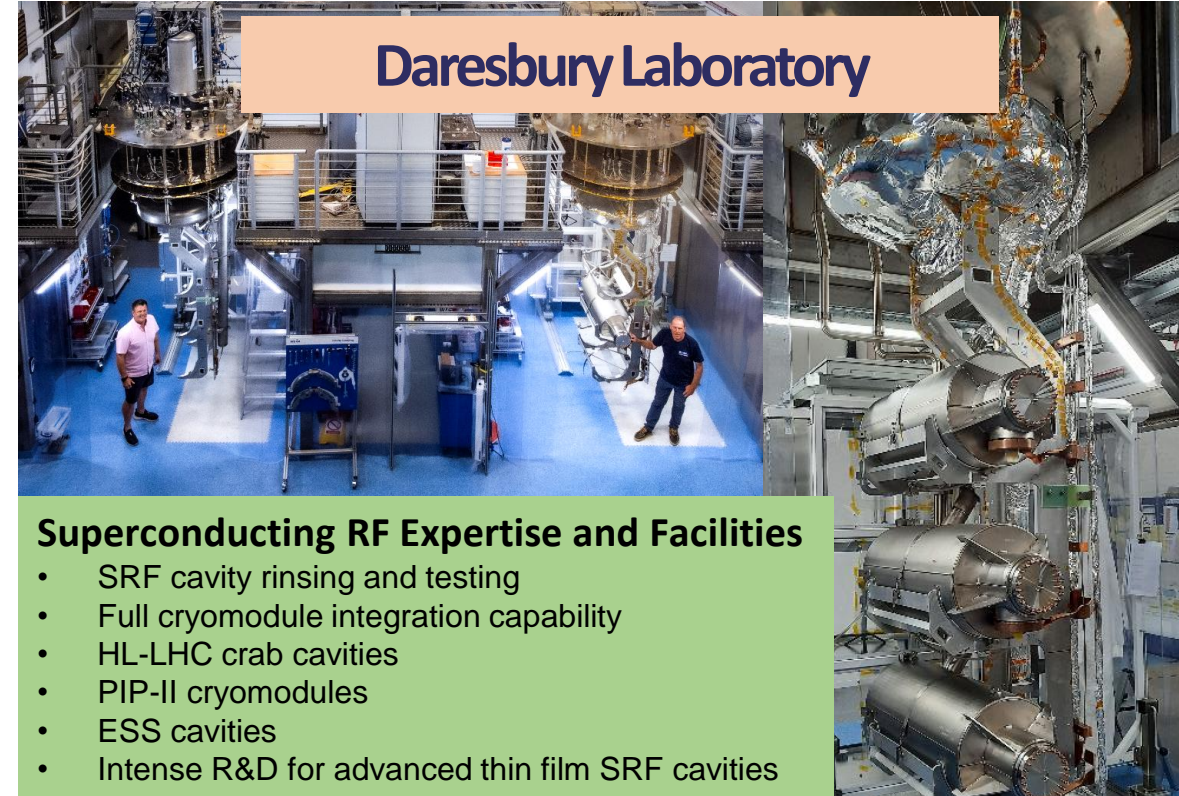
Preparation and validation of SRF cavities and cryomodules (cleanrooms, chemical etching, RF testing, cryogenic systems, and cryostats).

DESY



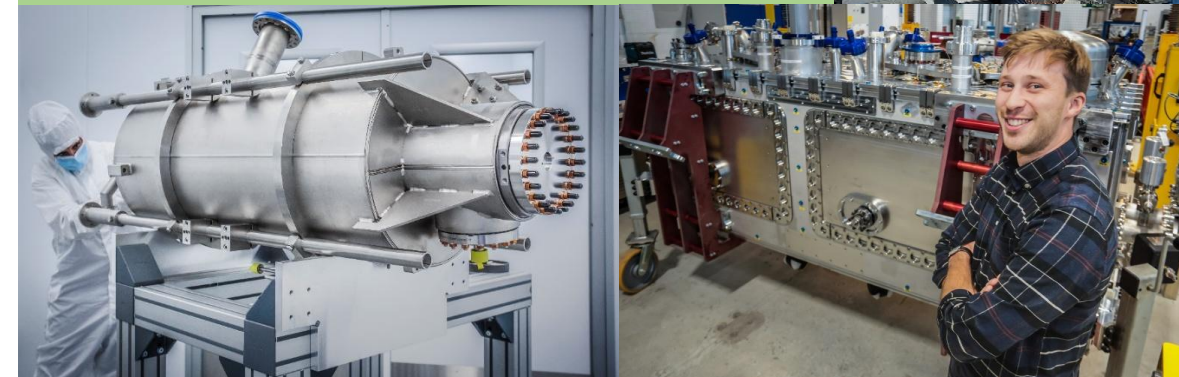
Large scale infrastructure SRF development and test

Daresbury Laboratory



Superconducting RF Expertise and Facilities

- SRF cavity rinsing and testing
- Full cryomodule integration capability
- HL-LHC crab cavities
- PIP-II cryomodules
- ESS cavities
- Intense R&D for advanced thin film SRF cavities

