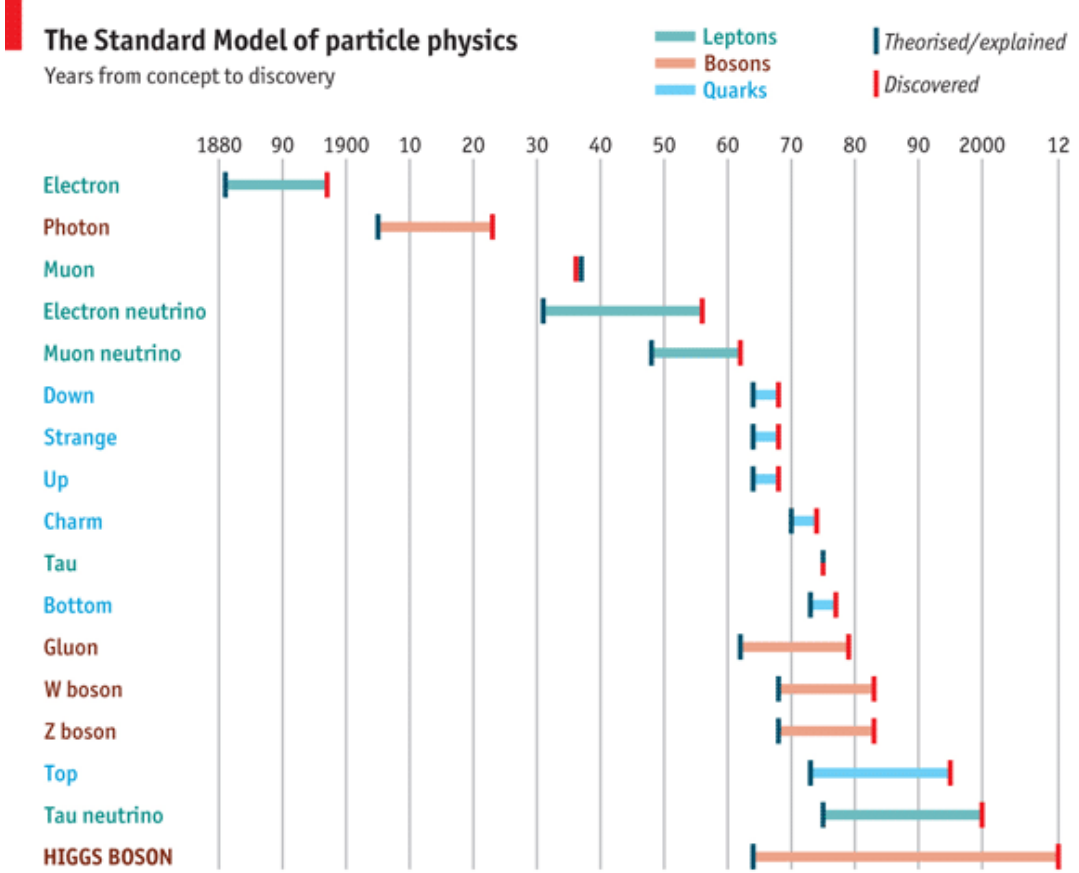
Romanian HEPP Community: ready for post-LHC era?

Calin Alexa, Particle Physics Dept., IFIN-HH

In (not just) my view, the scientific issues we face today are the most difficult + profound ones our field has seen since the 1930s

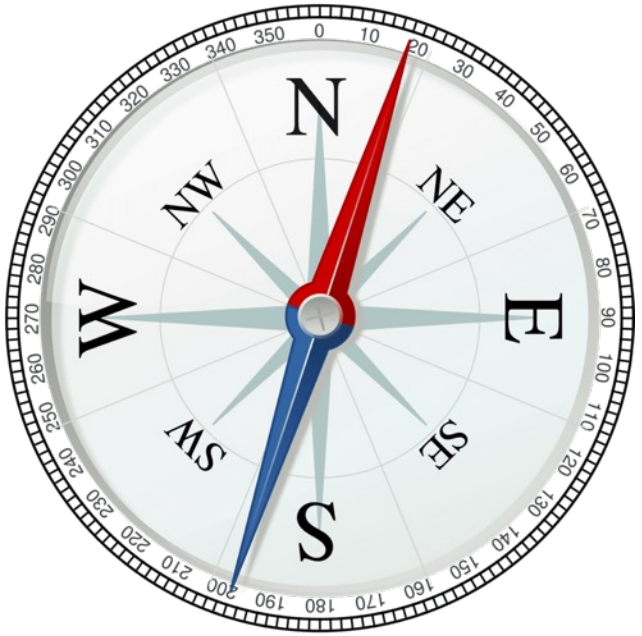
The questions raised by the accelerating universe, and the higgs discovery, both go to the heart of our understanding of the nature of spacetime, quantum mechanics + the vacuum.



