

FCC Feasibility Study Goals, Timelines, Organisation

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on behalf of the FCC collaboration and FCCIS DS team



Work supported by the **European Commission** under the **HORIZON 2020** projects **EuroCirCol**, grant agreement 654305; **EASITrain**, grant agreement no. 764879; **ARIES**, grant agreement 730871, **FCCIS**, grant agreement 951754, and **E-JADE**, contract no. 645479

<http://cern.ch/fcc>



photo: J. Wenninger

ESPP Update 2020 “High-priority future initiatives”

- 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**.
- “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..”**



Organisational Structure of the FCC Feasibility Study

<http://cds.cern.ch/record/2774006/files/English.pdf>

CERN/SPC/1155/Rev.2
CERN/3566/Rev.2
Original: English
21 June 2021

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Action to be taken

Voting Procedure

For decision	RESTRICTED COUNCIL 203 rd Session 17 June 2021	Simple majority of Member States represented and voting
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FUTURE CIRCULAR COLLIDER FEASIBILITY STUDY:

PROPOSED ORGANISATIONAL STRUCTURE

This document sets out the proposed organisational structure for the Feasibility Study of the Future Circular Collider, to be carried out in line with the recommendations of the European Strategy for Particle Physics updated by the CERN Council in June 2020. It reflects discussion at, and feedback received from, the Council in March 2021 and is now submitted for the latter's approval.

Main Deliverables and Timeline of the FCC Feasibility Study

<http://cds.cern.ch/record/2774007/files/English.pdf>

CERN/SPC/1161
CERN/3588
Original: English
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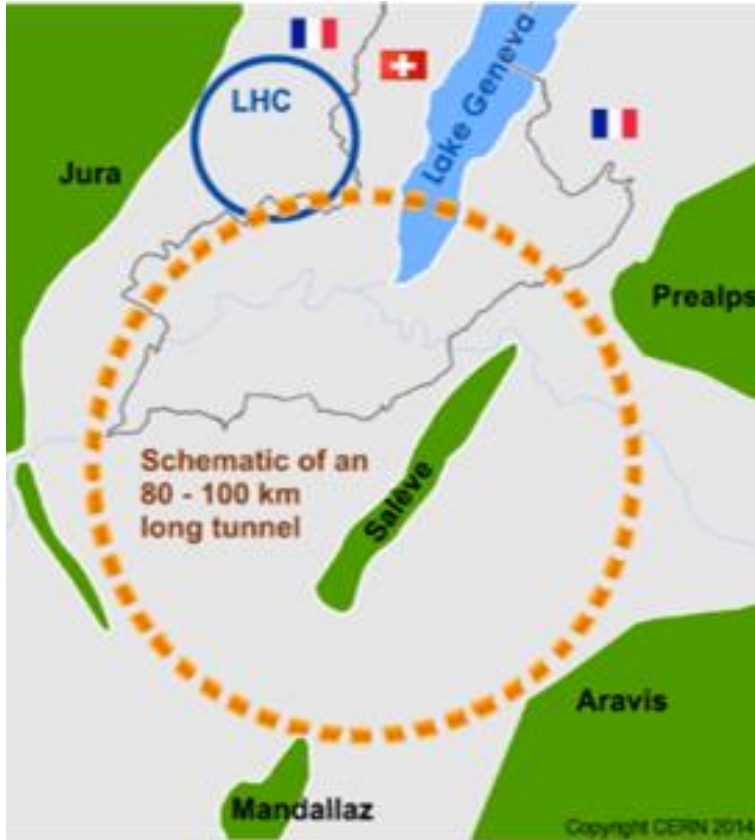
FUTURE CIRCULAR COLLIDER FEASIBILITY STUDY:

MAIN DELIVERABLES AND MILESTONES

This document describes the main deliverables and milestones of the study being carried out to assess the technical and financial feasibility of a Future Circular Collider at CERN. The results of this study will be summarised in a Feasibility Study Report to be completed by the end of 2025.

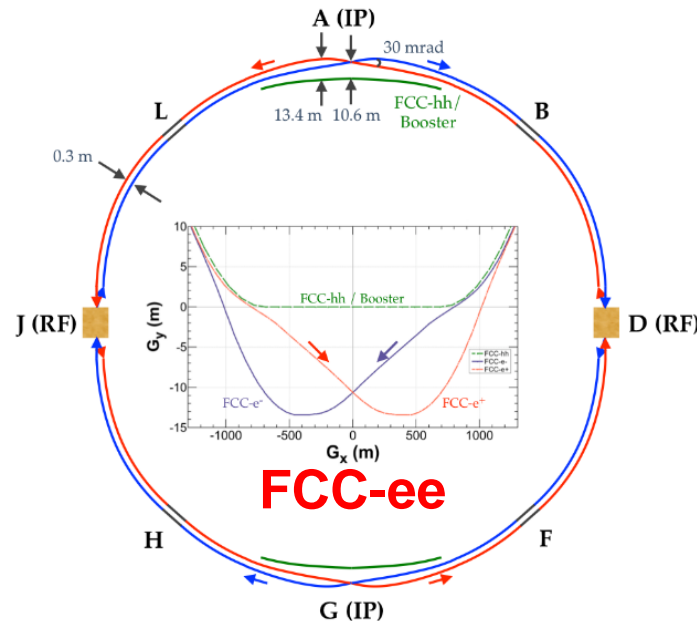
The FCC integrated program inspired by successful LEP – LHC programs at CERN

complementary physics, common civil engineering and technical infrastructures, building on and reusing CERN's existing infrastructure, FCC integrated project allows seamless continuation of HEP after HL-LHC



