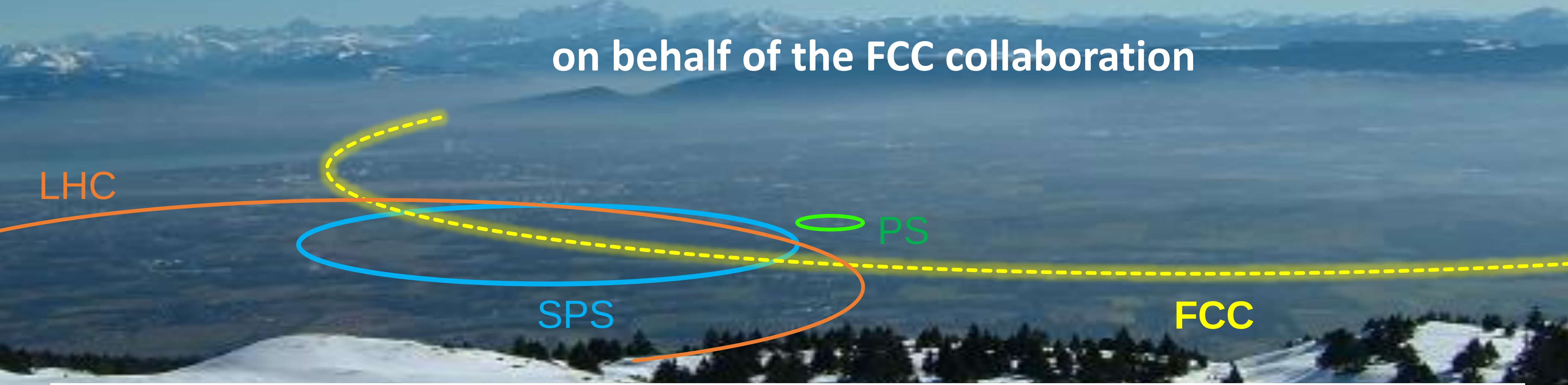
The FCC Feasibility Study

Michael Benedikt, CERN

on behalf of the FCC collaboration



FCC hh ee he | EuroCirCol A key to New Physics | EASITrain | ARIES | FUTURE CIRCULAR COLLIDER Innovation Study | E-JADE | http://cern.ch/fcc | CERN

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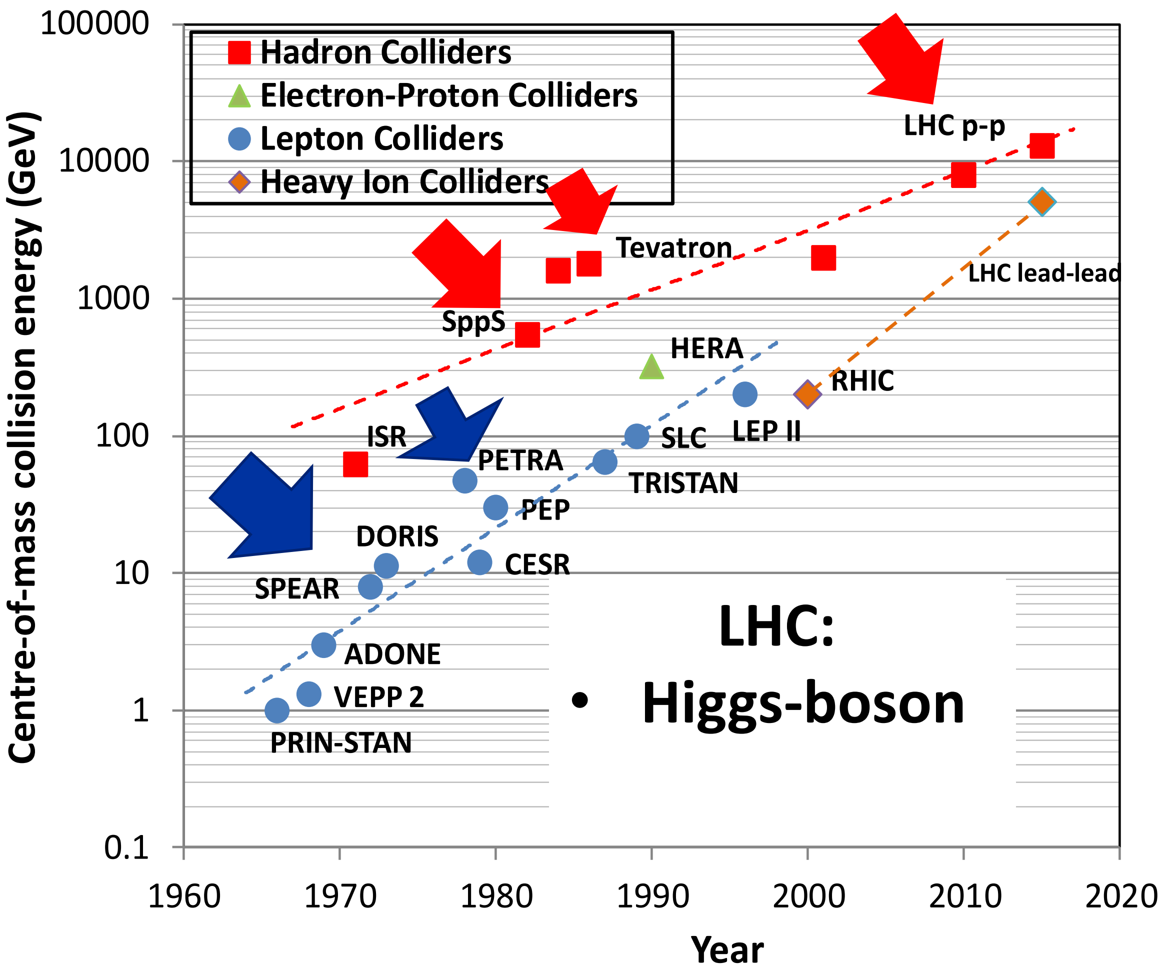
European Commission | Horizon 2020 European Union funding for Research & Innovation

photo: J. Wenninger

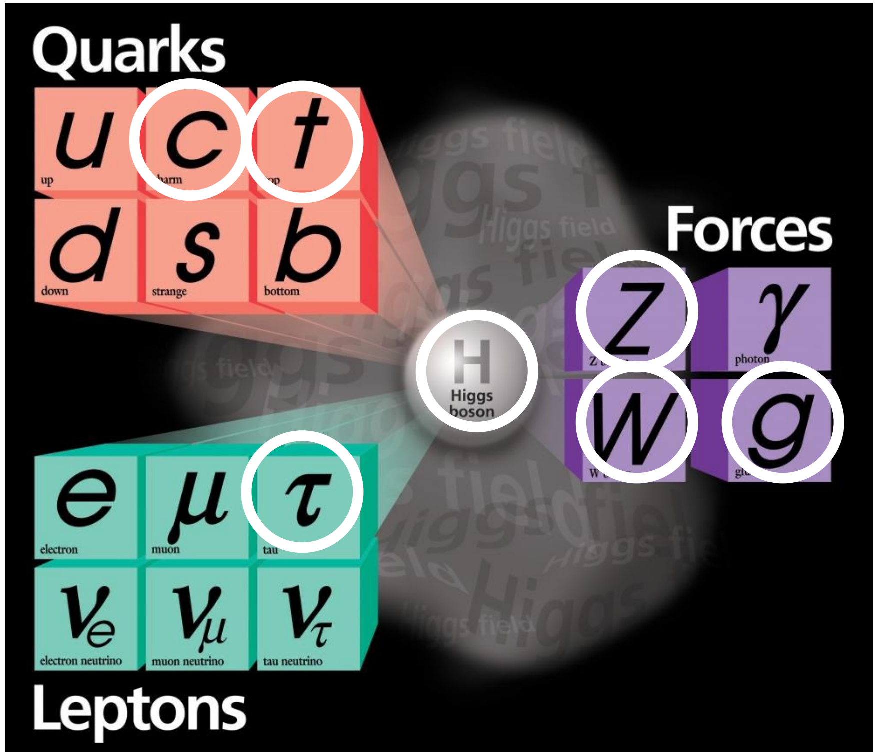
Discoveries with colliders



LHC:

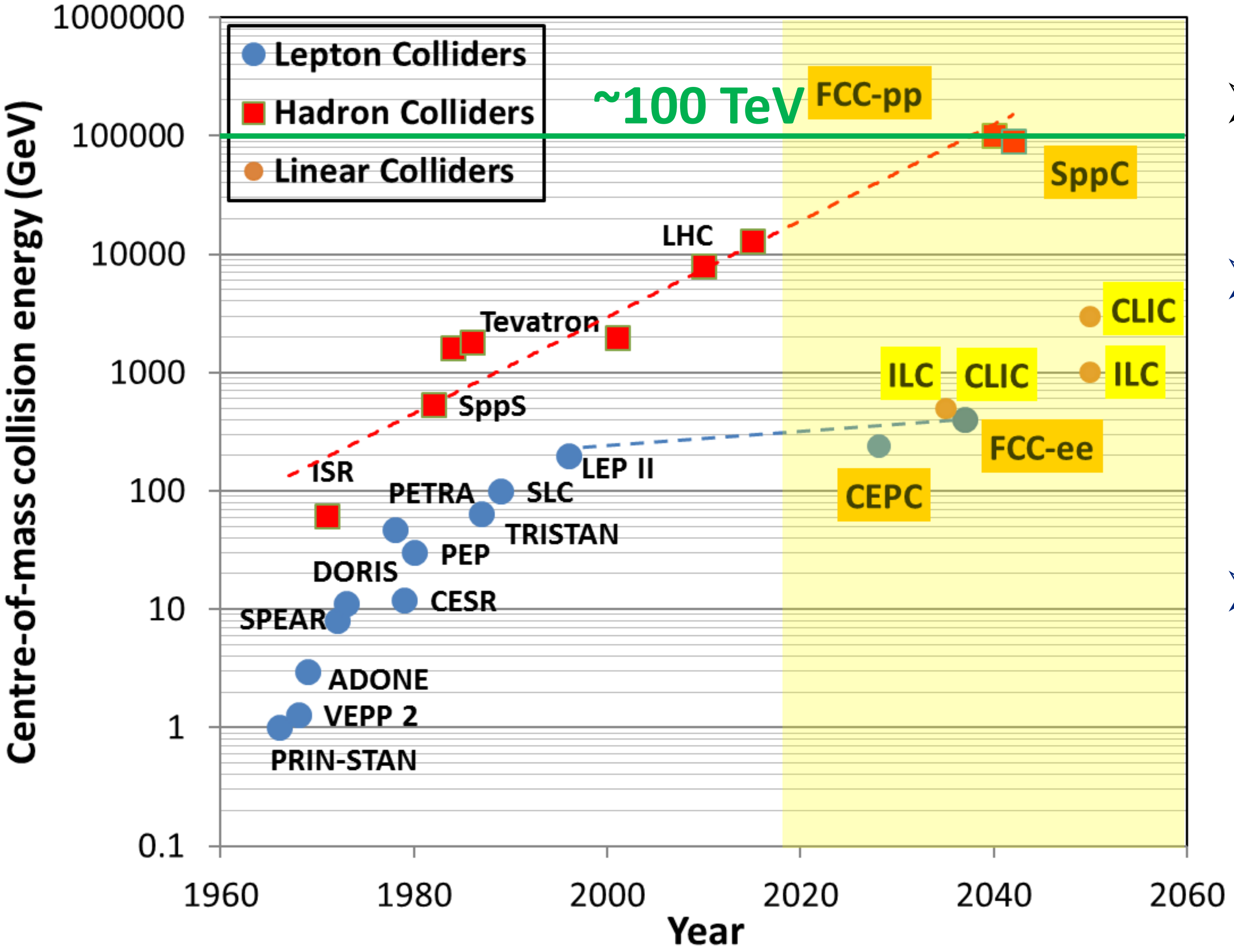
- **Higgs-boson**

Standard Model
Particles and forces



Colliders are powerful instruments in HEP for particle discoveries and precision measurements

High energy colliders under study



- **Linear e^+e^- colliders** (CLIC, ILC)
  E_{CM} up to ~ **3 TeV**
- **Circular e^+e^- colliders** (CepC, FCC-ee)
  E_{CM} up to ~ **400 GeV**
  limited by $e^{\pm}$ synchrotron radiation
  → **precision measurements**
- **Circular p-p colliders** (SppC, FCC-hh)
  E_{CM} up to ~ **100 TeV**
  energy (momentum) limited by **p = Bρ**
  → **direct discoveries at energy frontier**