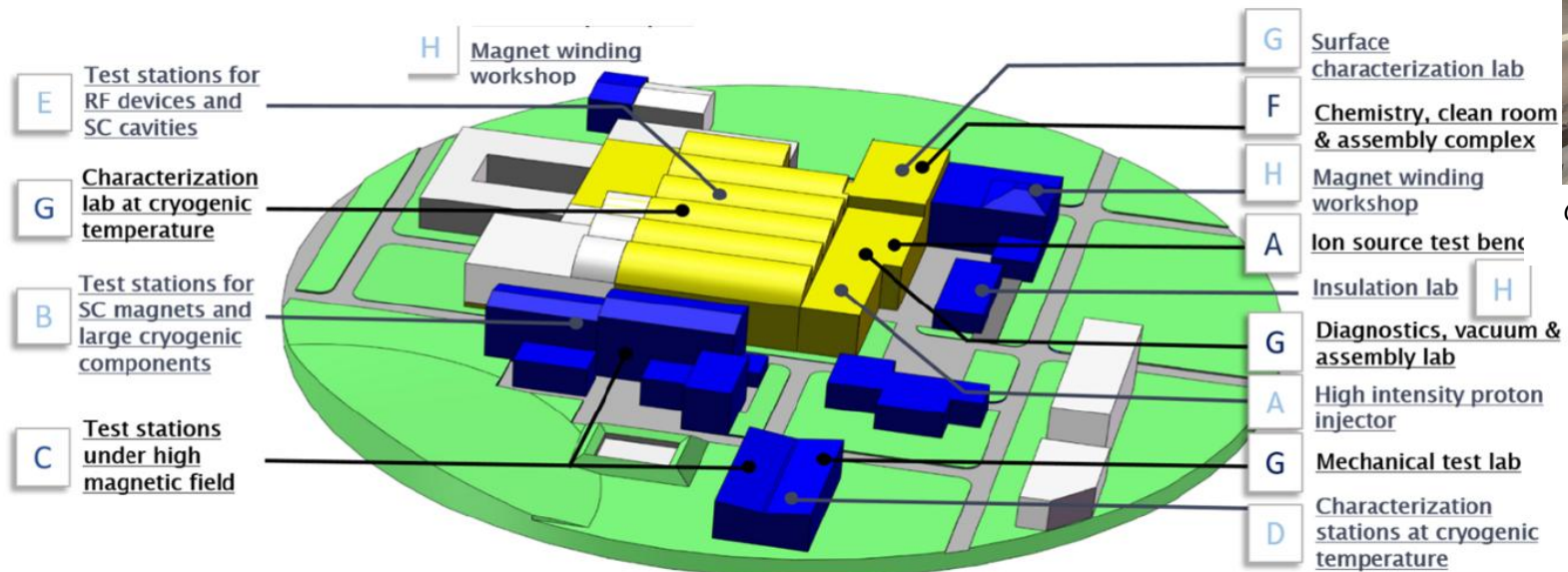


- accelerator-based experiments
- non-collider experiments
- test beam or irradiation facilities
- detector R&D facilities
- accelerator R&D facilities

Example of the LPPL strengths

IRFU (CEA)

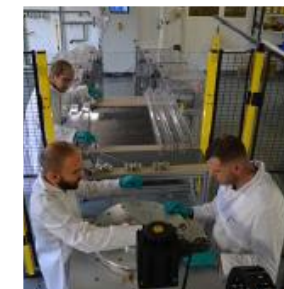
Synergium : Infrastructure for cryogenic, magnetic and accelerator developments



Clean rooms for assembly of cavities and cobot [F]



High intensity ion sources test bench [A]



Magnet winding workshop [H]



Pulsed Heat Pipe R&D [D]



Quadrupole magnets for HL-LHC [H]

CIEMAT

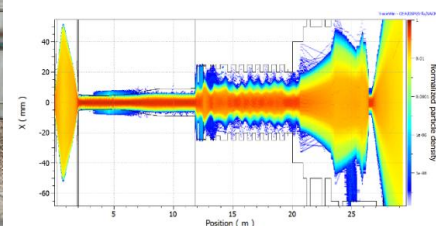


Magnet assembly hall for HL-LHC and FCC

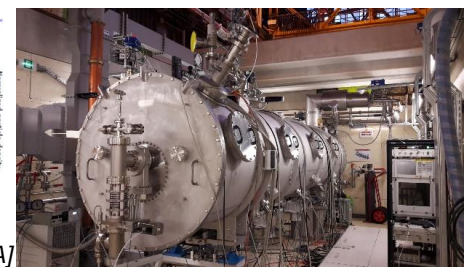


Large SC magnets test bench [B]

Synergium



Beam dynamics code suite simulation [A]



Test station for superconducting RF cryomodules [E]

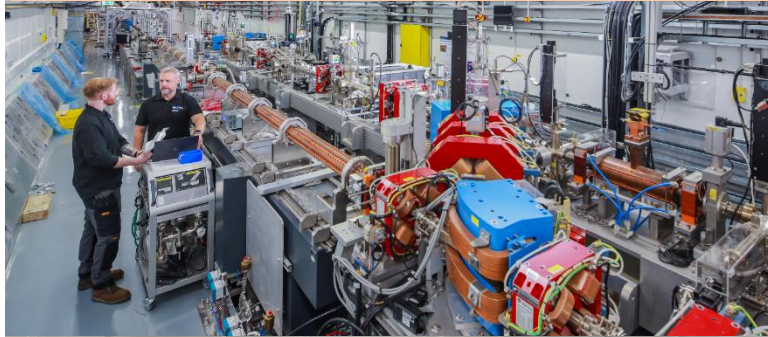


Member of the
quici
European project

- accelerator-based experiments
- non-collider experiments
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- detector R&D facilities
- accelerator R&D facilities