Nima Arkani-Hamed

https://indico.cern.ch/event/1135177/contributions/4788694/attachments/2474678/4246383/HiggsJul4CERN2022_NAH.pdf

where are we going and how do we get there?



https://europeanstrategyupdate.web.cern.ch/

The European Strategy Group (ESG) and the Strategy Secretariat for this update were established in June 2024 to organise the full process.

The remit of the European Strategy Group was also approved in June 2024.

A “Briefing Book” based on the input and discussions will then be prepared by the Physics Preparatory Group.

European Strategy for Particle Physics Update 2018 - 2020

https://europeanstrategy.cern/european-strategy-for-particle-physics

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High-priority future initiatives

A. An electron-positron Higgs factory is the highest-priority next collider. For the longer term, the European particle physics community has the ambition to operate a proton-proton collider at the highest achievable energy. Accomplishing these compelling goals will require innovation and cutting-edge technology:

- the particle physics community should ramp up its R&D effort focused on advanced accelerator technologies, in particular that for high-field superconducting magnets, including high-temperature superconductors;
- Europe, together with its international partners, should investigate the technical and financial feasibility of a future hadron collider at CERN with a centre-of-mass energy of at least 100 TeV and with an electron-positron Higgs and electroweak factory as a possible first stage. Such a feasibility study of the colliders and related infrastructure should be established as a global endeavour and be completed on the timescale of the next Strategy update.
[…]

B. Innovative accelerator technology underpins the physics reach of high-energy and high-intensity colliders. It is also a powerful driver for many accelerator-based fields of science and industry. The technologies under consideration include high-field magnets, high-temperature superconductors, plasma wakefield acceleration and other high-gradient accelerating structures, bright muon beams, energy recovery linacs.
The European particle physics community must intensify accelerator R&D and sustain it with adequate resources. A roadmap should prioritise the technology, taking into account synergies with international partners and other communities such as photon and neutron sources, fusion energy and industry. Deliverables for this decade should be defined in a timely fashion and coordinated among CERN and national laboratories and institutes.

Other essential scientific activities for particle physics

C. The success of particle physics experiments relies on innovative instrumentation and state-of-the-art infrastructures. To prepare and realise future experimental research programmes, the community must maintain a strong focus on instrumentation. Detector R&D programmes and associated infrastructures should be supported at CERN, national institutes, laboratories and universities. Synergies between the needs of different scientific fields and industry should be identified and exploited to boost efficiency in the development process and increase opportunities for more technology transfer benefiting society at large. Collaborative platforms and consortia must be adequately supported to provide coherence in these R&D activities. The community should define a global detector R&D roadmap that should be used to support proposals at the European and national levels.

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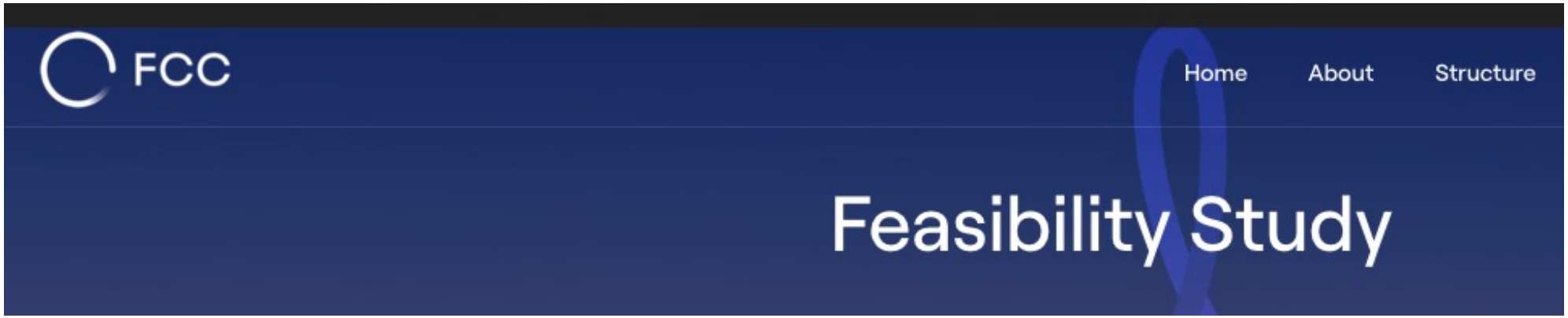
R&D Research Programme