ESPP Update, FCC Feasibility Study, June '20

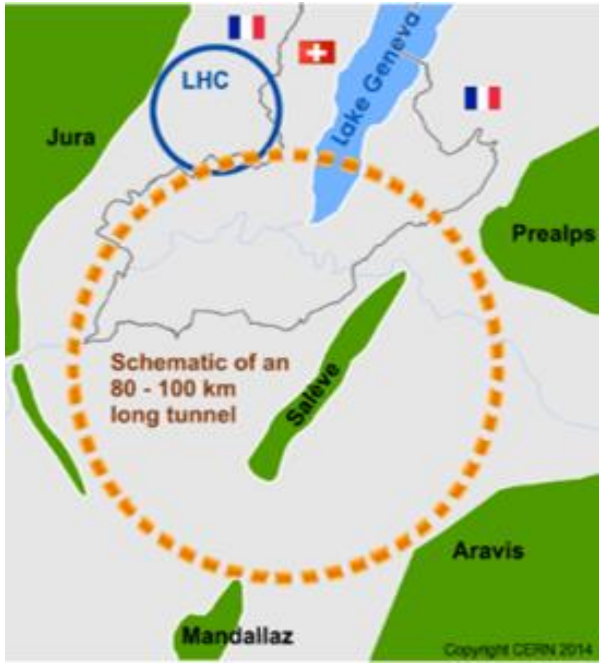
The FCC Feasibility Study (FS) will address a recommendation of the 2020 update of the European Strategy for Particle Physics (ESPP):

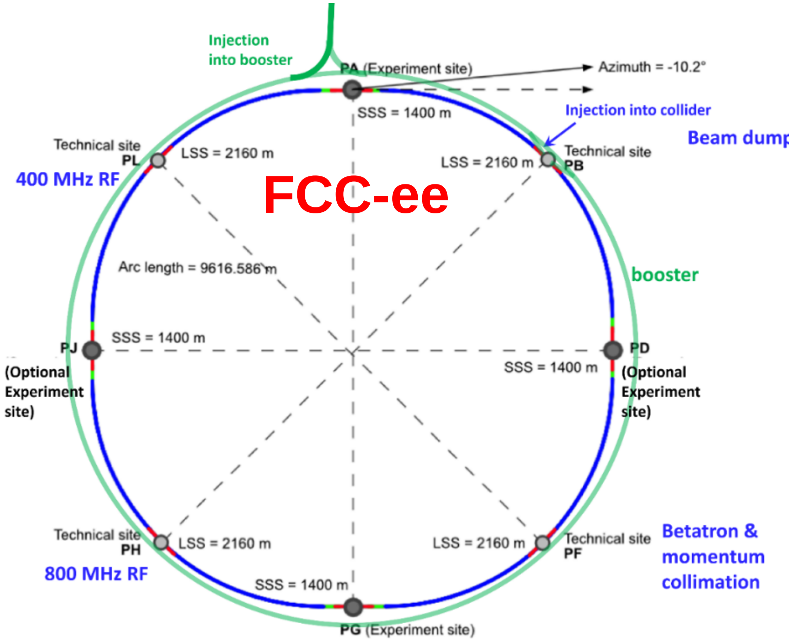
- An electron-positron Higgs factory is the highest-priority next collider. For the longer term, the European particle physics community has the ambition to operate a proton-proton collider at the highest achievable energy.
- "Europe, together with its international partners, should investigate the technical 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."

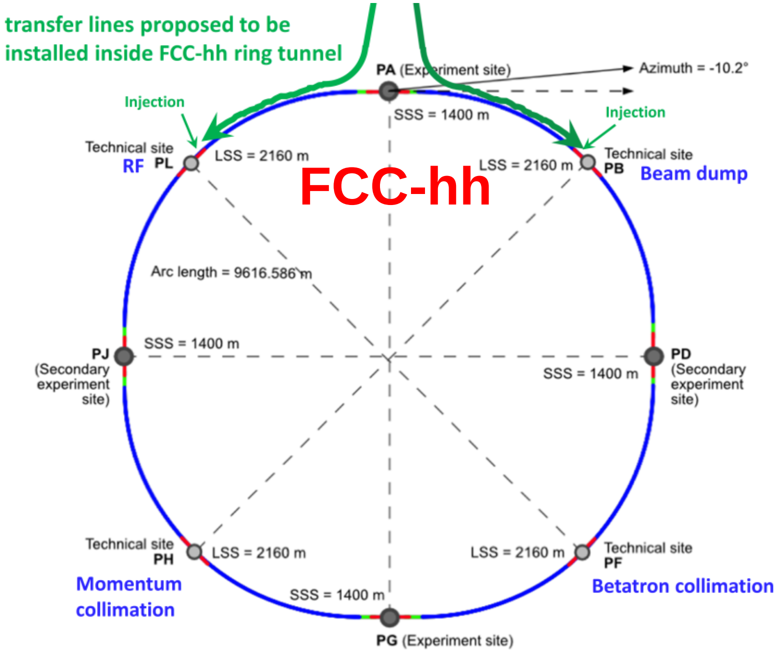
The FCC integrated program inspired by successful LEP – LHC programs at CERN

comprehensive long-term program maximizing physics opportunities

- **stage 1: FCC-ee (Z, W, H, $t\bar{t}$) as Higgs factory, electroweak & top factory at highest luminosities**
- **stage 2: FCC-hh (~100 TeV) as natural continuation at energy frontier, with ion and eh options**
- 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 completion of the HL-LHC program







2020 - 2040 | **2045 - 2060** | **2065 - 2090**

FCC integrated project technical schedule

1	2	3	4	5	6	7	8	9	10	11	………………..	19	20	~ 15 years operation	7 – 10 years	~ 25 years operation	70

Feasibility Study

EPPSU

Project preparation & administrative processes

Permis-sions

Update Permis sions

Funding strategy

Funding and in-kind contribution agreements

Funding and in-kind contribution agreements

Geological investigations, infrastructure detailed design and tendering preparation

Tunnel, site and technical infrastructure construction

FCC-ee dismantling, CE & infrastructure adaptations FCC-hh

FCC-ee accelerator R&D and technical design

FCC-ee accelerator construction, installation, commissioning

FCC-hh accelerator R&D and technical design

FCC-hh accelerator construction, installation, commissioning

Set up of international experiment collaborations, detector R&D and concept development

FCC-ee detector technical design

FCC-ee detector construction, installation, commissioning

FCC-hh detector R&D, technical design

FCC-hh detector construction, installation, commissioning

Superconducting wire and magnet R&D, short models

Long model magnets, prototypes, preseries

High-field magnet industrialization and series production

FUTURE CIRCULAR COLLIDER

FCC Feasibility Study (2021-2025): high-level objectives

- 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

F. Gianotti

FCC roadmap towards first e^+e^- collisions

Highest priority goals:

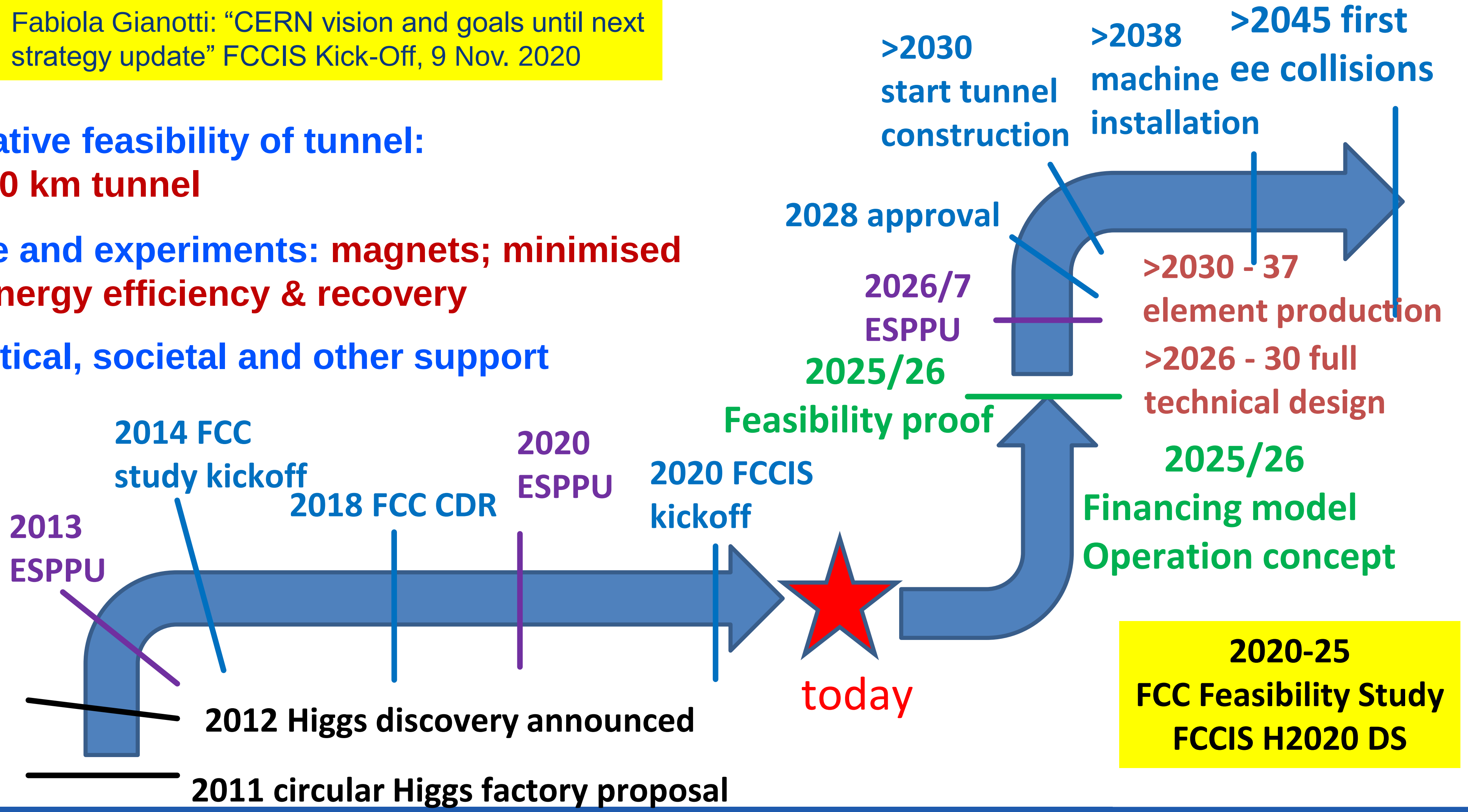
Fabiola Gianotti: “CERN vision and goals until next strategy update” FCCIS Kick-Off, 9 Nov. 2020

Financial feasibility

Technical and administrative feasibility of tunnel:
no show-stopper for ~100 km tunnel