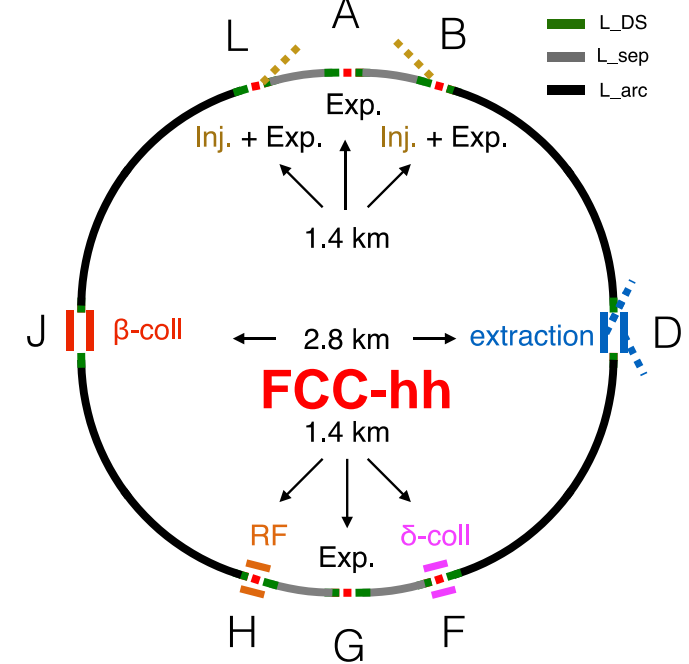
2020 - 2040

Phase 1 : FCC-ee
collisionneur electron - positon
usine à Higgs, Z, W, ttbar



2040 - 2055

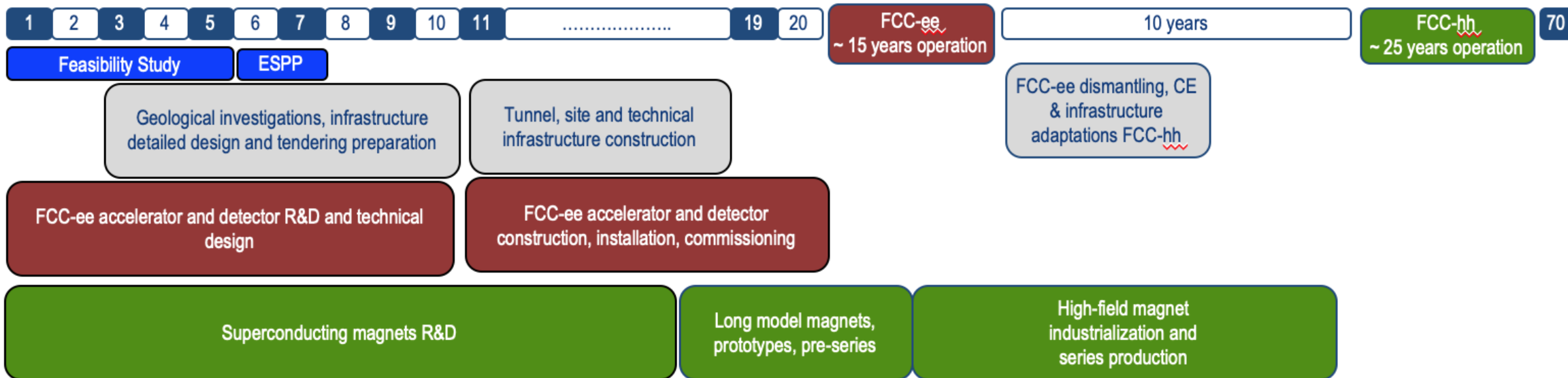
Phase 2 : FCC-hh
collisionneur proton - proton
frontière des hautes énergies



2060 - 2090

Timeline of the FCC integrated programme

Technical
schedule



	\sqrt{s}	L /IP (cm ⁻² s ⁻¹)	Int. L /IP(ab ⁻¹)	Comments	
e⁺e⁻ FCC-ee	~90 GeV 160 240 ~365	Z WW H top	230 x 10 ³⁴ 28 8.5 1.5	75 5 2.5 0.8	2-4 experiments Total ~ 15 years of operation
pp FCC-hh	100 TeV	5 x 10 ³⁴ 30	20-30	2+2 experiments Total ~ 25 years of operation	
PbPb FCC-hh	$\sqrt{s_{NN}} = 39\text{TeV}$	3 x 10 ²⁹	100 nb ⁻¹ /run	1 run = 1 month operation	
ep Fcc-eh	3.5 TeV	1.5 10 ³⁴	2 ab ⁻¹	60 GeV e- from ERL Concurrent operation with pp for ~ 20 years	
e-Pb Fcc-eh	$\sqrt{s_{eN}} = 2.2\text{ TeV}$	0.5 10 ³⁴	1 fb ⁻¹	60 GeV e- from ERL Concurrent operation with PbPb	

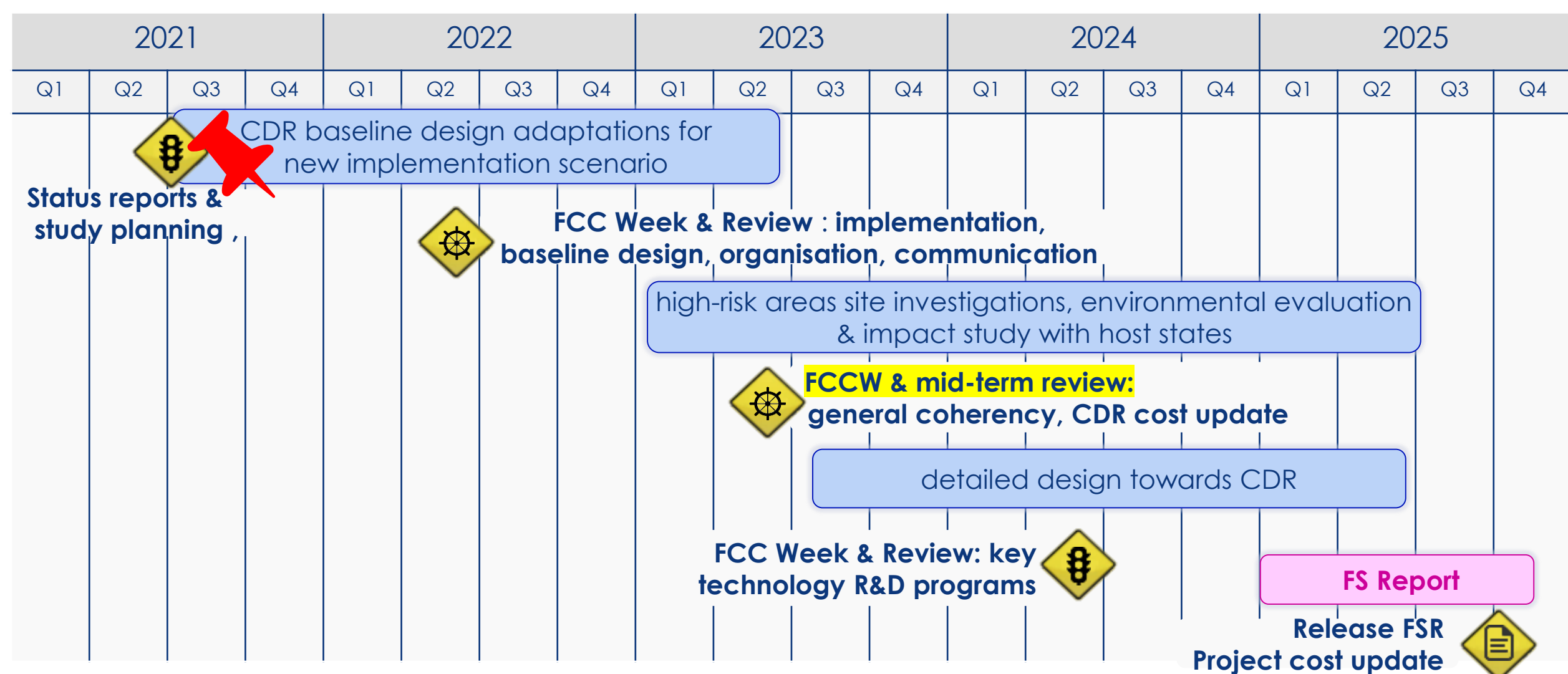


- Feasibility Study: 2021-2025
- If project approved before end of decade → construction can start beginning 2030s
- FCC-ee operation ~2045-2060
- FCC-hh operation 2070-2090++