Example of the LPPL strengths

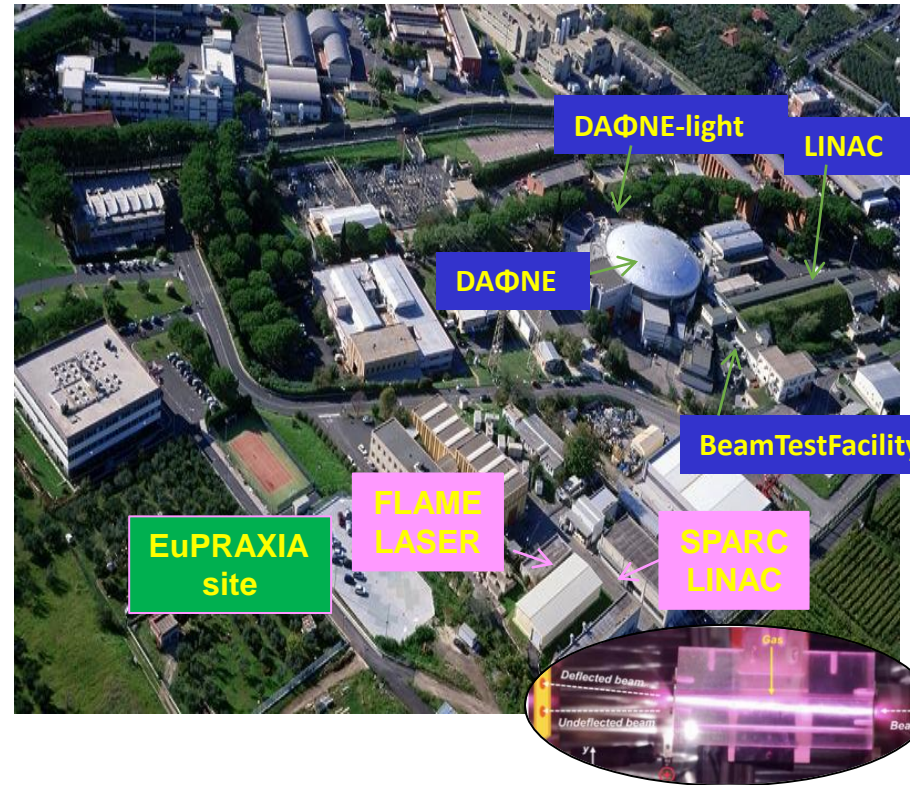
Daresbury Laboratory



CLARA Accelerator Test Facility

- Easy access to experiments in shielded hutch
- Flexibility; supporting wide range of experiments
- Open calls for competitive access to beamtime
- Integration of high power laser

Laboratori Nazionali Frascati (LNF)



LNF hosts 2 accelerator complexes

• SPARC_LAB:

- 200 MeV photoinjector+TW Laser development of PWLA
- Several photon's beam lines

• DAΦNE complex:

- Φ -factory collider
- Beam Test Facility e^\pm beams from the LINAC in 2 exp. halls

• DAΦNE-light:

- synchrotron light lab. 5 beamlines from IR to X



LNF is  project headquarters

- accelerator-based experiments
- non-collider experiments
- test beam or irradiation facilities
- detector R&D facilities
- accelerator R&D facilities

Example of the LPPL strengths

IJCLab(IN2P3)

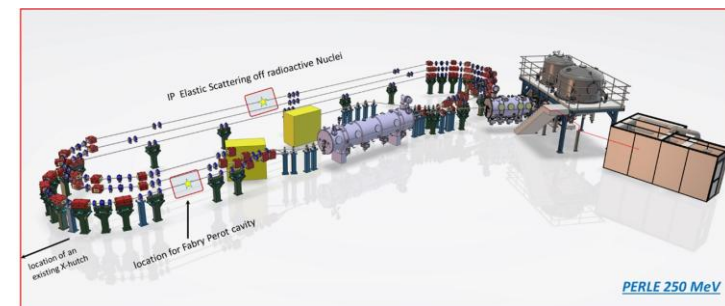


ThomX –home made accelerator : a compact X-ray source, combining a low-energy electron ring (50MeV) with a laser to produce high-intensity using inverse Compton scattering.