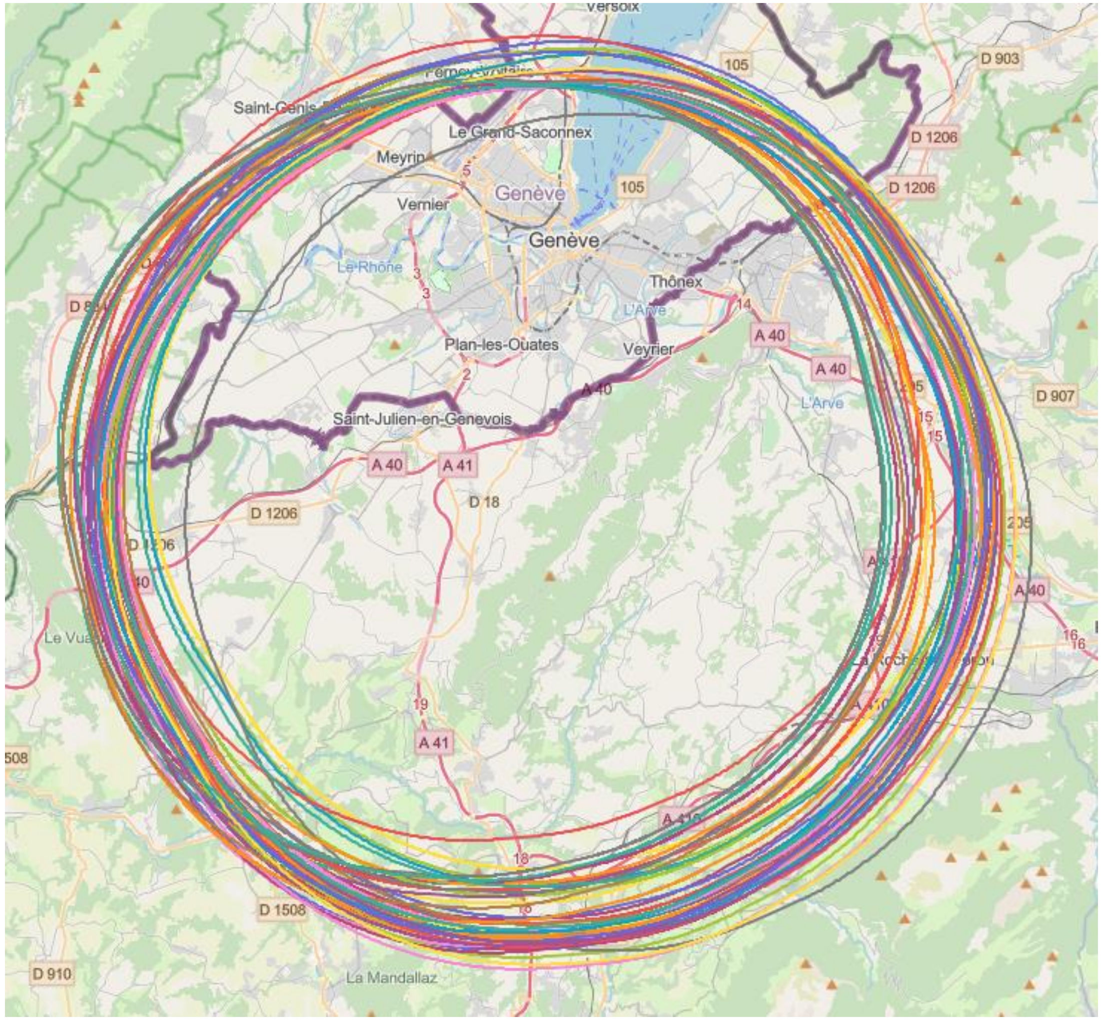
Technologies of machine and experiments: magnets; minimised environmental impact; energy efficiency & recovery

Gathering scientific, political, societal and other support



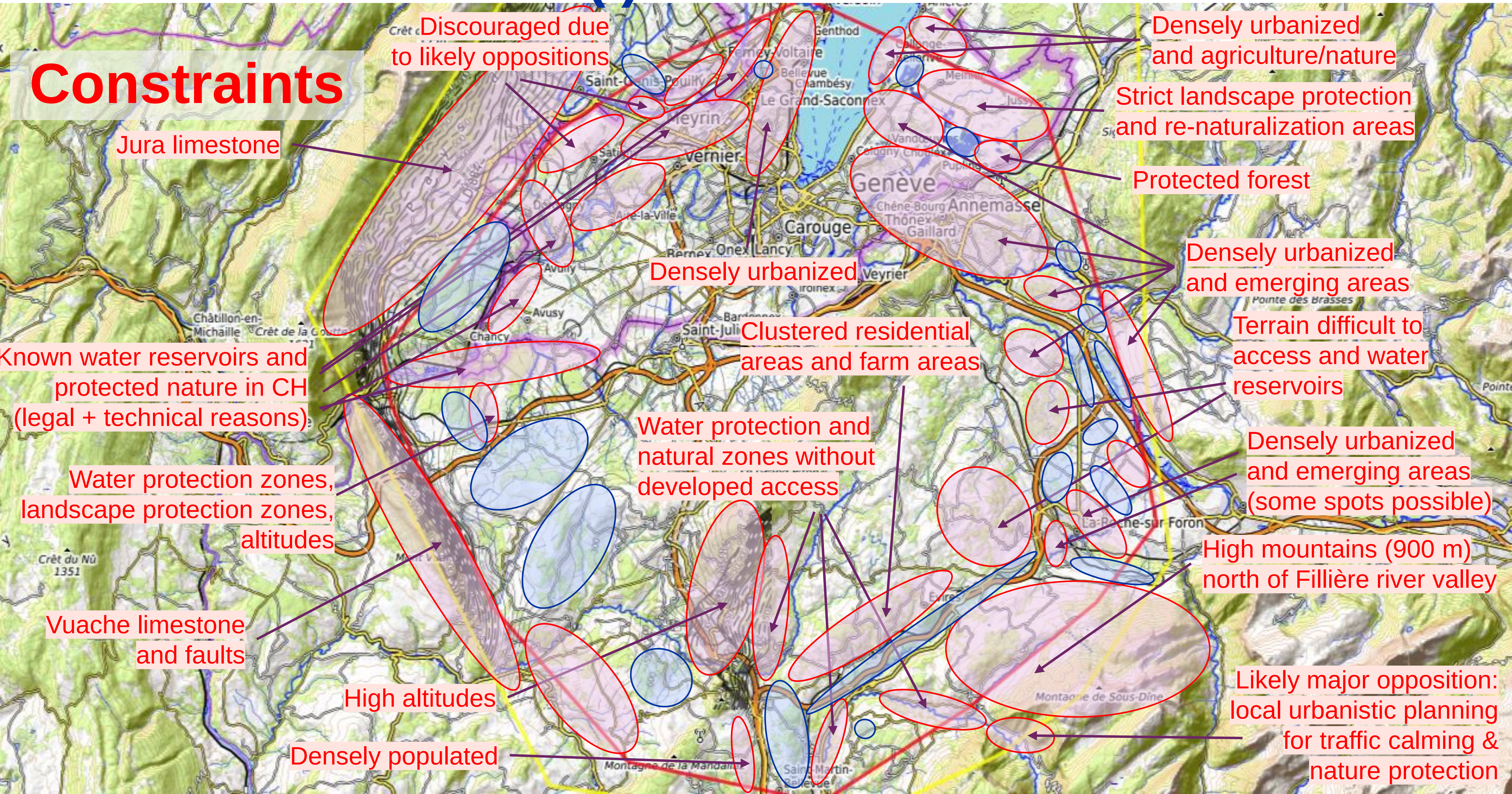
Implementation studies with host states

- layout & placement optimisation across both host states, Switzerland and France;
- following "avoid-reduce-compensate" directive of European & French regulatory frameworks;
- diverse requirements and constraints:
  - **technical feasibility of civil engineering** and subsurface geological constraints
  - **territorial constraints on surface** and subsurface
  - **nature, accessibility**, technical infrastructure, resource needs & constraints
  - **optimum machine performance and efficiency**
  - economic factors including benefits for, and synergies, with the **regional developments**
  - …
- collaborative effort: FCC technical experts, consulting companies, government-notified bodies



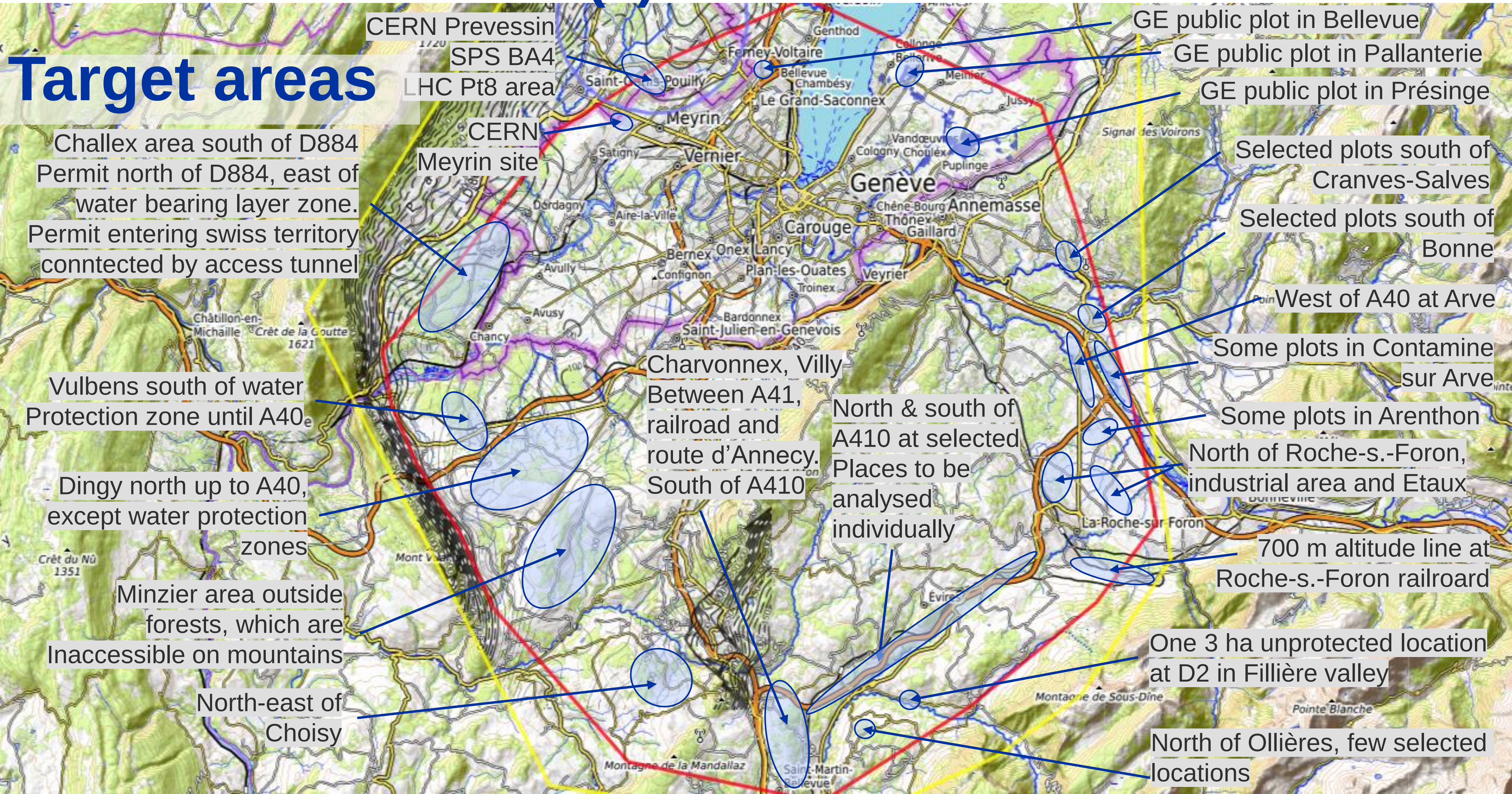
Placements studies (i)