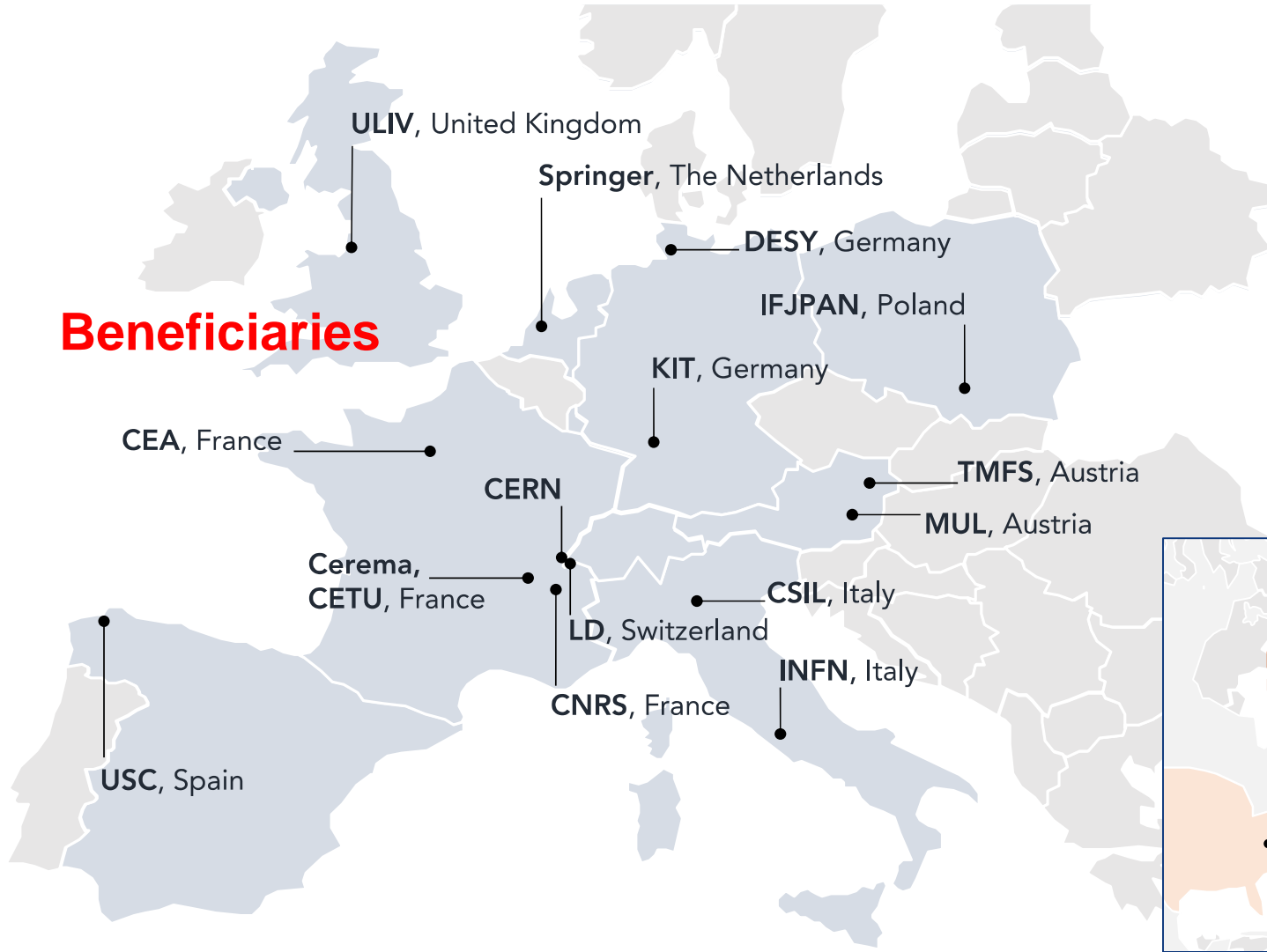
- ❑ demonstration of the [geological, technical, environmental and administrative feasibility](#) of the tunnel and surface areas and optimisation of [placement and layout of the ring](#) and related infrastructure;
- ❑ pursuit, [together with the Host States](#), of the preparatory administrative processes required for a potential project [approval](#) to identify and remove any showstopper;
- ❑ [optimisation of the design of the colliders and their injector chains](#), supported by R&D to develop the needed key technologies;
- ❑ elaboration of a [sustainable operational model](#) for the colliders and experiments in terms of human and financial resource needs, as well as [environmental aspects and energy efficiency](#);
- ❑ development of a [consolidated cost estimate](#), as well as the [funding and organisational models](#) needed to enable the project's technical design completion, implementation and operation;
- ❑ [identification of substantial resources from outside CERN's budget](#) for the implementation of the first stage of a possible future project (tunnel and FCC-ee);
- ❑ [consolidation of the physics case and detector concepts](#) for both colliders.

Results will be summarised in a [Feasibility Study Report](#) to be released at end 2025