DESY



Very powerful infrastructure for the research of novel acceleration technologies, including beams, Lasers etc., focused towards plasma based acceleration technologies



Mai 2025 Top: Introduction of the photocathode support, exit of clean room; bottom: Gun chamber measurement (very low pressure and RGA)

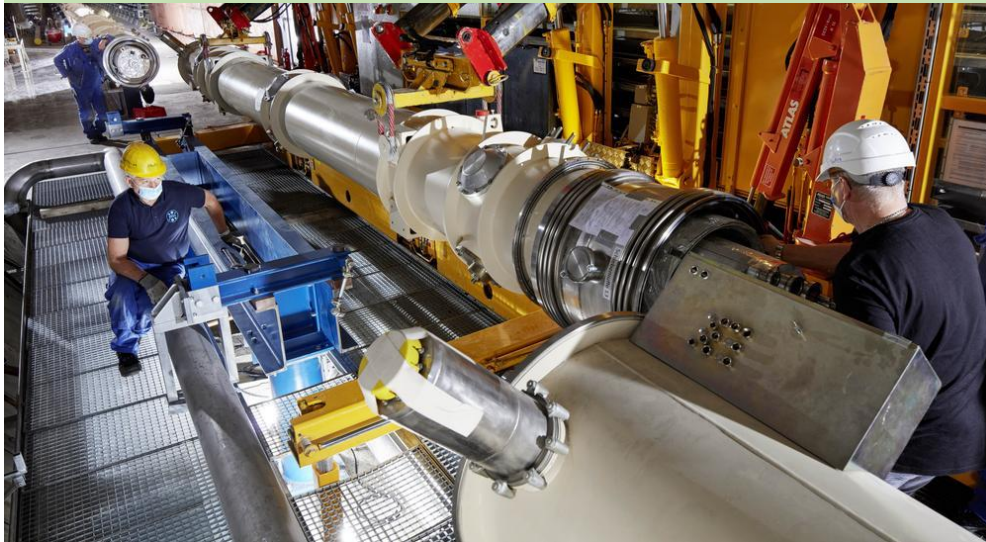
PERLE is a multi-turn, energy recovery linac (ERL) to demonstrate high-power, continuous-wave operation. (LHeC, FCC testbed). In construction

- accelerator-based experiments
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Example of the LPPL strengths

LNF

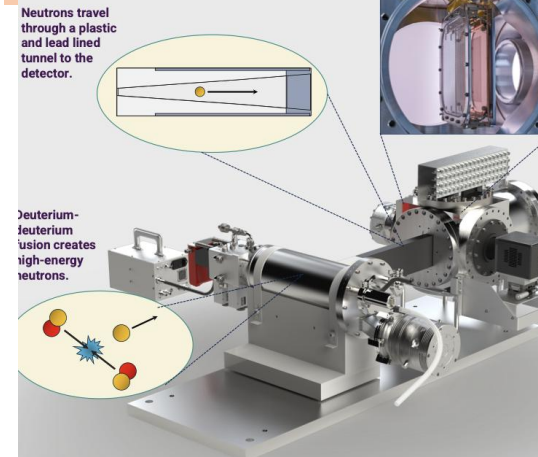
Installing a superconducting magnet
in the ALPSII experiment at **DESY**



ALPS II: axion search experiment with intl. participation running

- Future ambition: BabyIAXO, MADMAX, LUXE
- Provision of test beam for 400+ users / year

Rutherford Laboratory



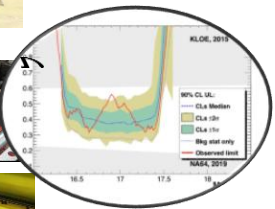
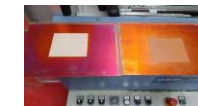
On campus science : MIGDAL experiment: at the ISIS neutron source on-campus

Fundamental physics experiments

- Positron Annihilation into Dark Matter Experiment **PADME@BTF**
- Finuda magnet for Light Axion Search with Haloscope
FLASH to probe the existence of cosmic axions of masses $\sim 10^{-6}$ eV



QUAX



PADME

- accelerator-based experiments
- non-collider experiments
- test beam or irradiation facilities
- detector R&D facilities
- accelerator R&D facilities

Example of the LPPL strengths

PSI



Muon rare decays,

and also PIONEER
@PSI ring cyclotron.

PSI inhouse particle physics - New High Intensity Muon Beams (HIMB)