Experiments | Teams | Participations

Search criteria: Search

Name	Synonym	Title	Program	Date of Approval
DRD1		Detector R&D Collaboration for Gaseous detectors	R&D	06-12-2023
DRD2		Detector R&D Collaboration for Liquid detectors	R&D	06-12-2023
DRD3		Detector R&D Collaboration for Solid-State detectors	R&D	06-12-2023
DRD4		Detector R&D Collaboration for Photon detectors and Particle ID	R&D	06-12-2023
DRD5		Detector R&D Collaboration for Quantum Sensors for particle physics	R&D	05-06-2024
DRD6		Detector R&D Collaboration for Calorimeters	R&D	06-12-2023
DRD7		Electronics and On-Detector Processing	R&D	05-06-2024


FCC
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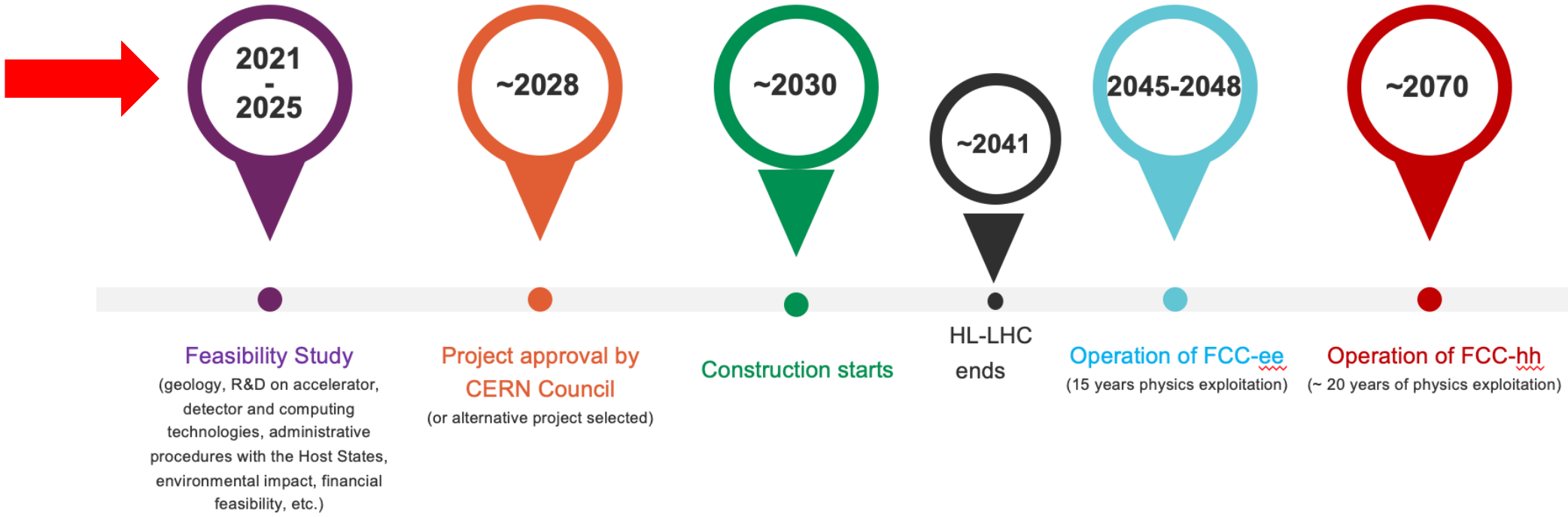
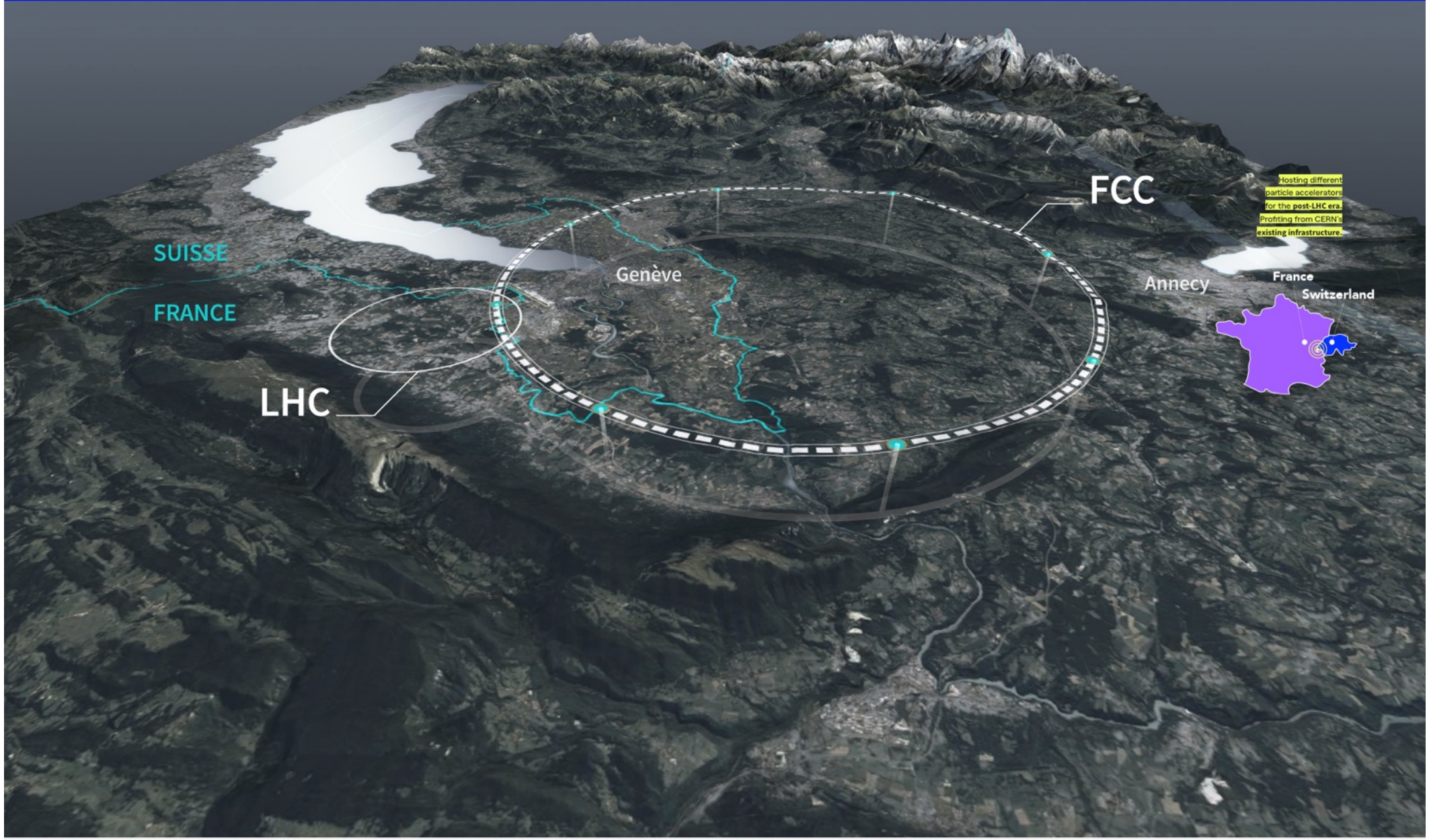
Feasibility Study


2021 - 2025
~2028
~2030
~2041
2045-2048
~2070
Feasibility Study
(geology, R&D on accelerator, detector and computing technologies, administrative procedures with the Host States, environmental impact, financial feasibility, etc.)
Project approval by CERN Council
(or alternative project selected)
Construction starts
HL-LHC ends
Operation of FCC-ee
(15 years physics exploitation)
Operation of FCC-hh
(~ 20 years of physics exploitation)

Timeline for the update of the European Strategy for Particle Physics



8
surface points

200
meter depth (avg)

Up to
4
experiments

7
decades of scientific research

Discovery	Precision measurements (discoveries)
SPS (1976) p-p - Z, W discovery (1983) Tevatron p-$\bar{p}$ (1983-2011) - top quark discovery (1995)	LEP (1989-2000) e^+-e^- precision measurements of Z and W HERA (1992-2007) e-p precision measurements (“scan” the proton)
LHC p-p (2008) - Higgs discovery (2012)	FCC (2045-2048) e^+-e^- precision measurements (Higgs properties, etc) CEPC (?) e-p precision measurements (Higgs properties, etc)
FCC p-p (2070) - discovery machine - SUSY? DM?	?