Feasibility Study Timeline

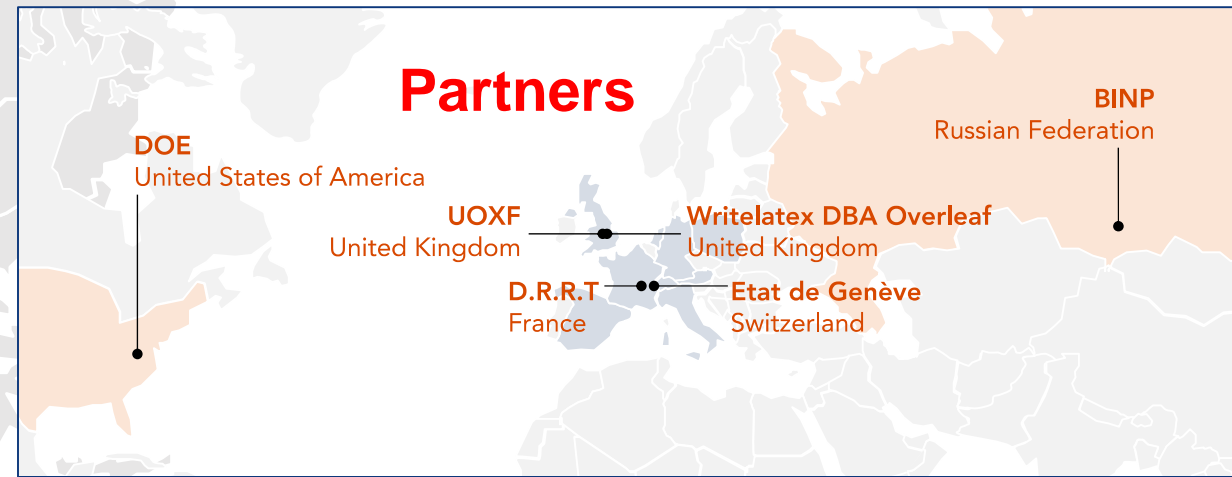


Beneficiaries



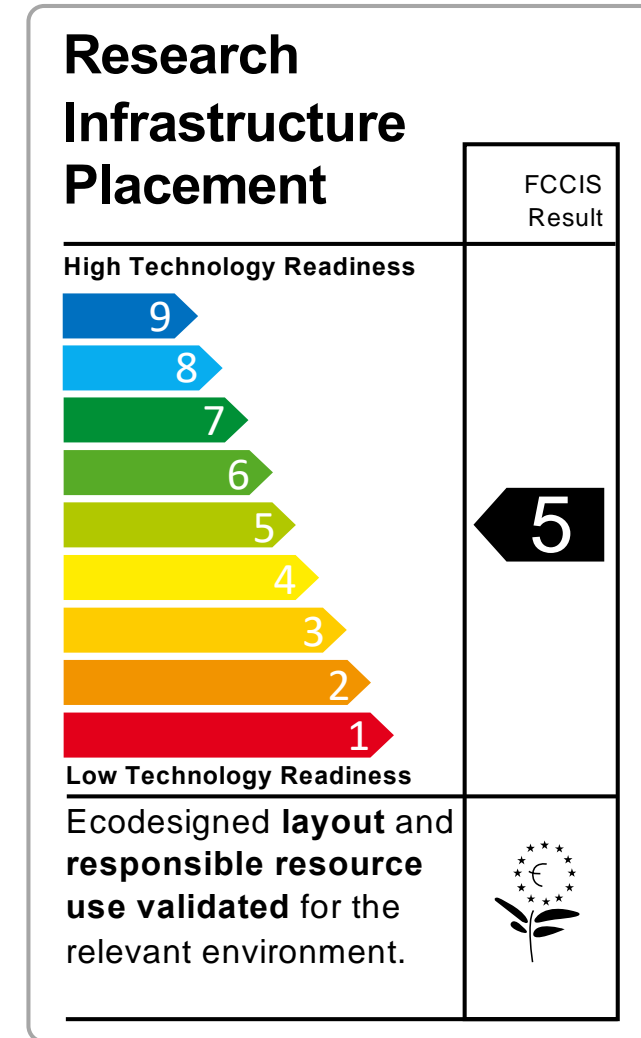
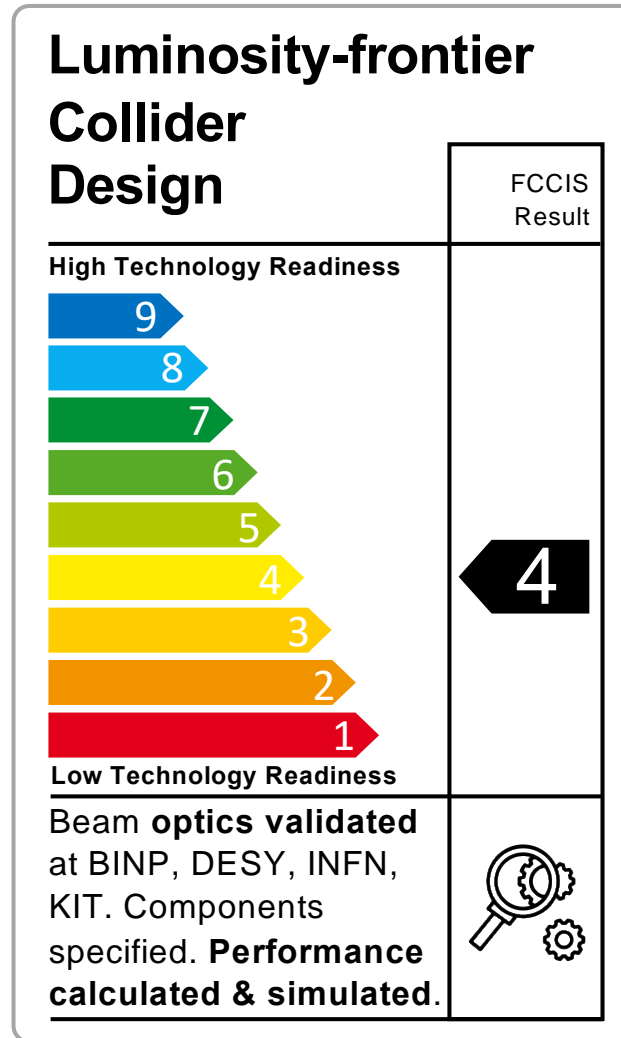
Topic	INFRADEV-01-2019-2020
Grant Agreement	FCCIS 951754
Duration	48 months
From-to	2 Nov 2020 – 1 Nov 2024
Project cost	7 435 865 €
EU contribution	2 999 850 €
Beneficiaries	16
Partners	6