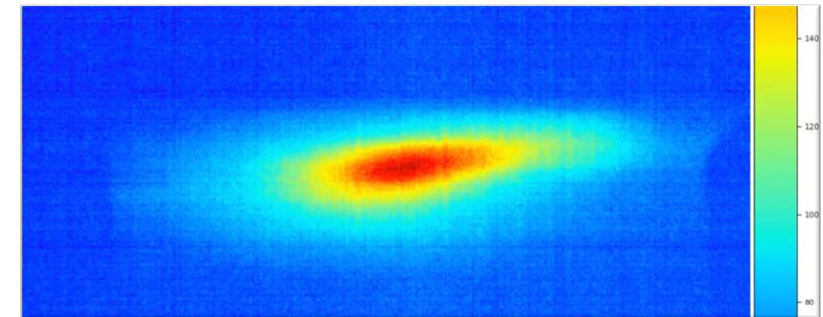
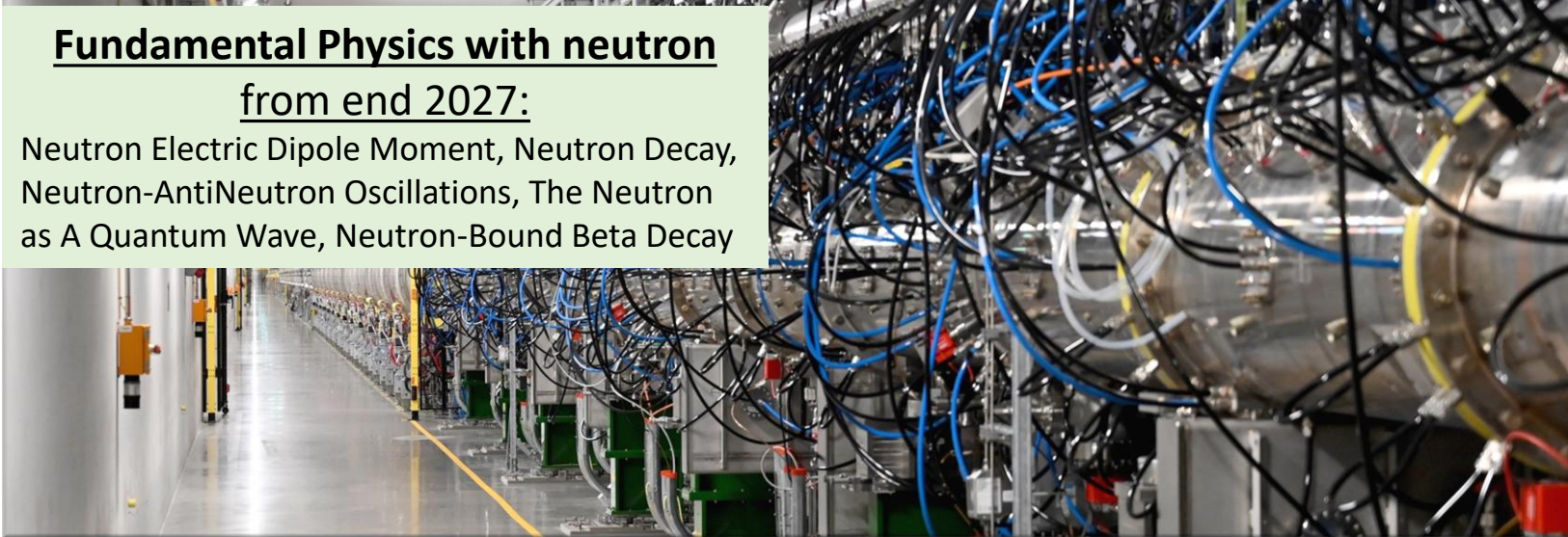
- Intensities of surface muons to $1E10/s$ (e.g. used to feed the Mu3e experiment), MEG.
- HIMB is part of the IMPACT upgrade project at PSI <https://www.psi.ch/impact> that also includes a new production facility for radio isotopes.

LDG core accelerator technologies strongly contribute to ESS

Fundamental Physics with neutron

from end 2027:

Neutron Electric Dipole Moment, Neutron Decay, Neutron-AntiNeutron Oscillations, The Neutron as A Quantum Wave, Neutron-Bound Beta Decay