J. Gutleber, V. Mertens



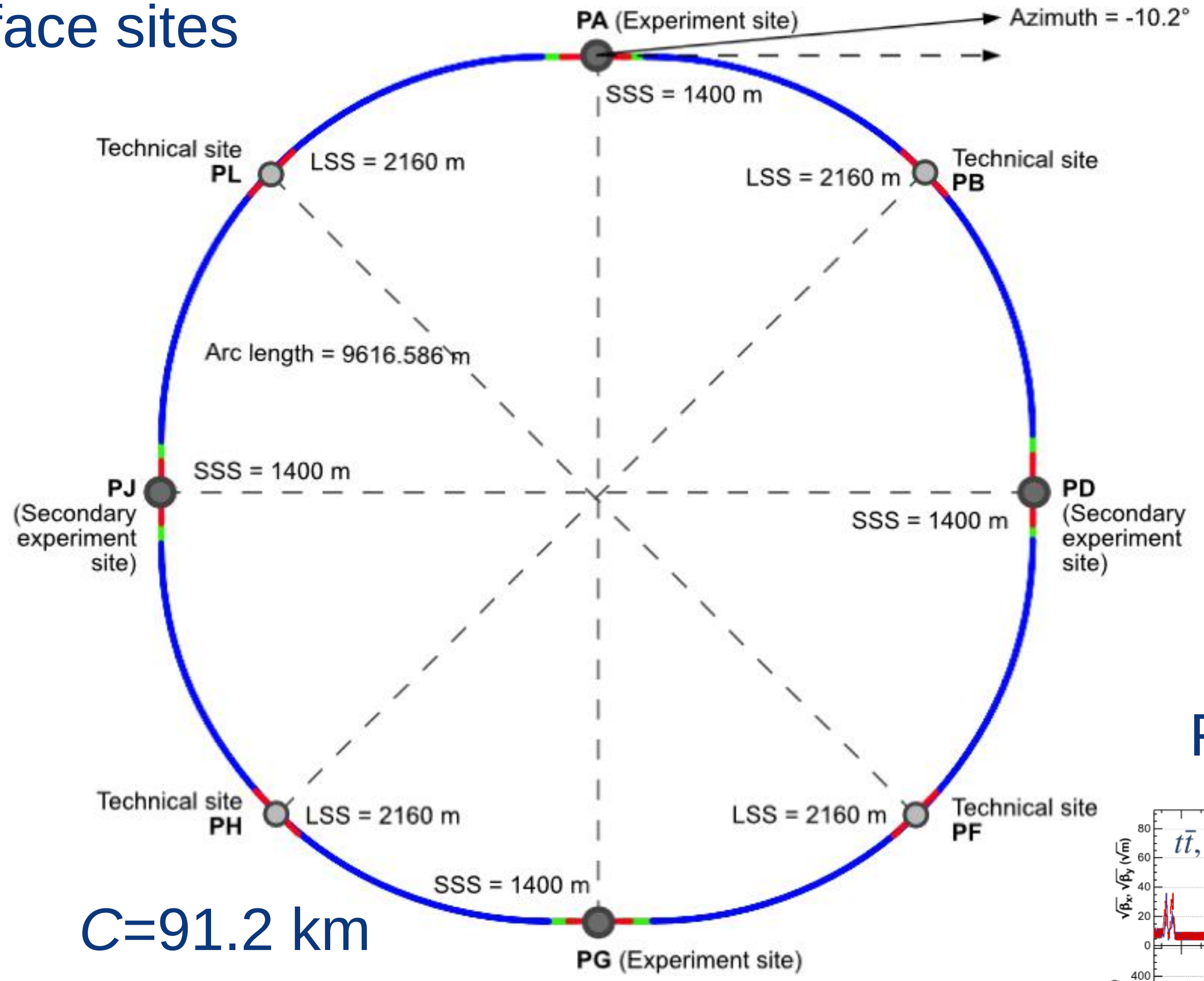
Placements studies (ii)

J. Gutleber, V. Mertens



new “lowest risk” placement/optics allows 4 exp’s

8 surface sites

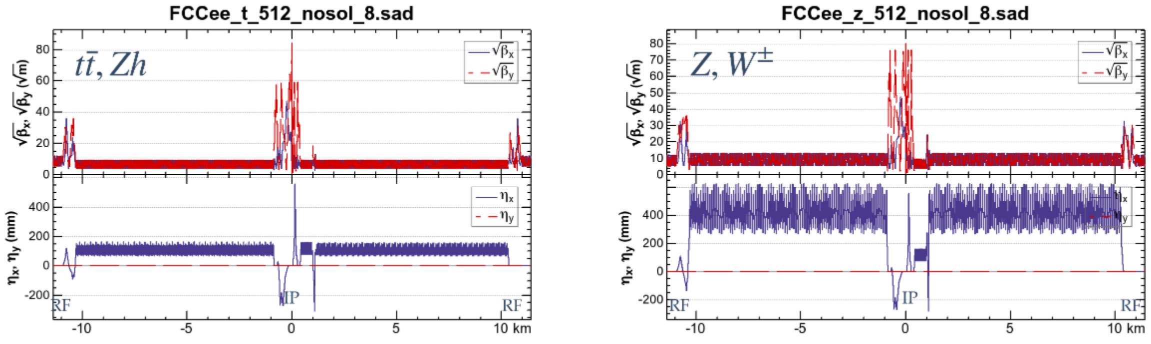


C=91.2 km

4-fold symmetry
and
4-fold superperiodicity

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

FCC-ee beam optics for ¼ ring K. Oide

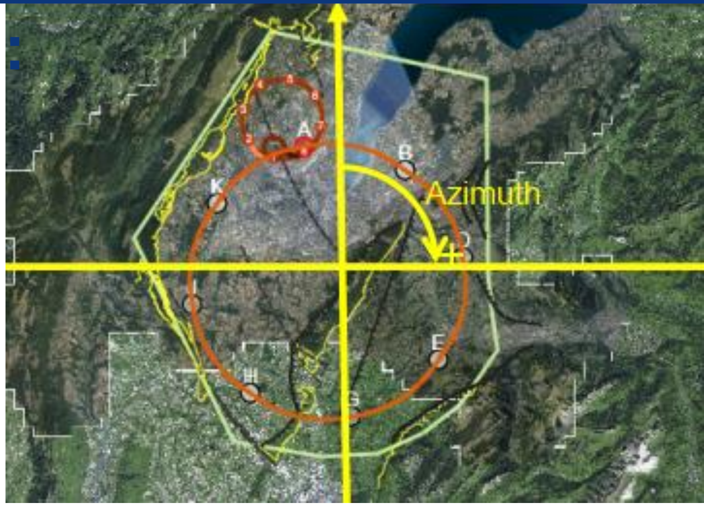


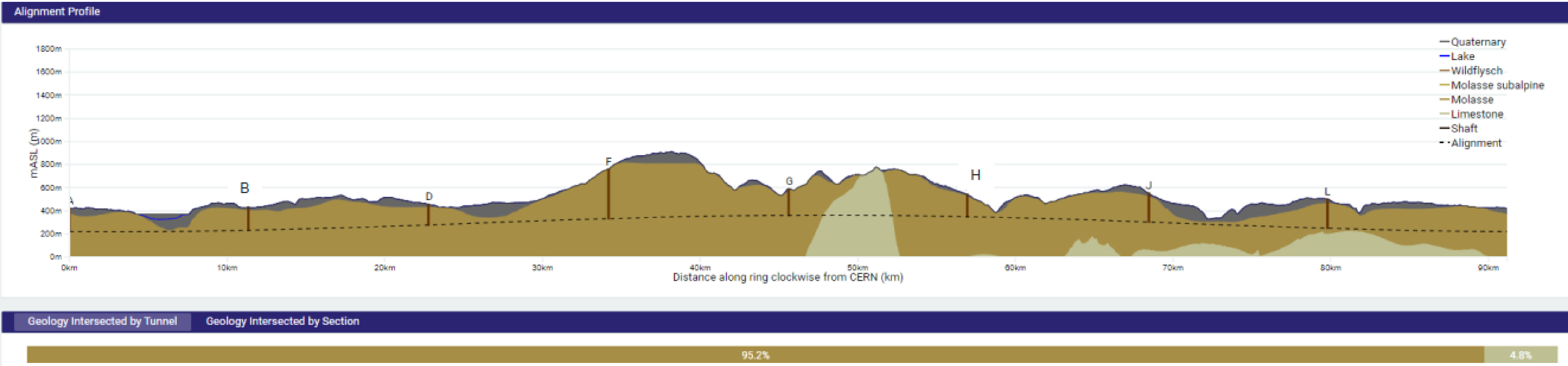
FCC implementation - footprint baseline

Present implementation variant was established considering:

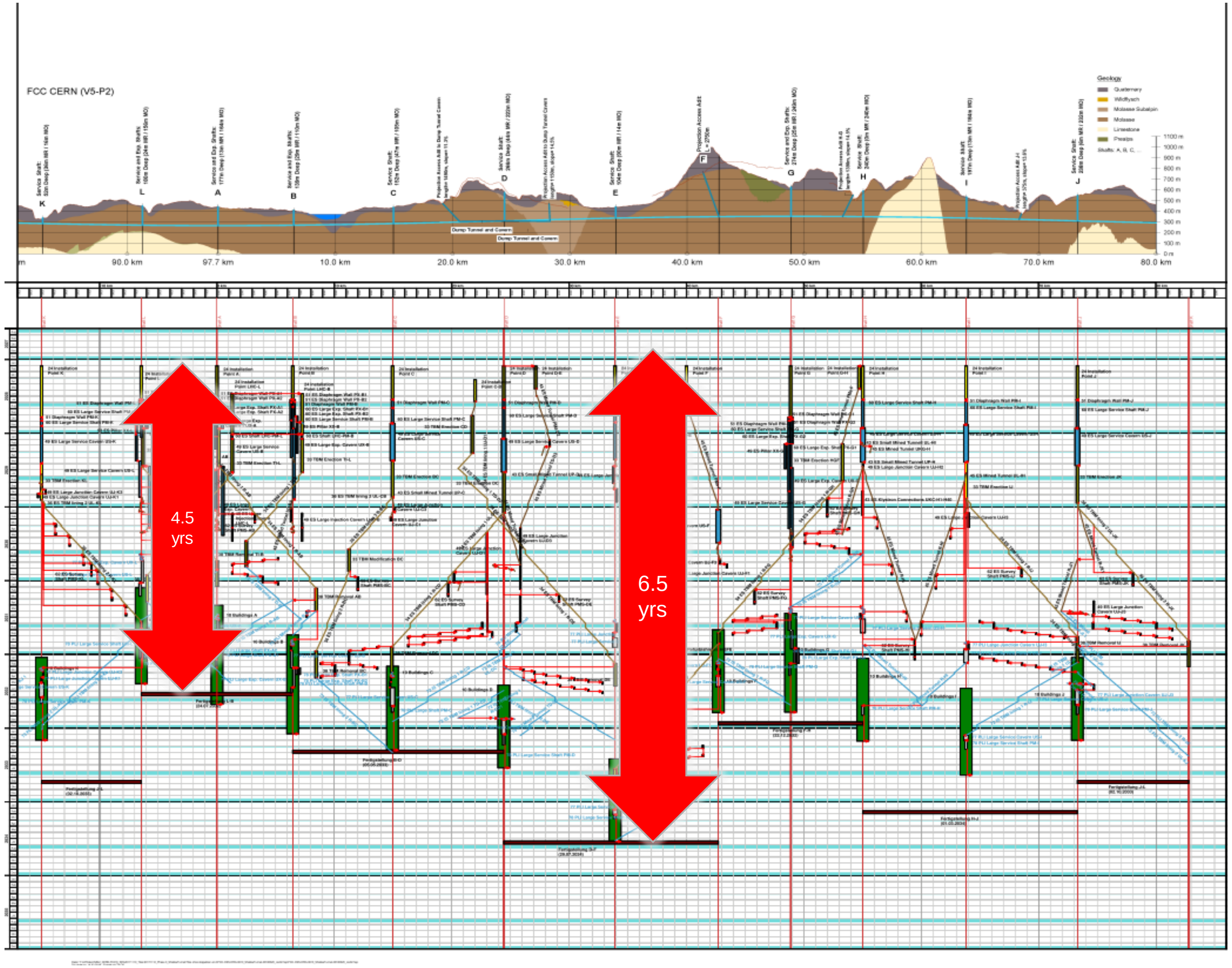
- Geological 3D model and tunnelling risks
- Territorial aspects from previous studies, also with Host States
- No site visits, no interactions with land owners have taken place yet

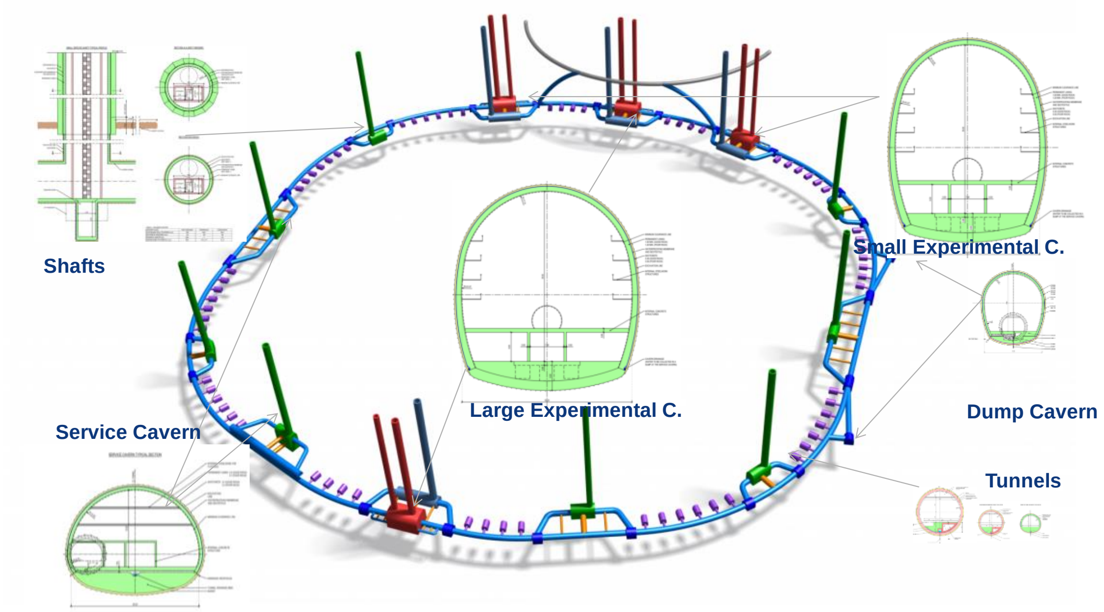
- **91.2 km circumference**
- **95% in molasse geology for minimising tunnel construction risks**
- **8 surface sites with ~5 ha area each.**