Partners



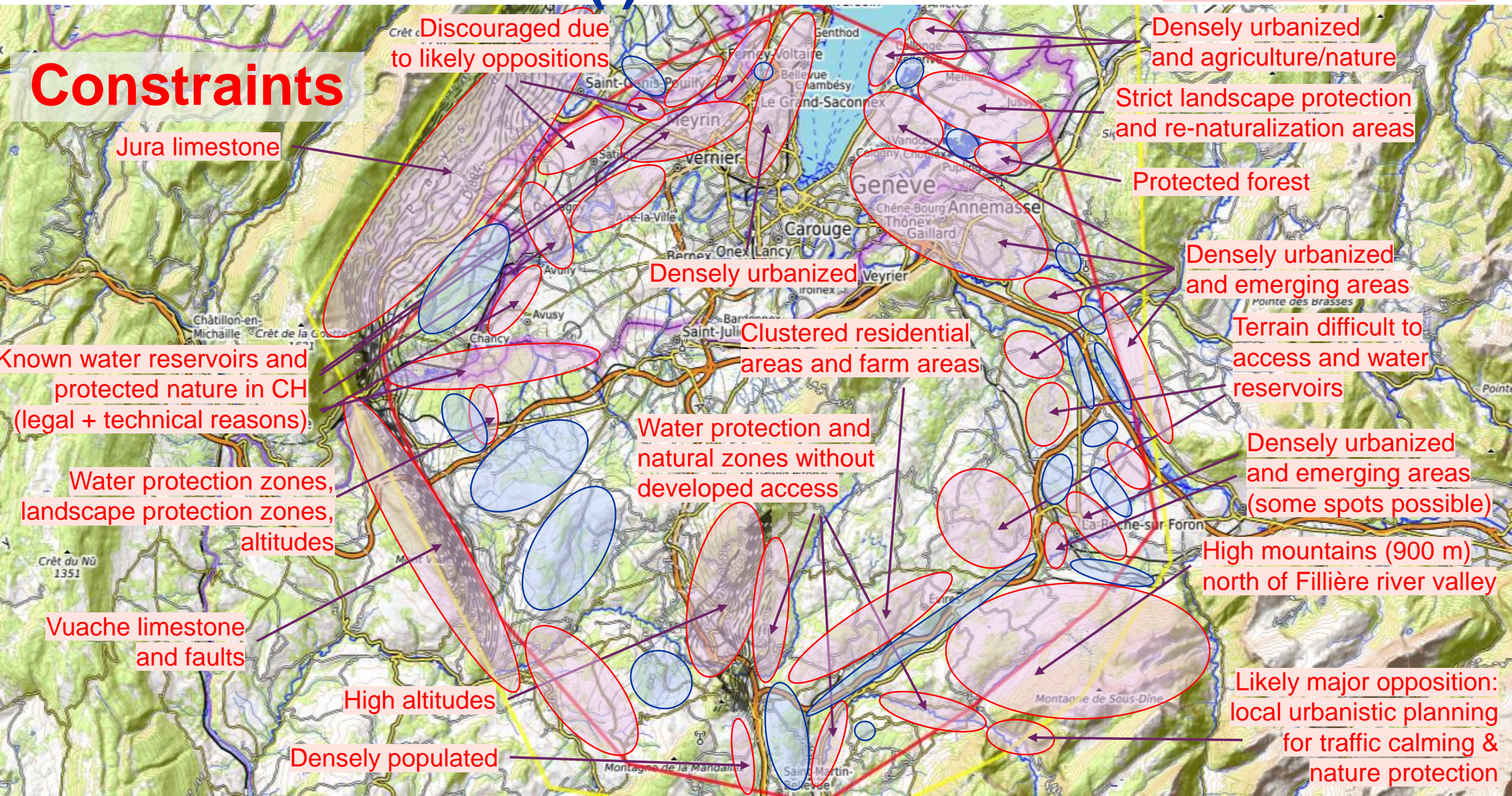
Objectives of FCCIS (Description of Action)

- **O1: Design a circular luminosity frontier particle collider** with a research programme to remain at the forefront of research
- **O2: Demonstrate the technical and organizational feasibility** of a 100 km long, circular particle collider
- **O3: Develop an innovation plan for a long-term sustainable research infrastructure** that is seamlessly integrated in the European research landscape
- **O4: Engage stakeholders** from different sectors of the society
- **O5: Demonstrate the role and impact of the research infrastructure in the innovation chain**, focusing on responsible resource use and managing environmental impacts



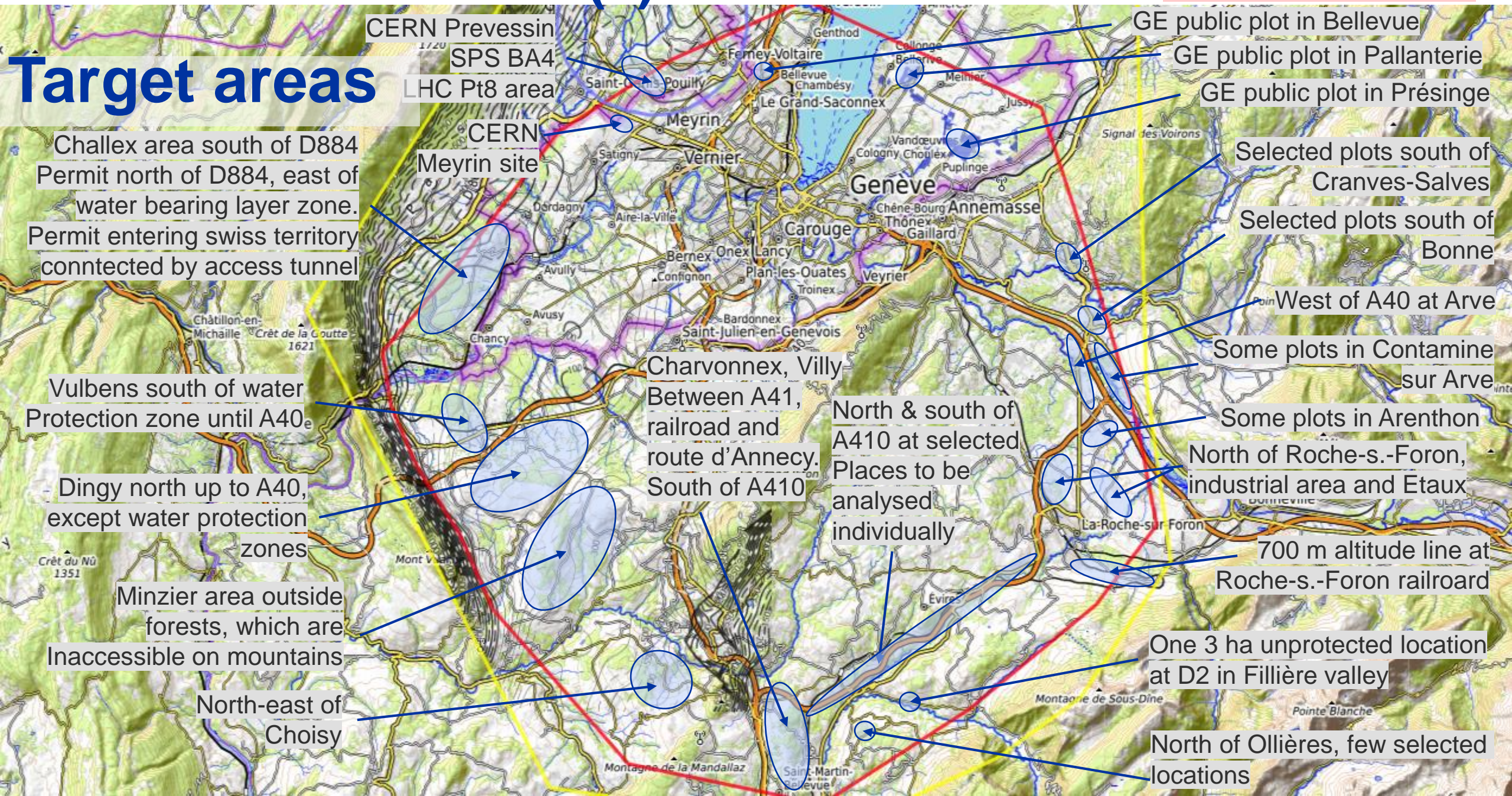
Placements studies (i)