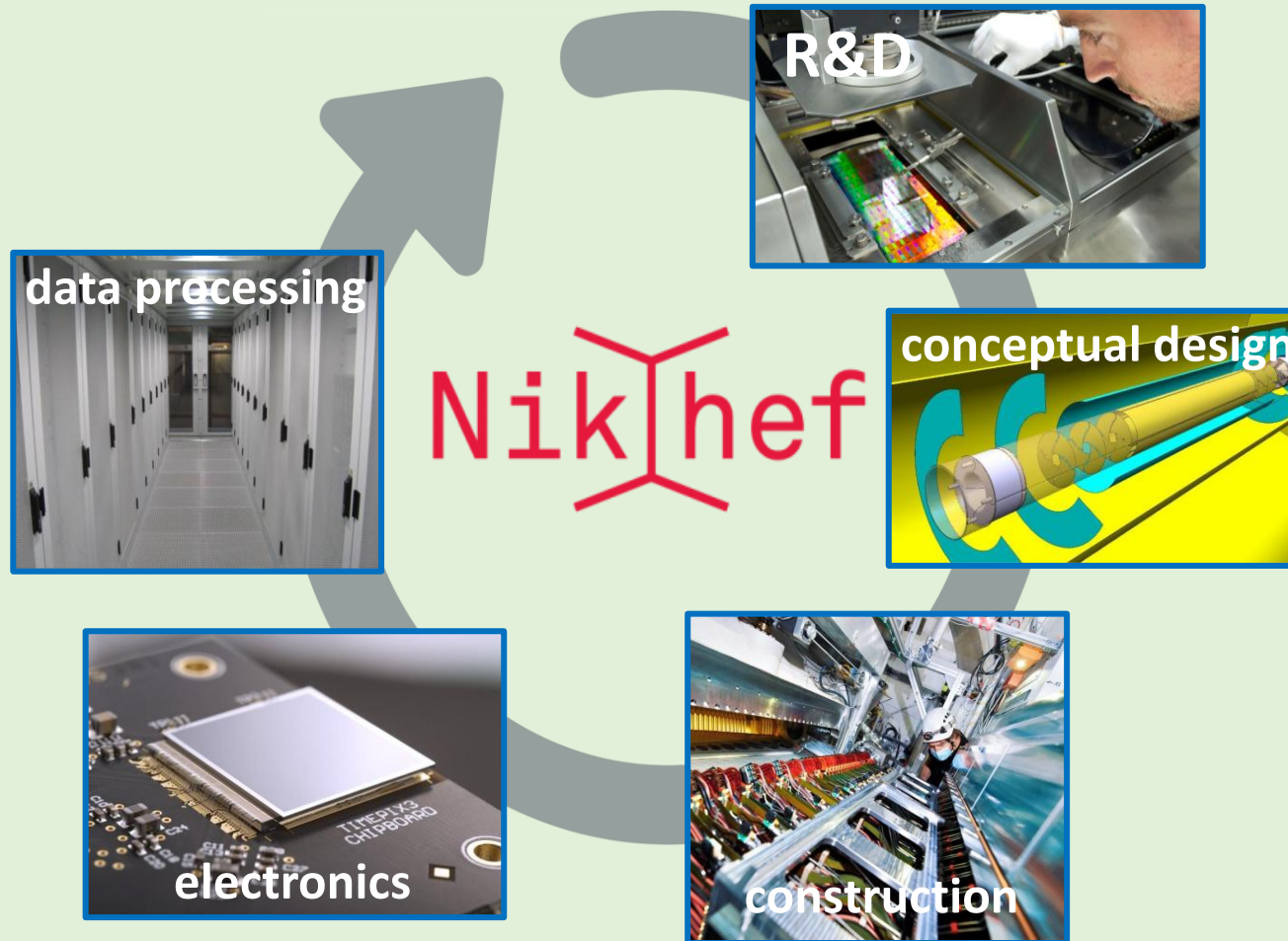


Role of national labs, strategy implementation
ESPPU 2026 Open Symposium (Venice)

- accelerator-based experiments
- non-collider experiments
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Example of the LPPL strengths

lifecycle of detector technology



Nikhef's key asset:
Nikhef master the entire life cycle of detector technology

→ *from conceptual design to tier-1 data processing*

All stages are brought together under one roof, enabling integrated, end-to-end detector development.

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Example of the LPPL strengths

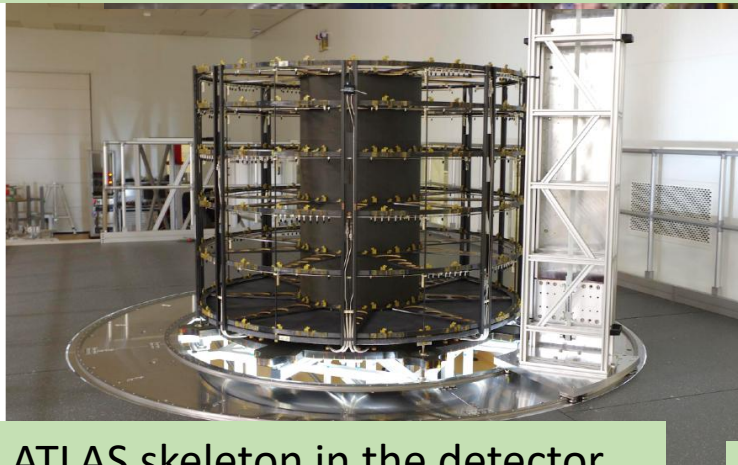
DESY

LNF

Advanced detector development/ construction/ testing at DESY



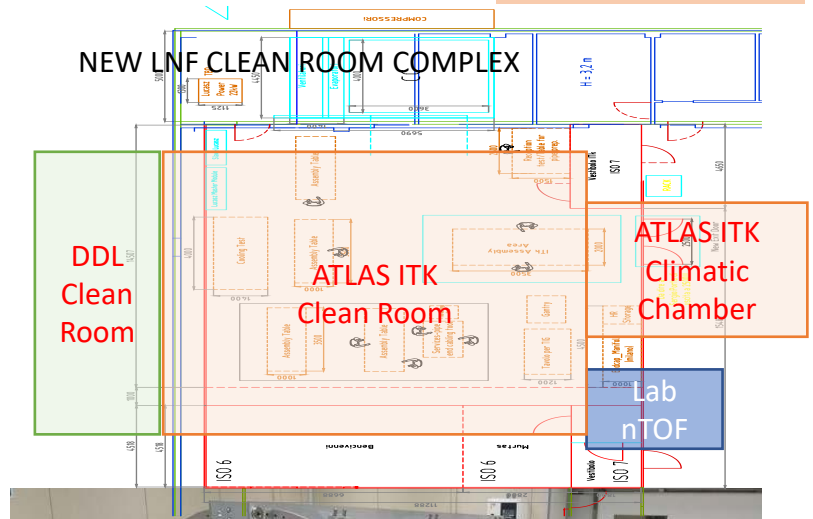
The DESY test beam experimental areas



ATLAS skeleton in the detector assembly facility



The detector assembly facility at DESY



ATLAS ITK Mechanical Support for the integration of the Endcap @LNF

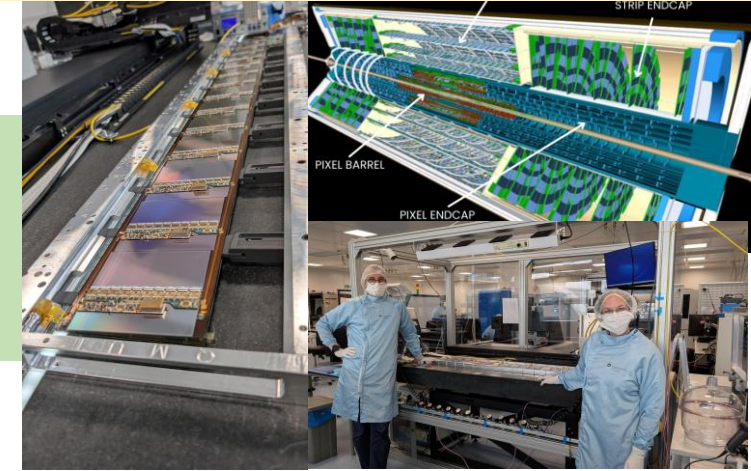
- accelerator-based experiments
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Example of the LPPL strengths