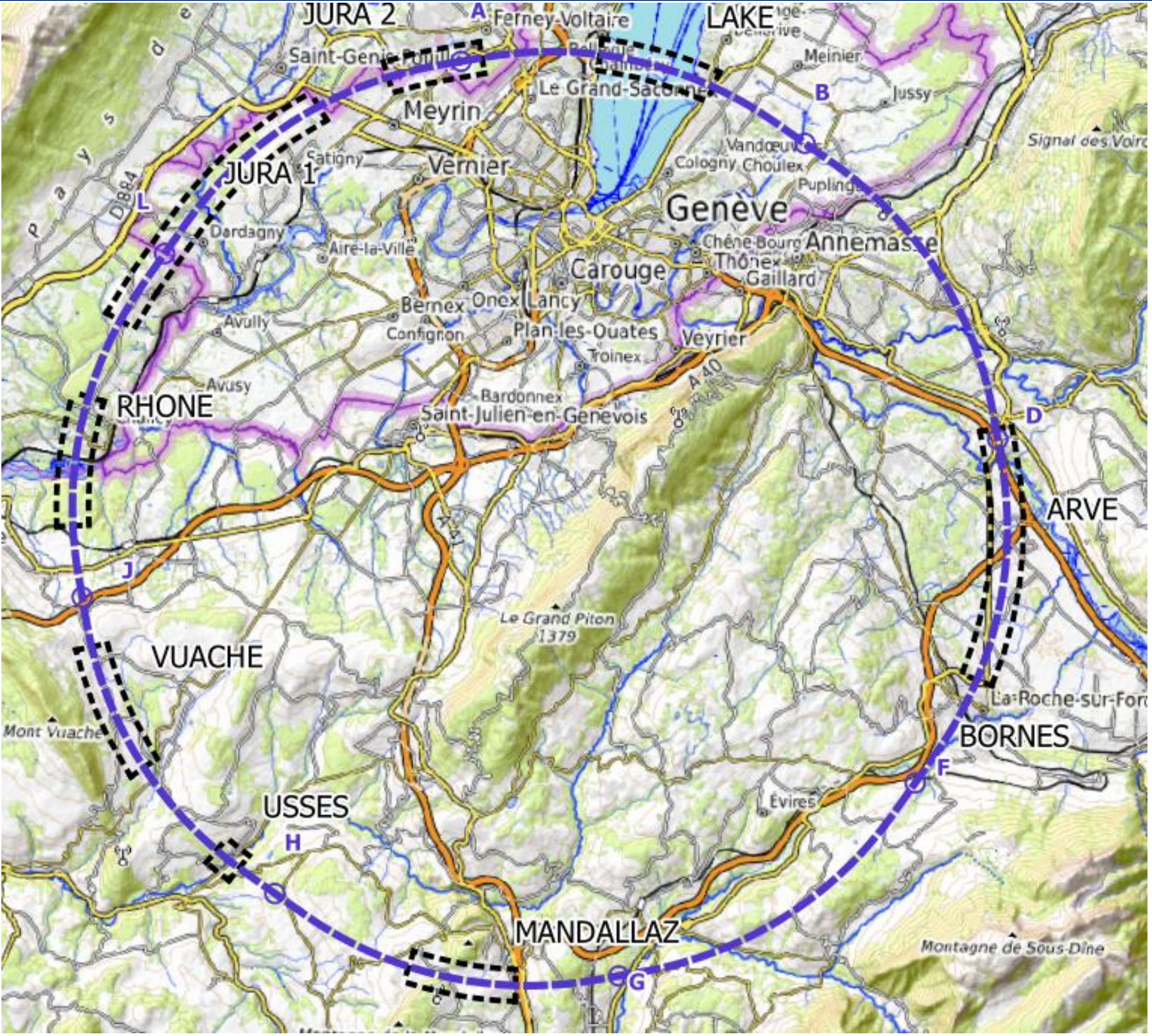
Civil engineering studies





- **Total construction duration 7 years**
- **First sectors ready after 4.5 years for start of technical infrastructure installation**

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

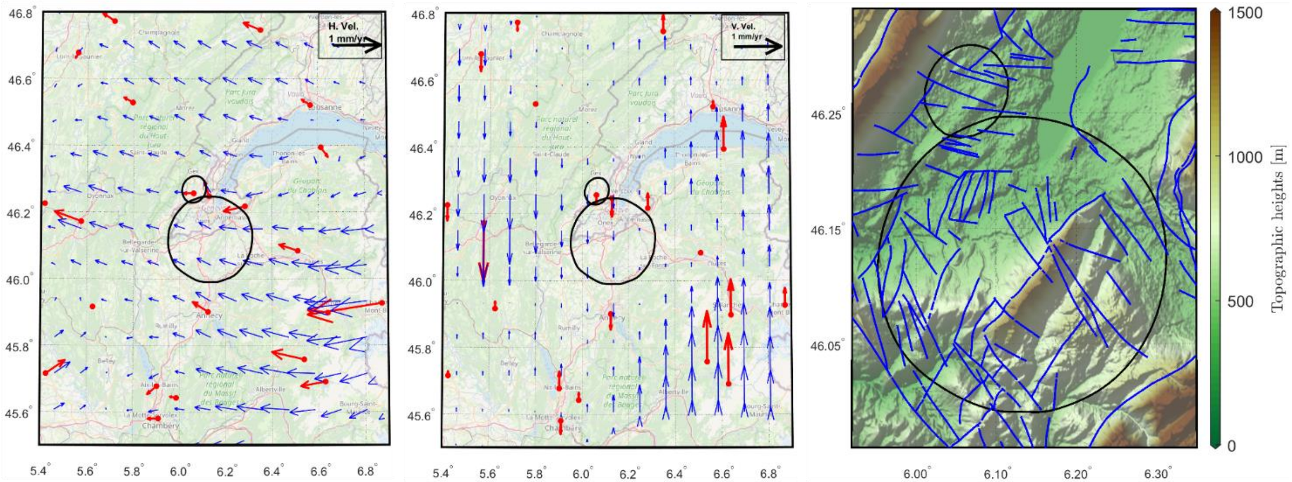
Geodesy Surface Reference Network

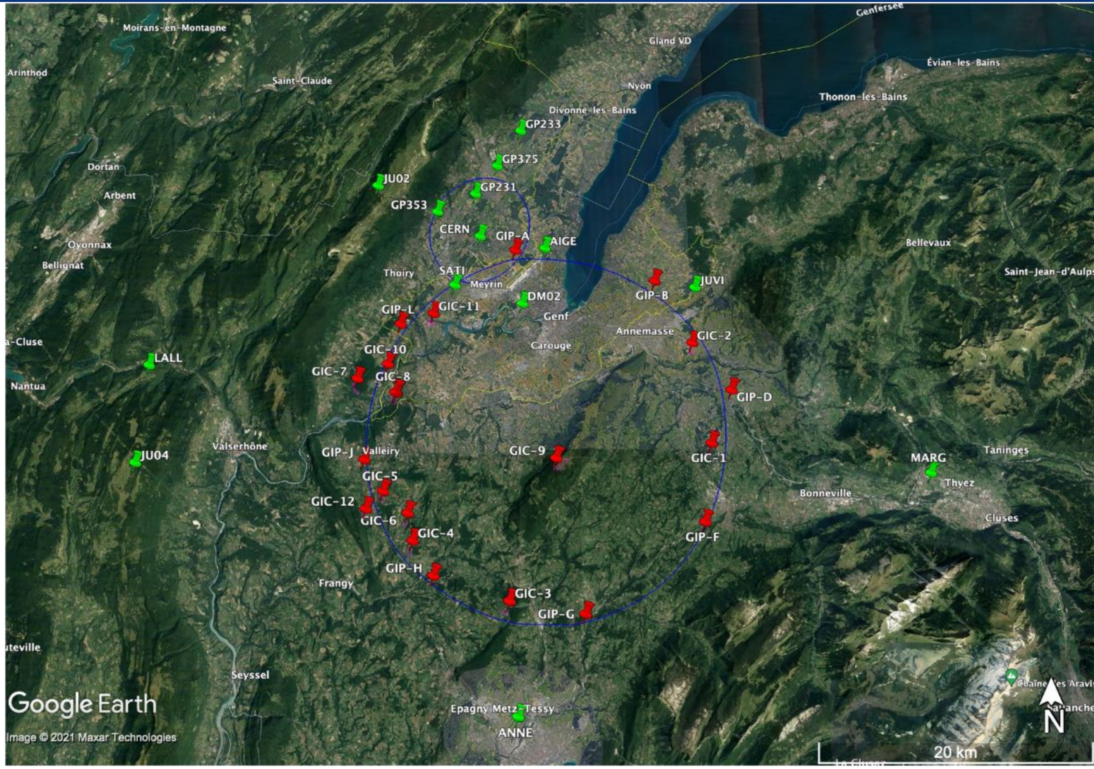
Surface geodetic network needs to be spatially extended

- Realization of a coordinate reference frame (CTRF) for georeferencing of site investigation data and as basis for all geospatial works using global navigation satellite system (GNSS) and surveying instruments
- GNSS-based monitoring of the geokinematic surface deformations (assure stable main geodetic points, quantify differential displacements which may affect later alignment)

EUREF surface velocity field
(differential displacements)

Faults
(potential discontinuities of displacements)





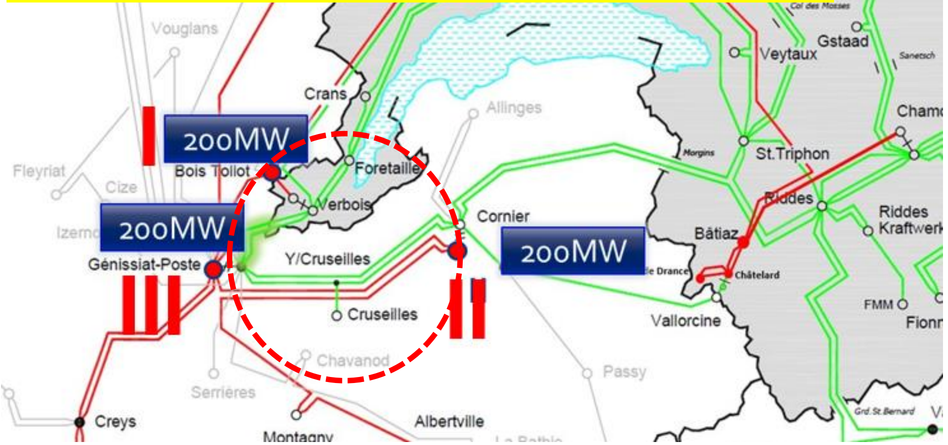
CTRF uses existing surface points and
8 pillars in vicinity of access shafts, 1 point near centroid