Constraints



Placements studies (ii)

Target areas



CERN Preveessin
SPS BA4
LHC Pt8 area

GE public plot in Bellevue
GE public plot in Pallanterie
GE public plot in Présinge

Challex area south of D884
Permit north of D884, east of water bearing layer zone.
Permit entering swiss territory connected by access tunnel

CERN Meyrin site

Selected plots south of Cranves-Salves
Selected plots south of Bonne

Vulbens south of water protection zone until A40

Charvonnex, Villy
Between A41, railroad and route d'Annecy.
South of A410

North & south of A410 at selected places to be analysed individually

West of A40 at Arve
Some plots in Contamine sur Arve

Dingy north up to A40, except water protection zones

Some plots in Arenthon
North of Roche-s.-Foron, industrial area and Etaux

Minzier area outside forests, which are inaccessible on mountains

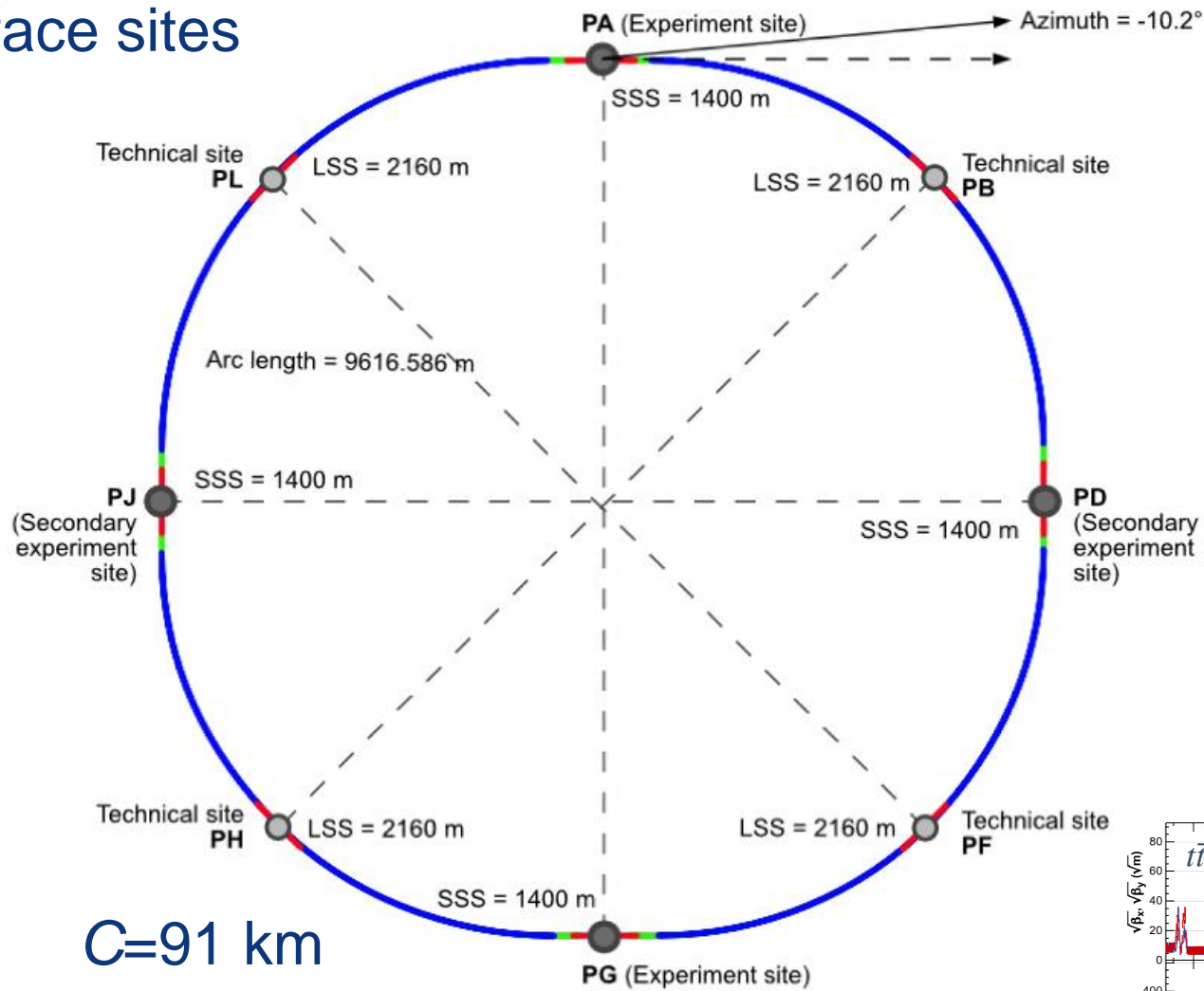
700 m altitude line at Roche-s.-Foron railroad

North-east of Choisy

One 3 ha unprotected location at D2 in Fillière valley

North of Ollières, few selected locations

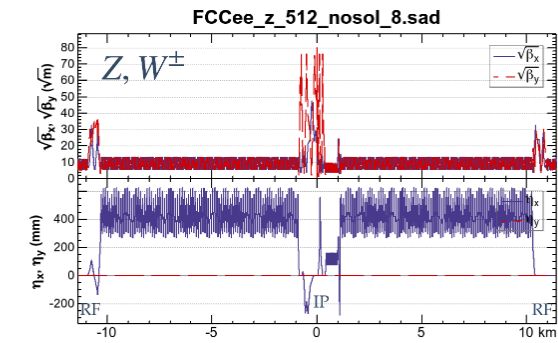
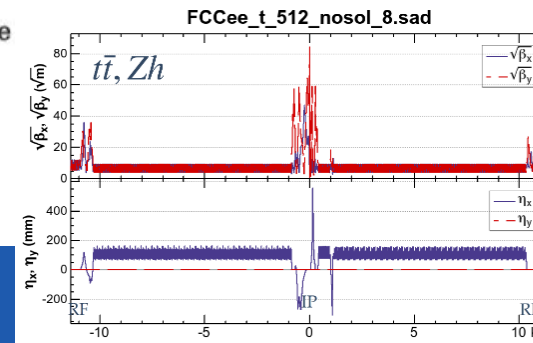
8 surface sites