Summary of the Romanian contributions to DRD and FCC

Participating institutions:

- 4 institutes: IFIN-HH, ITIM Cluj-Napoca, INFM, ISS
- 3 universities: University Politehnica of Bucharest (UPB), University of Bucharest (UB), University Transylvania Brasov (UTB)

DRD1 (continuation of RD51)

- WP 1 - Trackers, Hodoscopes, Large area muon systems (IFIN-HH, UPB, UTB)
- WG 4 - Modelling and Simulations (IFIN-HH, UB)
- WG 3 - Optimization of Straw Chamber Technologies (IFIN-HH)
- WG 5 - Electronics for Gaseous Detectors (IFIN-HH, UPB, UTB)

DRD3 (continuation of RD50)

- WP 2 - WG3 - Radiation damage characterization and sensor operation at extreme fluences (INFM, IFIN-HH, UB)

DRD4

- WG 4.1 - Photon Detector, WG 4.2 - Particle ID, WG 4.3 - Technological activities, WG 4.6 - Novel ideas and far-future (IFIN-HH)
- Detector trigger system using the FPGA pulse processing algorithms (prospects) (IFIN-HH)

DRD6

- WP 1 - HighCompactCalo (ISS)
- WP 2 - Liquified Noble Gas Calorimeters (IFIN-HH, UB, UPB)
- WP 3 - Optical calorimeters (ITIM)

DRD7

- Work Package 7.5b - From Front-End to Back-End with 100GbE (prospects) (IFIN-HH, UPB)

FCC (*Allegro detector concept*)

- Tile hadronic calorimeter (ITIM Cluj-Napoca) and LAr EM calorimeter (IFIN-HH, UPB, UB)
- Contributions to the design of the Allegro EM and hadronic calorimeters and detector performance studies with simulation. (IFIN-HH, ITIM, UB, UPB)

TileCal for FCC,

23 September 2024

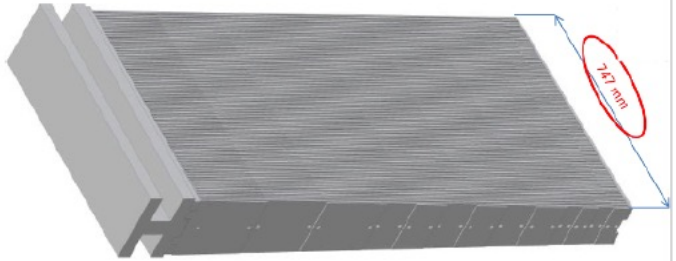
- Request for next EP-R&D:
- Using the current TileCal modules we could only instrument 0.025 in ϕ, too much lateral leakage
- Aim to build 3 to 5 mini modules (~70cm wide), 1 tonne each; would allow 6x0.025 in ϕ
- 3-4 tiles per readout channel
- Use leftover scintillator material and fibers from ATLAS-TileCal construction and eventually new scintillators from PEN / PET.

Team in ITIM-Cluj with the first elements of the absorber stacks

DRD6 Task 3.3.2: Tile Calorimeter

31 October 2024

- Aim is to build 3 to 3 mini-modules for use at testbeam:
  - over 70cm wide,
  - about 1 Tone each
- CAD design realised at ITIM Cluj.
- first period of master and filler plate produced by laser cutting using DD11/1.0332 EN 10111:2008 continuously hot rolled low carbon sheets.
- Next steps:
  - design of other mini-module components: girder support need better understanding os space needed for FE electronics.
  - design of custom devices: stacking fixtures, glueing machine, strap welding safety handling…
  - certifying detailed production procedure.