Geomonitoring requires early on
11 network points near faults and tunnel

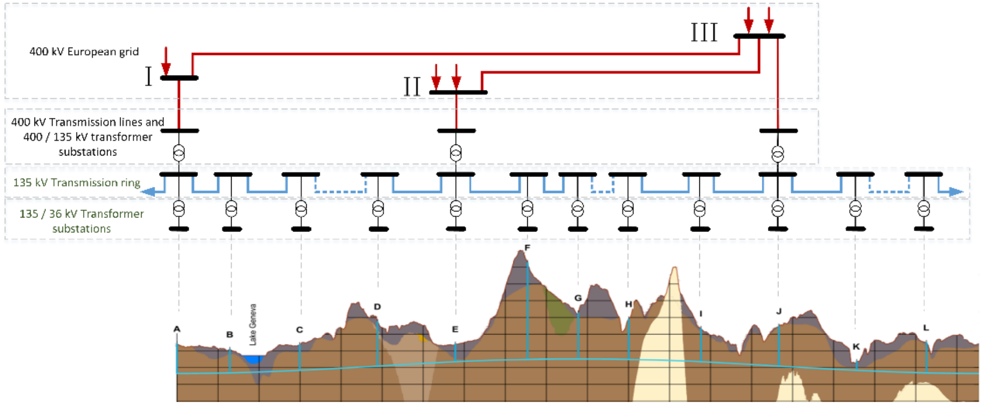
CHART collaboration with ETH Zuerich

supply & distribution of electrical energy

additional 200 MW available for FCC at each of the three 400 kV sources

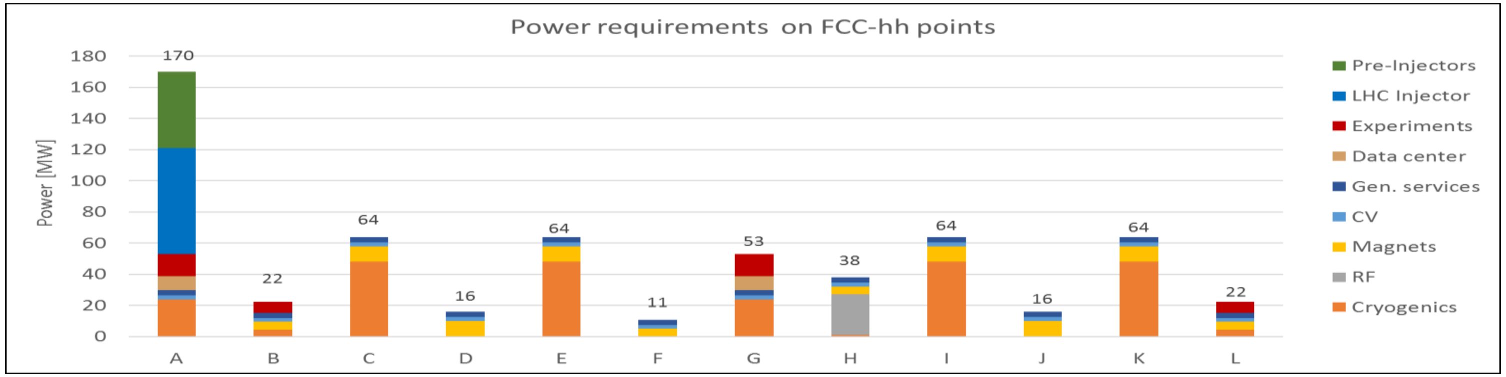


---- 400 kV ---- 230 kV

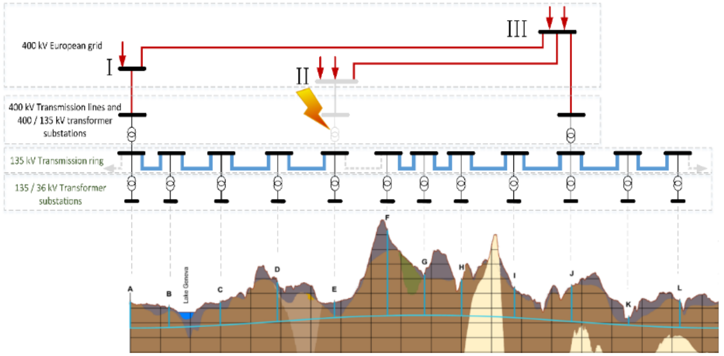


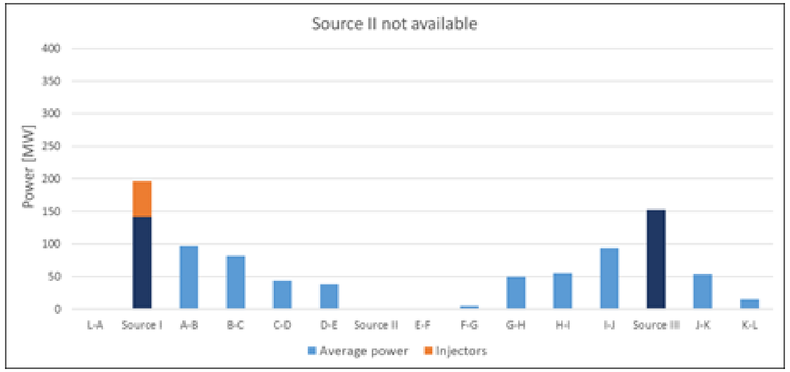
3 x 400 kV connections
+ 135 kV underground power distribution (NC)

per-point power requirements as input for infrastructure-optimized conceptual design (peak FCC-ee: 260-340 MW, total FCC-hh: 550 MW)



If one power source goes down fall back to “degraded mode“: FCC remains cold, vacuum preserved, controls on, RF off, no beam (“standby”); all FCC points supplied from 2 other 400 kV points, through the power transmission line





FCC-ee basic design choices

Double ring e+ e- collider

Common footprint with FCC-hh,

Asymmetric IR layout and optics to limit synchrotron radiation towards the detector

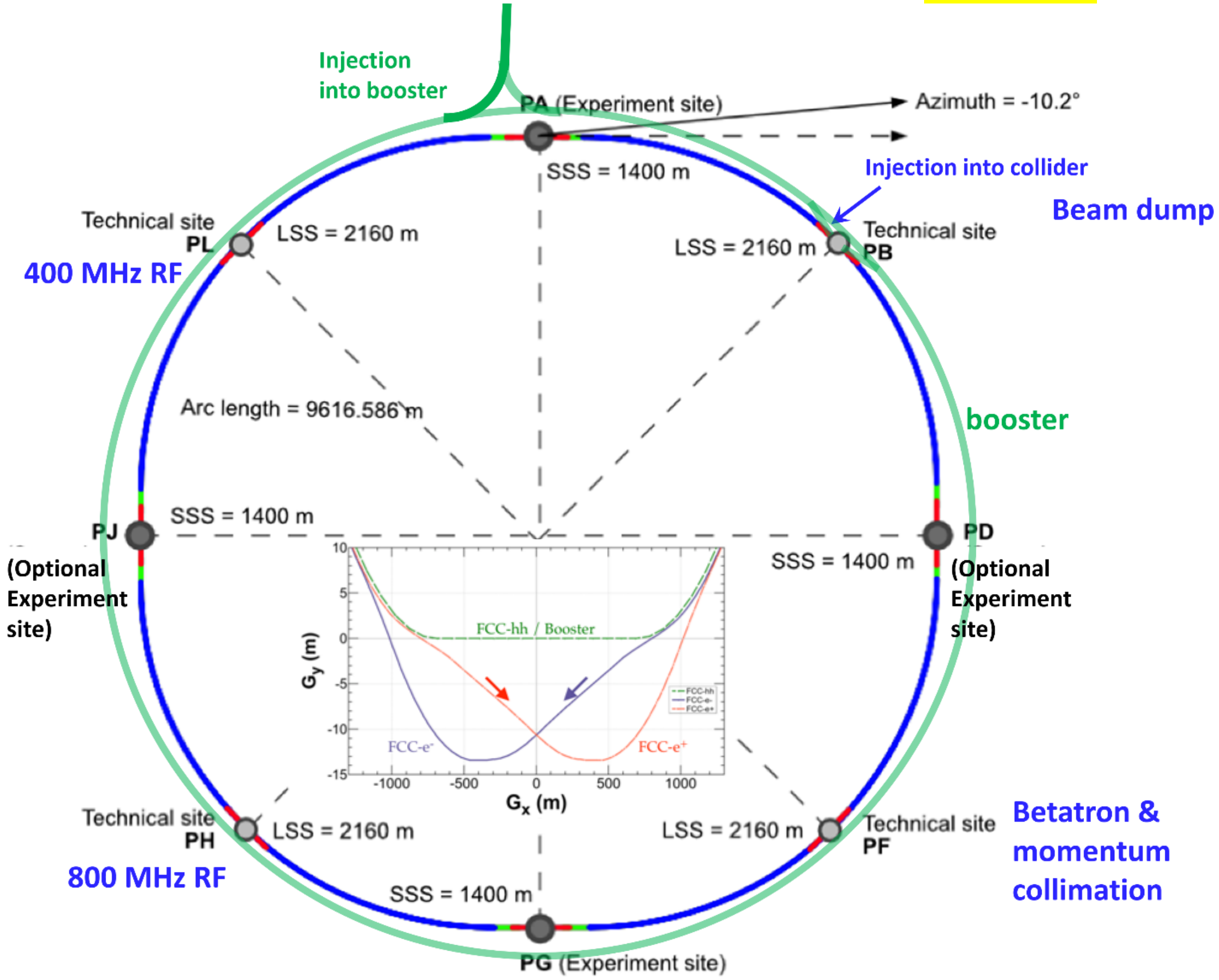
Perfect 4-fold superperiodicity allowing 2 or 4 IPs; large horizontal crossing angle **30 mrad, crab-waist collision optics**

Synchrotron radiation power 50 MW/beam at all beam energies. Energy loss ΔE per turn:

$$\Delta E \sim \gamma^4/r = (E/m_0)^4/r$$

Top-up injection scheme for high luminosity
Requires **booster synchrotron in collider tunnel**