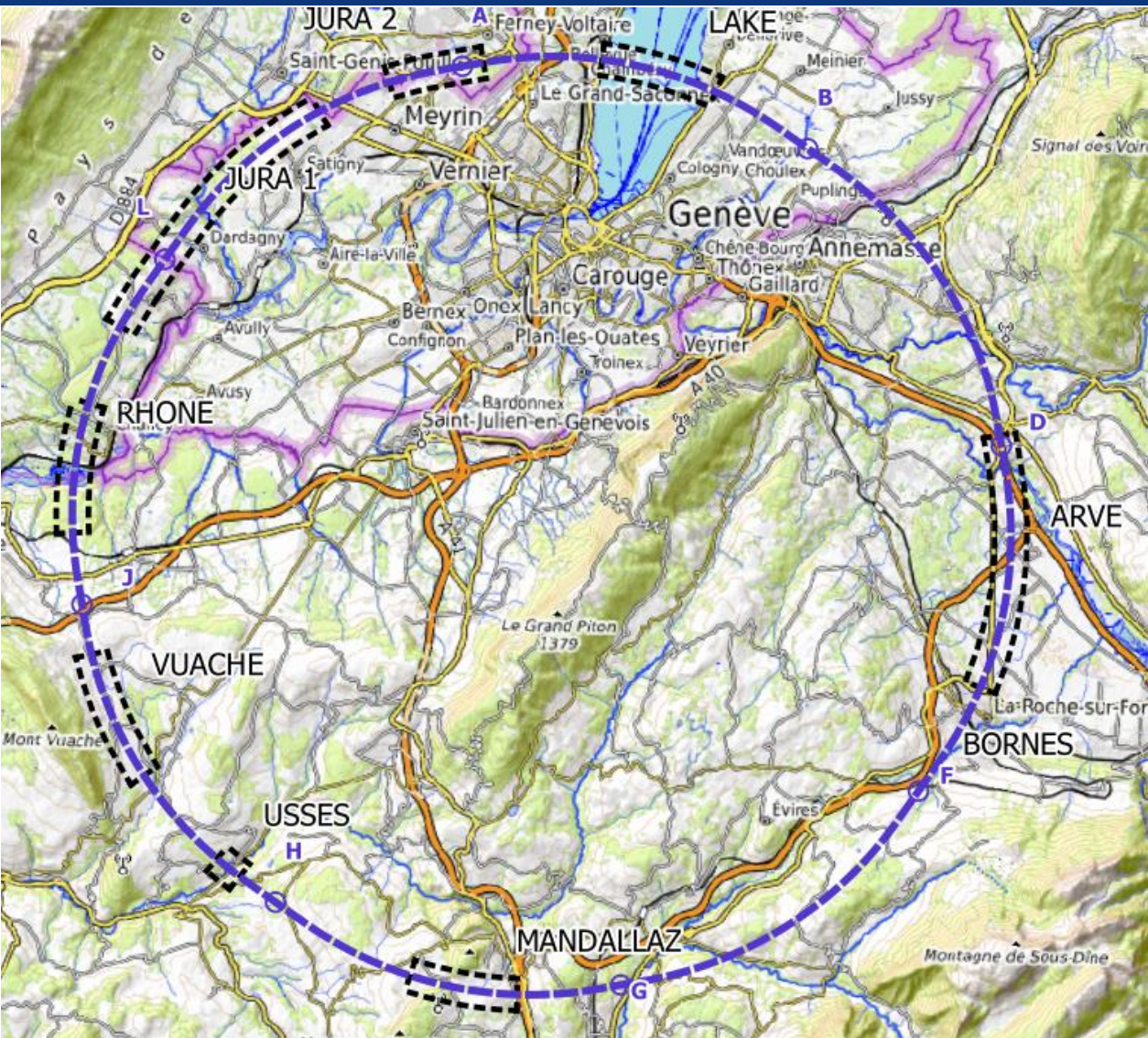
4-fold symmetry
and
4-fold superperiodicity

FCC-ee 2 or 4 Ips
FCC-hh 4 IPs

FCC-ee beam optics for $\frac{1}{4}$ ring K. Oide



Plans for high-risk area site investigations



JURA, VUACHE (3 AREAS)

- Top of limestone
- Karstification and filling-in at the tunnel depth
- Water pressure

LAKE, RHÔNE, ARVE AND USSES VALLEY (4 AREAS)

- Top of the molasse
- Quaternary soft grounds, water bearing layers

MANDALLAZ (1 AREAS)

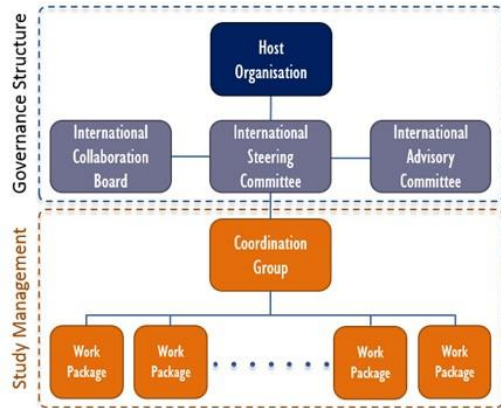
- Water pressure at the tunnel level
- Karstification

BORNES (1 AREA)

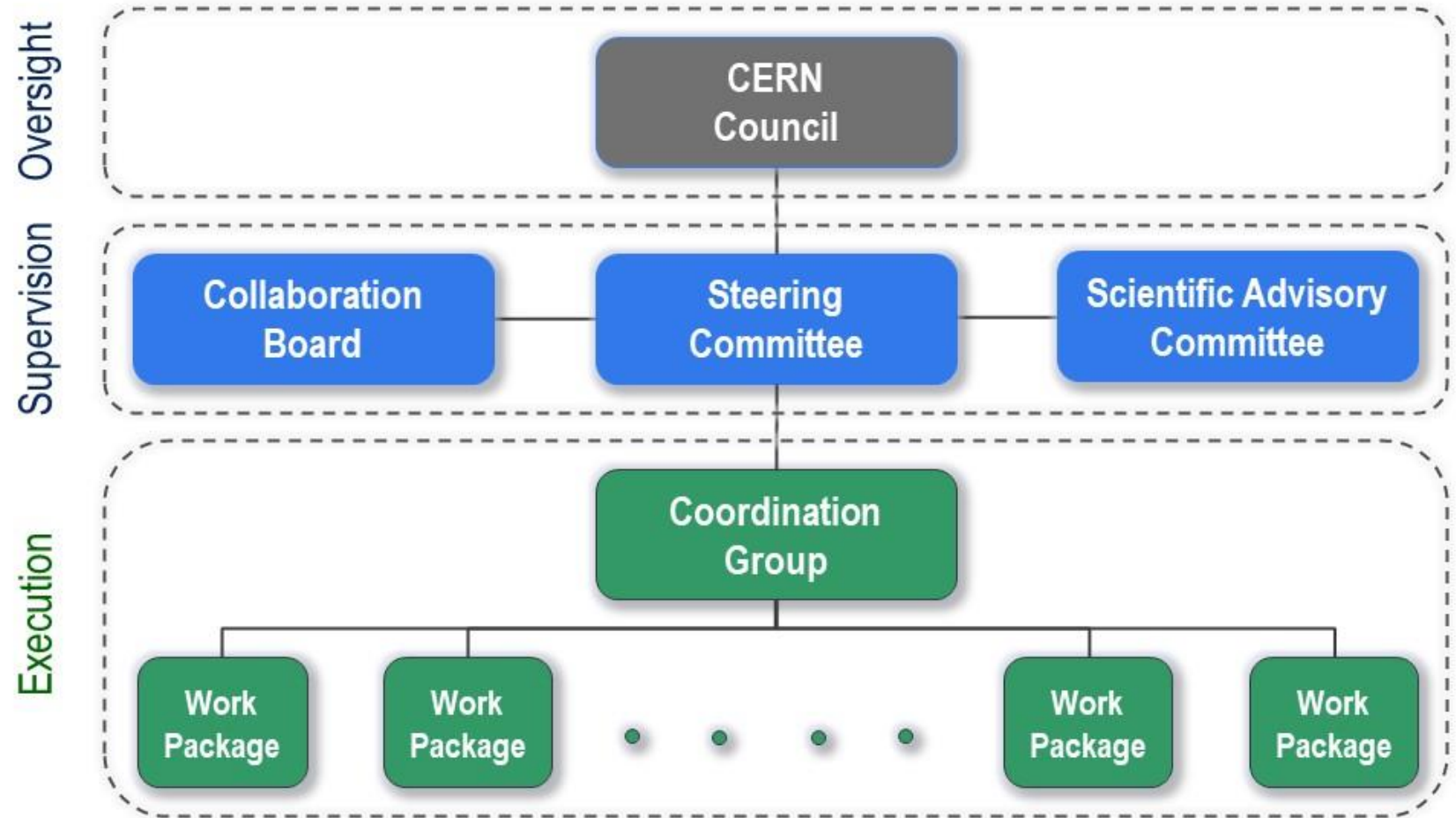
- High overburden molasse properties
- Thrust zones