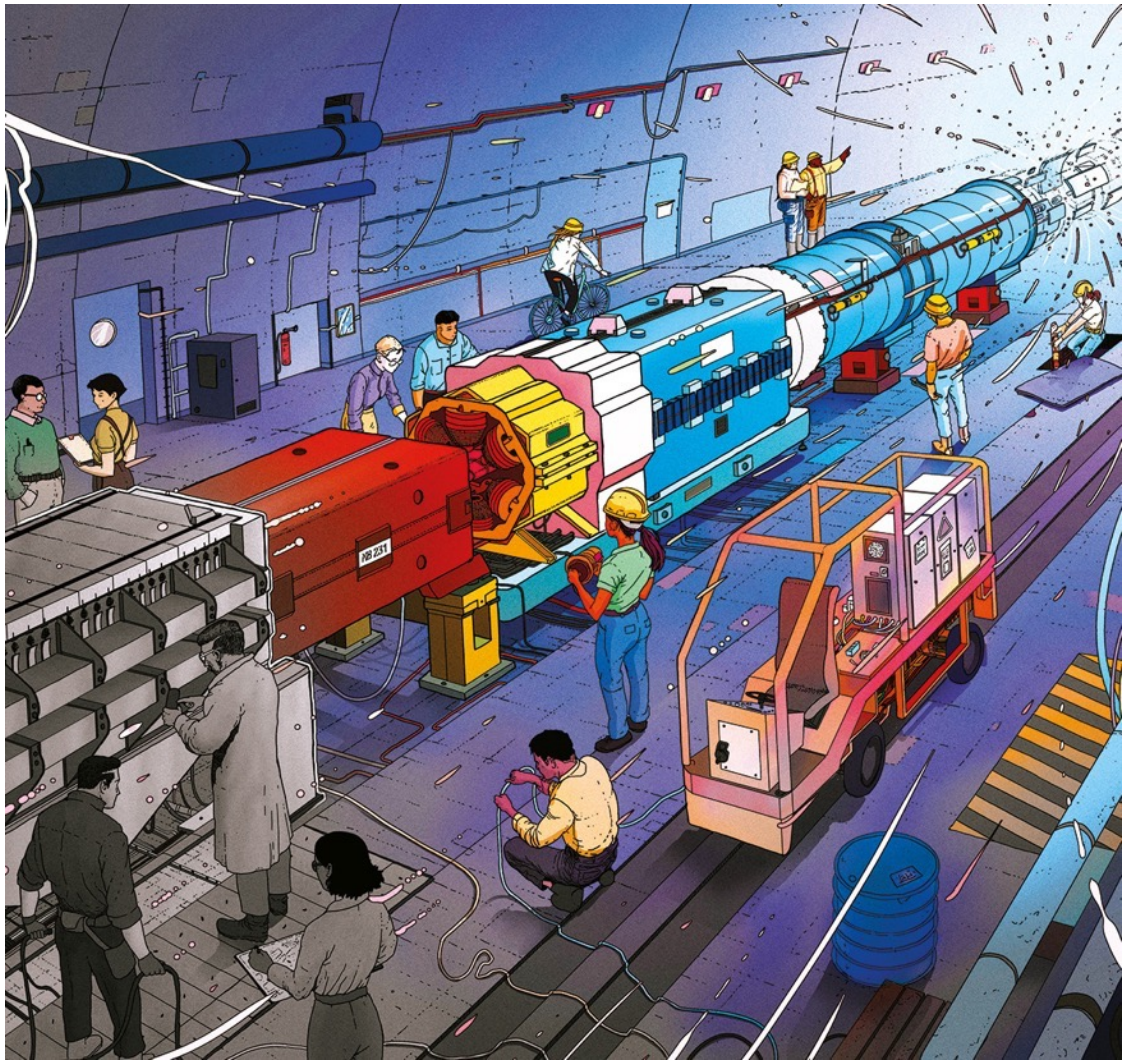


Education and outreach - prepare HR for future

Voices from a new generation (CERN Courier, 20 September 2024, https://cerncourier.com/a/voices-from-a-new-generation/)

Early-career researchers tell what they think is the key strategic issue for the future of high-energy physics:

- Invest in accelerator innovation
- Reward technical work with career opportunities
- A revolving door to industry
- Collaboration, retention and support
- Redesign collaborations for equitable opportunity
- Reward risk taking
- Our employment model stifles creativity
- Embrace private expertise and investment
- Stability would stop the brain drain
- Reduce environmental impacts
- Invest in software and computing talent
- Strengthen international science
- Recognise R&D



Joint National Master Programme on (experimental) "High-Energy Physics":

- West University of Timișoara
- University Al. Ioan Cuza from Iași
- University Babes-Bolyai from Cluj-Napoca
- University of Bucharest

- initiated by HEP colleagues from IFIN-HH and UB
- start in October 2025
- will ensure training of human resources for Romanian participation in scientific projects at CERN
- research practice for students will take place both in their own university and in national research institutes (IFIN-HH and ITIM Cluj-Napoca) with which the universities are partners in research projects financed by the CERN-RO Program

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