Rutherford Laboratory

Particle physics detector design/construction/analysis

- Silicon detectors (ITk dominantly at present); calorimetry; readout
- Software, Grid computing (Tier 1+2); hardware and software triggers
- R&D: silicon; FPGA; Liquid O, quantum technologies
- ATLAS, CMS, LHCb, Hyper K, DUNE, XLZD, LZ, AION, DarkSide, EIC



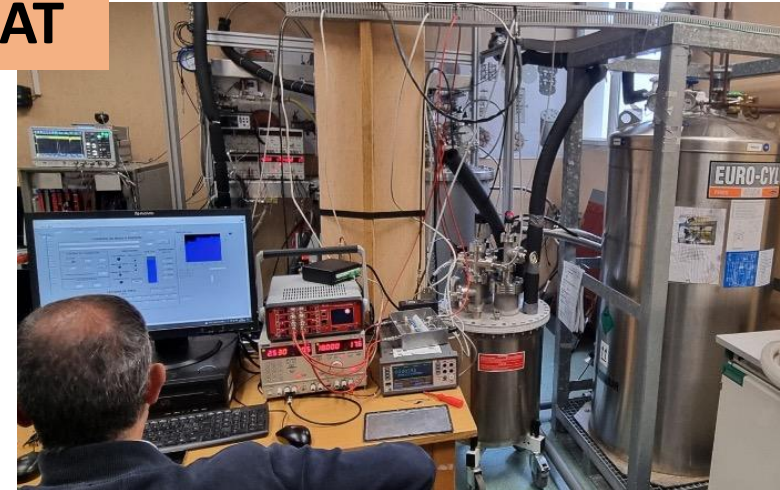
Rutherford Laboratory



Operating underground lab

- NE of England
- ~ 0 radon; low cosmic ray
- Candidate site for XLZD, quantum experiments and quantum computing research

CIEMAT

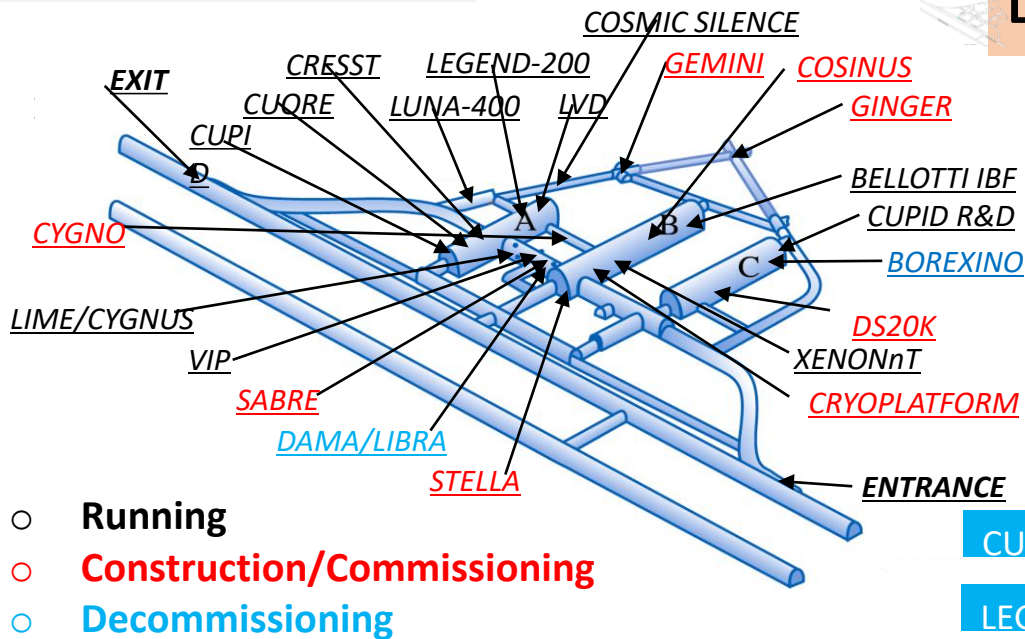


Cryolab for SiPM calibration for DUNE

- accelerator-based experiments
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Example of the LPPL strengths

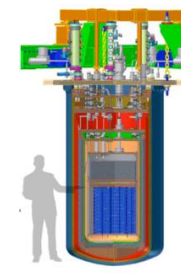
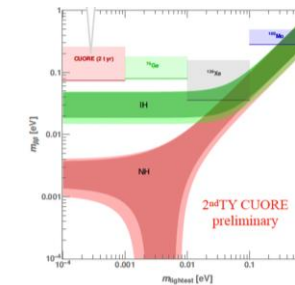
LNGS Experiments



Strategy Double Beta Decay and DarkMatter @LNGS

Considering **3/4 big experiments on DBD and DM** with other R&D activities on smaller experiments LNGS are practically fully committed until 2040.