**Site investigations planned for mid 2023 – mid 2025:
~40-50 drillings, 100 km of seismic lines**

- New structure very similar to the first phase of the FCC Study (2014-2020), leading to the Conceptual Design Report as input to the ESPPU.



- Classical structure common to CERN projects.



Status of Global FCC Collaboration

Increasing international collaboration as a prerequisite for success:

links with science, research & development and **high-tech industry** will be essential to further advance and prepare the implementation of FCC

147

Institutes

30

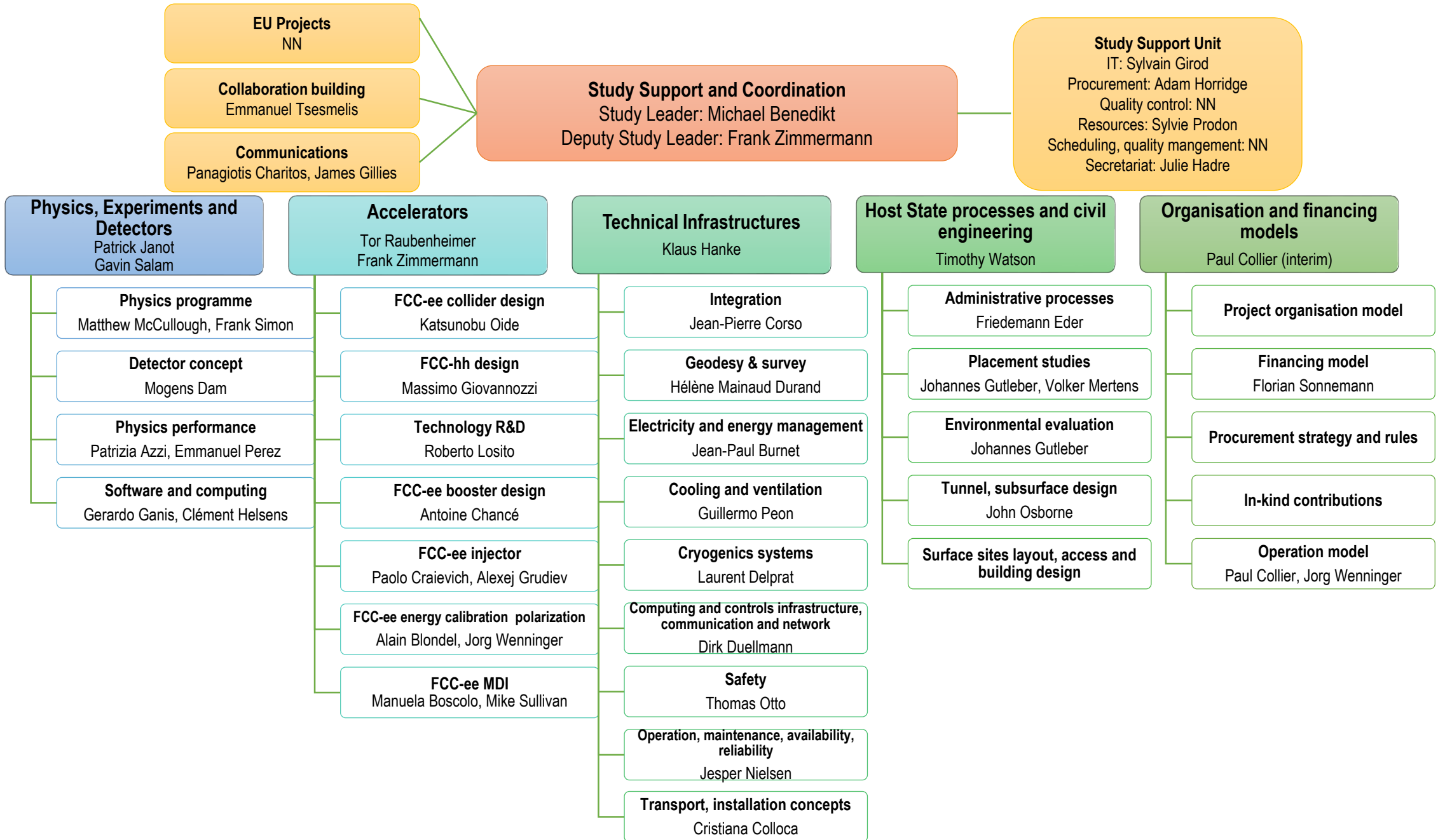
Companies

34

Countries



FCC Feasibility Study – coordination team and contact persons





In Paris 30 May to 3 June 2022

***We are looking forward
to seeing you there !***

- Following the European Strategy Update, the **organization structure and major milestones and deliverables for the FCC Feasibility Study** were approved by the **CERN Council** in **June 2021**.
- Main activities concern the **development and confirmation of a concrete implementation scenario** in collaboration with **host state authorities**, accompanied by **machine optimization, physics studies and technology R&D**, performed via **global collaboration** and supported by the **EC H2020 Design Study FCCIS**, with the goal to **demonstrate feasibility by 2025/26**.
- Long term goal: **world-leading HEP infrastructure for 21st century** to push the particle-physics **precision and energy frontiers** far beyond present limits.