This strategy is complementary and synergic with future study at the accelerator facilities.



For a optimal strategy implementation it is important **to enhance Collaborations between CERN and the Large Particle Physics Laboratories (LPPL)**

The highly competent workforce at the LPPLs often provides very cost effective work; Often, it also leverages CERN funding to obtain national funding.

Important to consider that often in the LPPL the accelerator/detector/infrastructure...developments are not made exclusively for HEP but also for other fields. Thus HEP could go into a win-win situation benefitting of these synergies.

In the second part of the talk we show some **areas for potential improvement and the consequent proposal to discuss and which are the basis of the work of this working group**

→ Expanding Global Accelerator R&D

- The LPPLs are instrumental in developing next-generation accelerator technologies.
- The **accelerator roadmap demonstrates a broad involvement and collaboration between European institutions** already today.

We now aim to implement in a more focused and efficient manner the accelerator road map which will be the updated, with new priorities set in the 2026 update of the ESPP

For that is essential / Proposals

- ✓ to intensify **coordination and networking** and **strengthen the ties between the different laboratories** that make up the LDG and more largely LPPL
- ✓ that **CERN delegates responsibilities to the LDG** and that synergies and complementarities are exploited according to the established road map to enhance the overall expertise in accelerator development in Europe.
- ✓ that **collaborations are also discussed and coordinated through the LDG** to take into account **top-down consideration**

→ Fostering Collaborations for a Next Generation Collider Facility

As shown in the previous slides, many LPPLs have competences relevant for the next collider project

Proposals

- ✓ Although such collaborations exist already, the identification of **further topics of collaborations** would be important
- ✓ **After decision, the process to assign external research and work packages (with possible in-kind)** in such large project(s), should be made as **transparent** as possible to motivate contributions from many laboratories.
- ✓ **Delegation of significant responsibilities from CERN to LPPL.**
- ✓ As a consequence, we **propose to implement new shared infrastructures in the LPPL** (e.g., CHART PSI-ETH, explicitly for CERN future colliders; see next slide for details)."

As an example → Fostering Collaborations for a Next Generation Collider Facility

Switzerland contributes to key technologies of integrated FCC

FCCee related projects

- Injector demonstrator at SwissFEL P³
- **Sustainability**: HTS-based magnets save 20-30% power/CO₂ footprint
 - Synergies with smaller accelerators, light sources
- novel cryogenics concepts like liquid-hydrogen



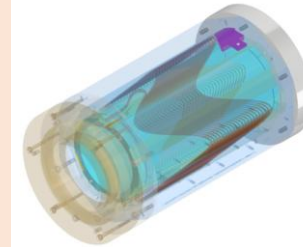
FCChh: rapid entry into high field magnet R&D, both LTS and **HTS**

- **Applied superconductivity**: e.g. conductor development
- Materials expertise: **training-free** superconducting magnets
- Stress-managed FCChh dipole magnet demonstrator design
- Integrate selected international partners in collaborations

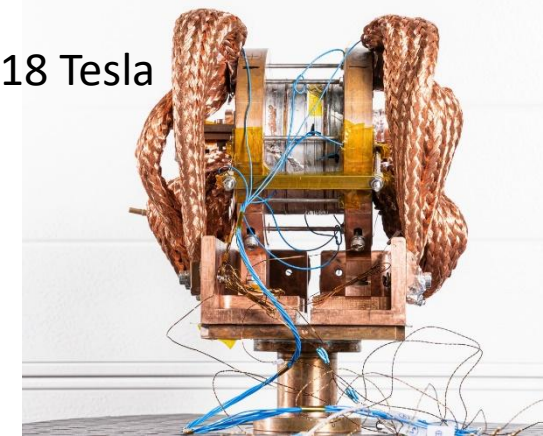


Swiss Accelerator
Research and
Technology

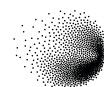
www.chart.ch



18 Tesla



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra



27/06/2025

Role of national labs, strategy implementation
ESPPU 2026 Open Symposium (Venice)

→ Strengthening the Diversity of the Physics Programme

As shown before LPPLs play a key role in hosting and supporting regional and global experiments

→ **HEP in Europe will benefit from a broader and more diverse range of experiments.**

Proposals

Increase and better formalize CERN's engagement in off-site experiments at national laboratories and universities, particularly for small to medium-sized projects.

- *Particularly the engineering capacities of CERN would be of great benefit for some of these experiments and could also help maintain or develop critical expertise.*
- *And/or strongly helping national laboratories — for example, through increased outsourcing to them.*

→ Enhancing Detector R&D and Infrastructure

As shown before LPPLs play a key role in hosting several test beams and R&D facilities (we call it off-site Infrastructure)

→ HEP in Europe will benefit from profiting more / sharing / selecting / updating these infrastructures.

Proposals

- **Increase support for these off-site infrastructures.** *These (or part of) facilities could be better shared / mutualized. Decisions could be taken to target how to **upgrade** and eventually **where to centralize**.*
- **better formalize CERN's engagement in these off-site infrastructures.** CERN support would help the **LPPLs** to justify using their own resources for supporting the activity.

What next for the activities of this working group

Summary : Master plan in a slide

Summary : Master Plan → Proposals