K. Oide,



Stage 1: FCC-ee collider parameters

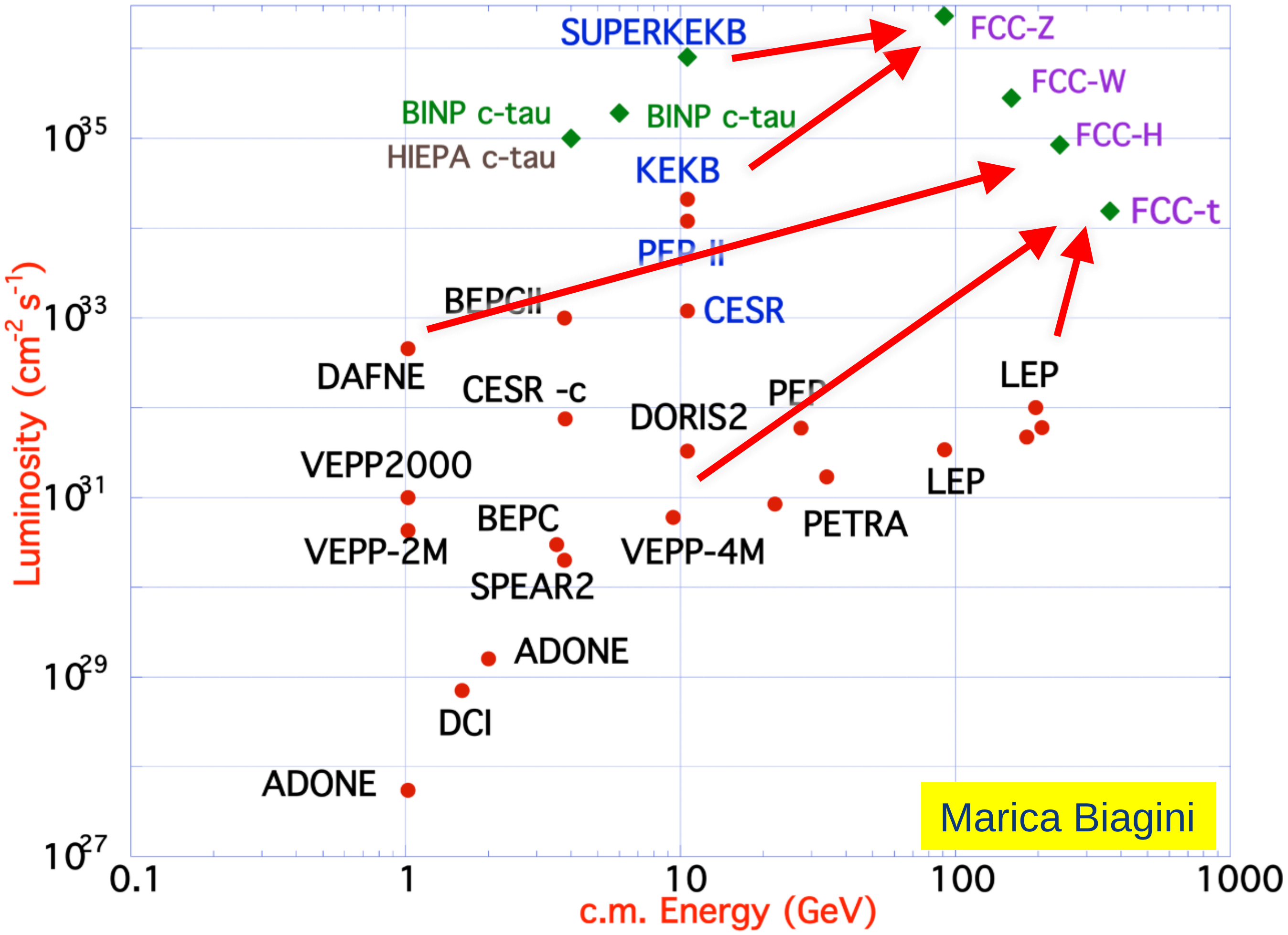
FUTURE CIRCULAR COLLIDER

K. Oide, D. Shatilov,

Parameter [baseline 2 IPs, 91.2 km, T_{rev}=0.3 ms]	Z	WW	H (ZH)	ttbar
beam energy [GeV]	45	80	120	182.5
beam current [mA]	1280	135	26.7	5.0
number bunches/beam	12000	880	272	40
bunch intensity [10^{11}]	2.02	2.91	1.86	2.37
SR energy loss / turn [GeV]	0.0391	0.37	1.869	10.0
total RF voltage 400/800 MHz [GV]	0.120/0	1.0/0	2.48/0	4.0/7.67
long. damping time [turns]	1170	216	64.5	18.5
horizontal beta* [m]	0.1	0.2	0.3	1
vertical beta* [mm]	0.8	1	1	1.6
horizontal geometric emittance [nm]	0.71	2.17	0.64	1.49
vertical geom. emittance [pm]	1.42	4.32	1.29	2.98
horizontal rms IP spot size [μm]	8	21	14	39
vertical rms IP spot size [nm]	34	66	36	69
beam-beam parameter ξ_x / ξ_y	0.003/ .159	0.011/0.111	0.0187/0.129	0.096/0.138
rms bunch length with SR / BS [mm]	4.38 / 12.1	3.55 / 7.06	3.34 / 5.12	2.02 / 2.56
luminosity per IP [10^{34} $cm^{-2}s^{-1}$]	193	22	7.7	1.31
total integrated luminosity / year [ab^{-1}/yr]	46	5.3	1.9	0.33
beam lifetime rad Bhabha / BS [min]	35	32	9	16

FCC-ee design concept

based on lessons and techniques from past colliders (last 40 years)



B-factories: KEKB & PEP-II:
- double-ring lepton colliders,
- high beam currents,
- top-up injection

DAFNE: crab waist, double ring

S-KEKB: low β_y*, crab waist

LEP: high energy, SR effects

VEPP-4M, LEP: precision E calibration

KEKB: e^+ source

HERA, LEP, RHIC: spin gymnastics

combining successful ingredients of several recent colliders → highest luminosities & energies

FCC-ee physics program staging

working point	luminosity/IP $[10^{34}\ cm^{-2}s^{-1}]$	total luminosity (2 IPs)/ yr	physics goal	run time [years]
***Z* first 2 years**	100 (50% nominal)	26 ab^{-1}/year	**150 ab^{-1}**	**4**
***Z* later**	200	48 ab^{-1}/year		
W	25	6 ab^{-1}/year	**10 ab^{-1}**	**2**
H	7.0	1.7 ab^{-1}/year	**5 ab^{-1}**	**3**
machine modification for RF installation & rearrangement: **1 year**				
top 1st year (350 GeV)	0.8 (50% nominal)	0.2 ab^{-1}/year	**0.2 ab^{-1}**	**1**
top later (365 GeV)	1.4	0.34 ab^{-1}/year	**1.5 ab^{-1}**	**4**

total program duration: 15 years - ***including machine modifications***

phase 1 (*Z, W, H*): 9 years, phase 2 (top): 6 years

FCC-ee RF staging scenario

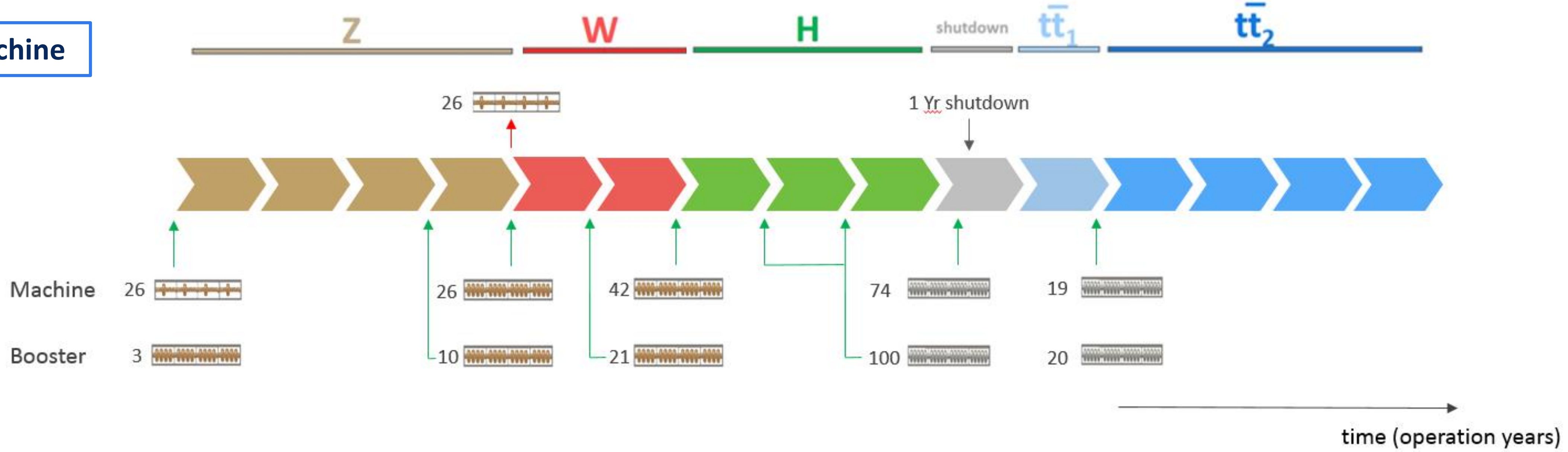
“Ampere-class” machine

WP	V_{rf} [GV]	#bunches	I_{beam} [mA]
Z	0.1	16640	1390
W	0.44	2000	147
H	2.0	393	29
ttbar	10.9	48	5.4

“high-gradient” machine

three sets of RF cavities to cover all options for FCC-ee & booster:

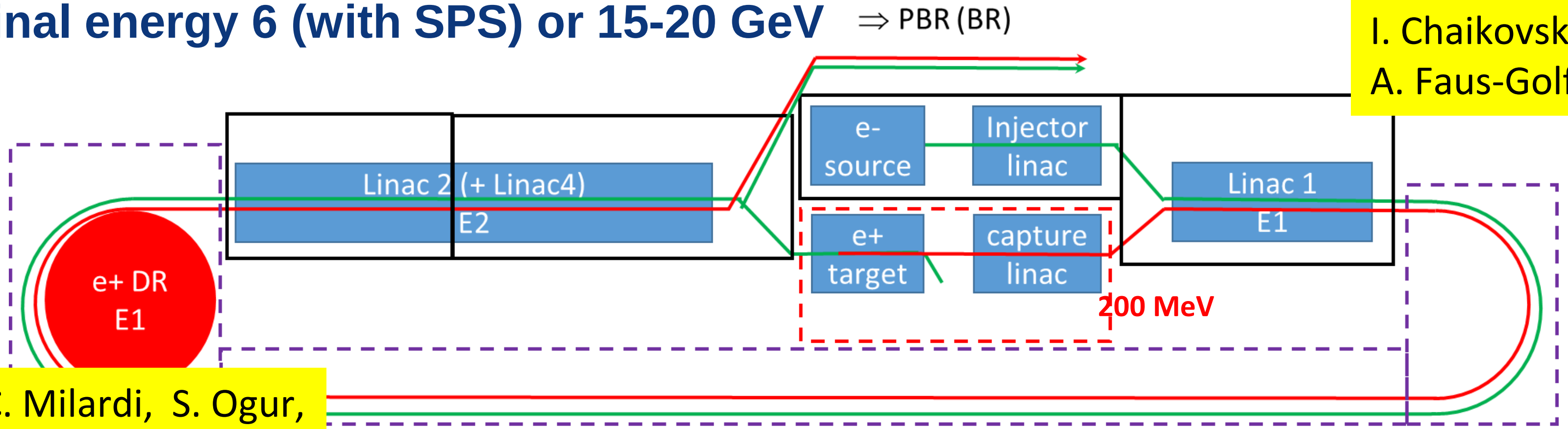
- **high intensity (Z, FCC-hh): 400 MHz mono-cell cavities (4/cryom.)**
- **higher energy (W, H, t): 400 MHz four-cell cavities (4/cryomodule)**
- **ttbar machine complement: 800 MHz five-cell cavities (4/cryom.)**
- **installation sequence comparable to LEP (≈ 30 CM/shutdown)**



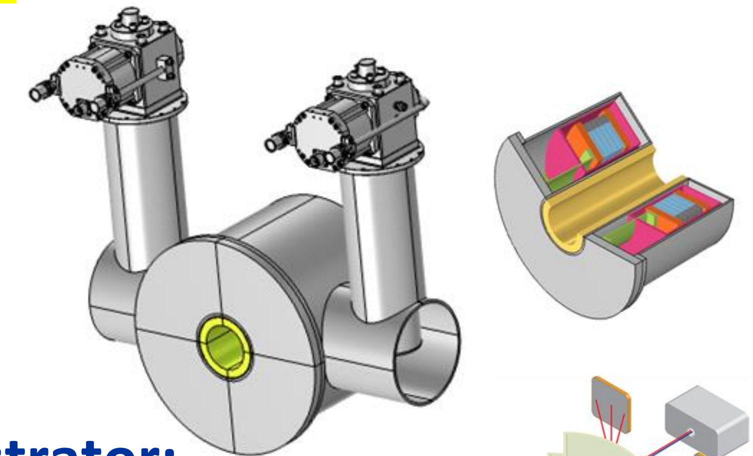
FCC-ee pre-injector complex

final energy 6 (with SPS) or 15-20 GeV

I. Chaikovska, B. Bai, A. Faus-Golfe et al.

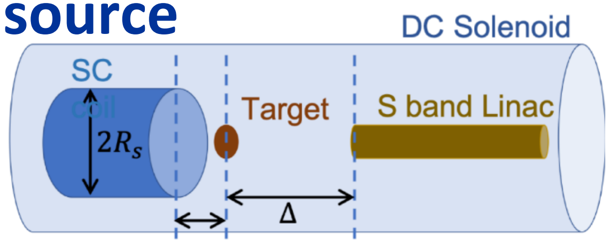


C. Milardi, S. Ogur, O. Etisken



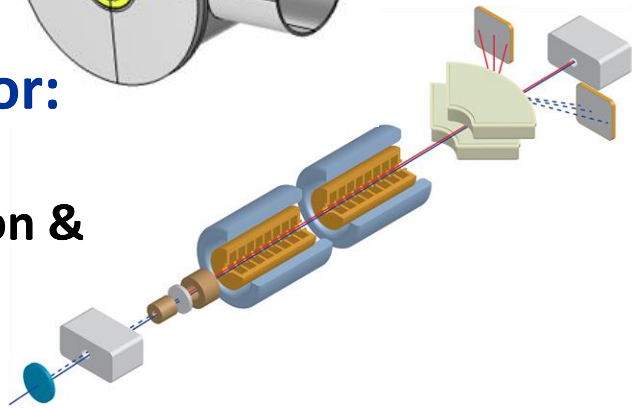
high-yield positron source

target with SC solenoid
Or flux concentrator

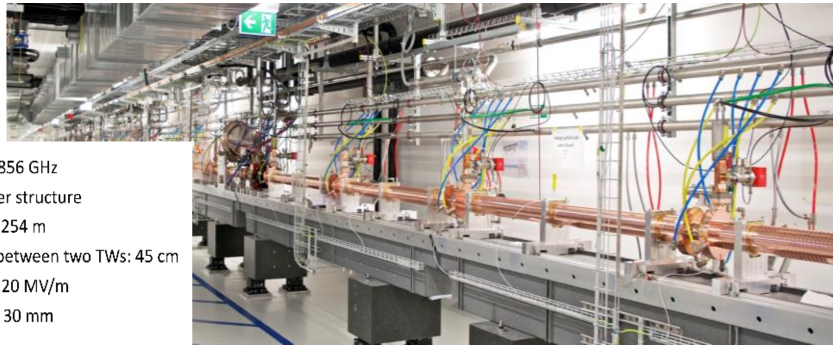


FCC-ee demonstrator:

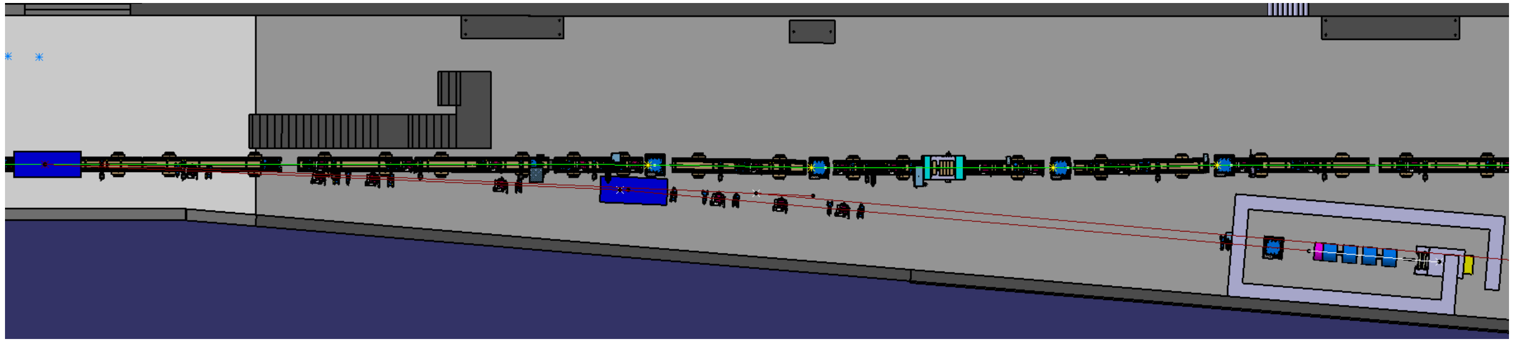
e^+ source at SwissFEL in 2025 for e^-/e^+ conversion & capture efficiency



SwissFEL 6 GeV C-band linac

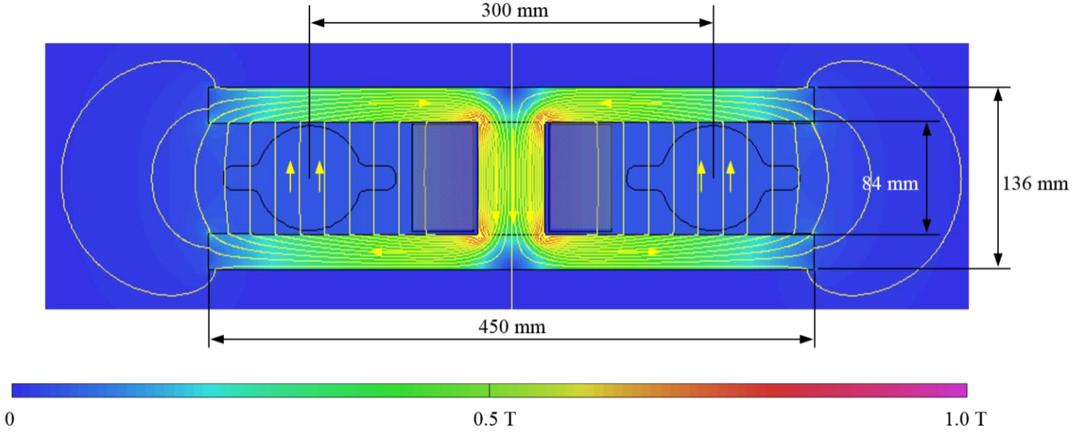


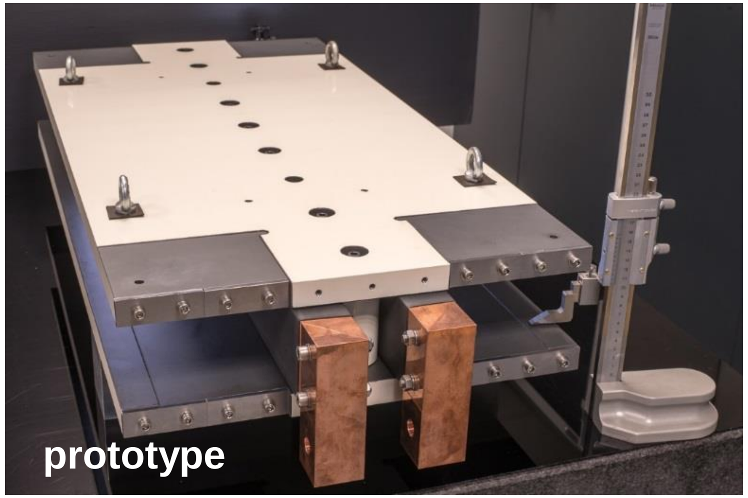
- Freq : 2.856 GHz
- 90 cells per structure
- Length: 3.254 m
- Distance between two TWs: 45 cm
- Gradient: 20 MV/m
- Aperture: 30 mm

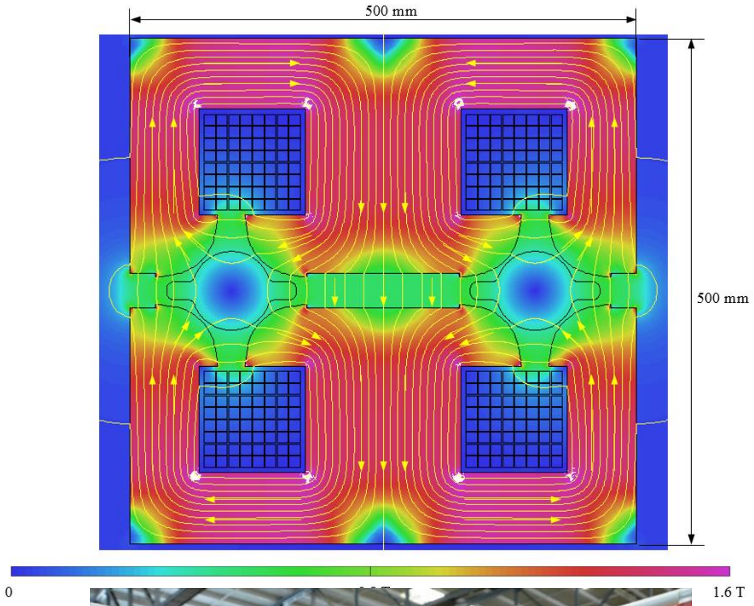


Prototypes of FCC-ee low-power magnets

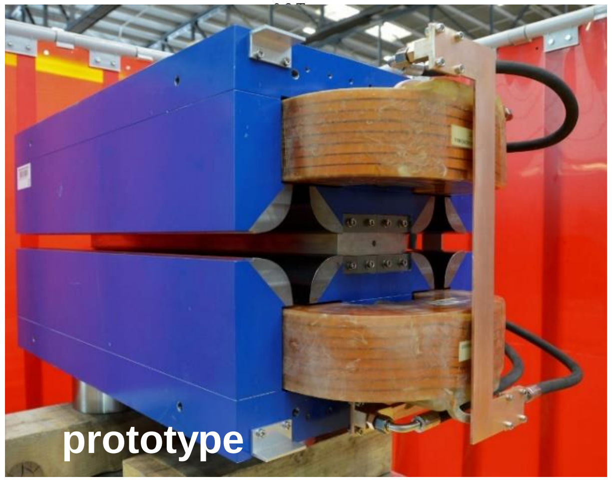
Twin-dipole design with 2× power saving
16 MW (at 175 GeV), with Al busbars





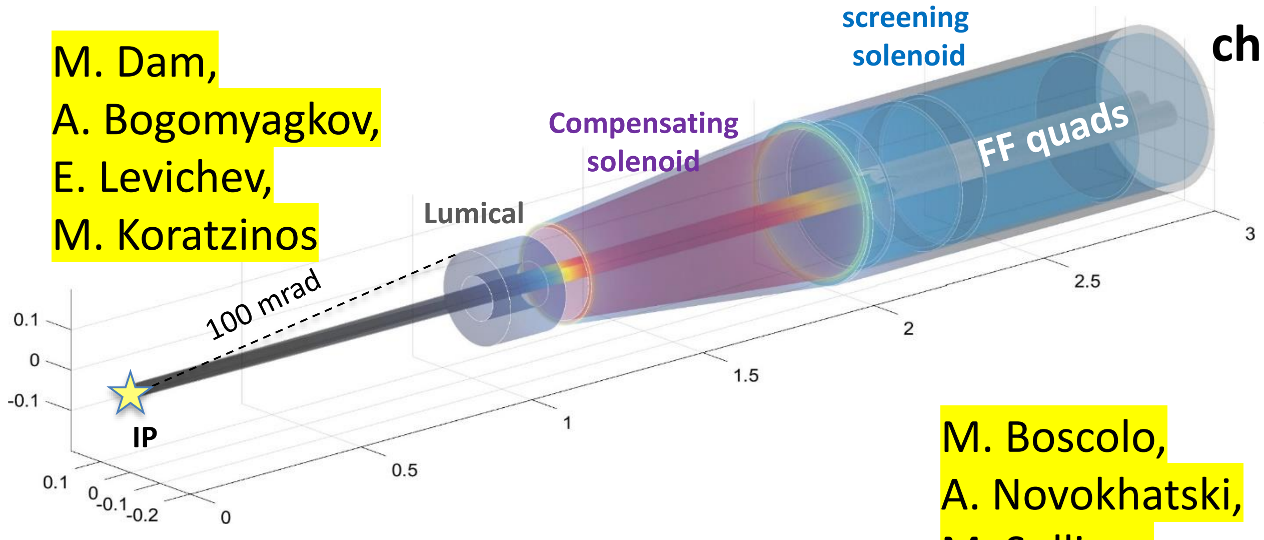


Twin F/D arc quad design with 2× power saving 25 MW (at 175 GeV), with Cu conductor



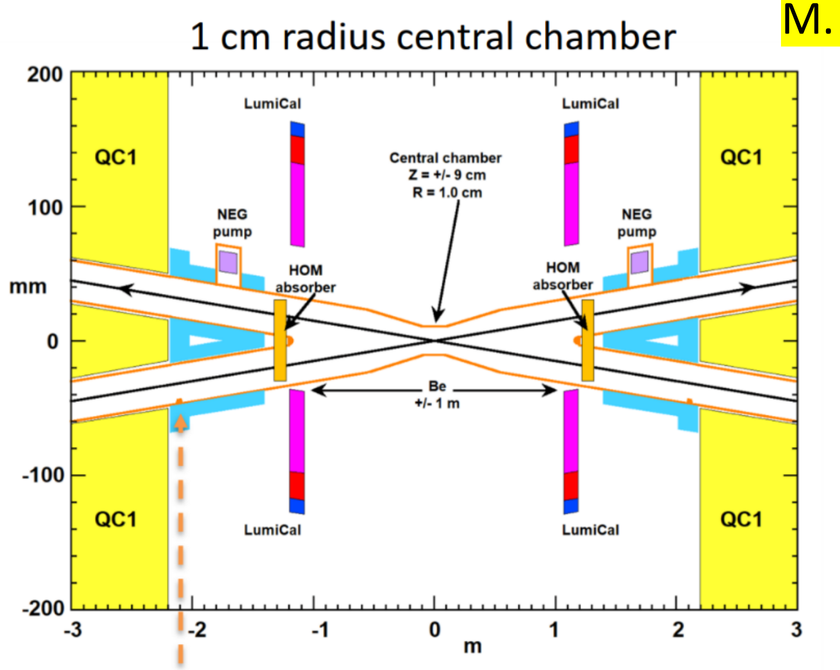
FCC-ee Machine Detector Interface

M. Dam,
A. Bogomyagkov,
E. Levichev,
M. Koratzinos



challenging integration:
2 T detector solenoid,
luminosity monitor
(Bhabha scattering),
compensation &
shielding solenoids

M. Boscolo,
A. Novokhatski,
M. Sullivan



narrow central chamber with 1 cm radius, also avoids trapped modes

prototype Q1
canted cosine theta with fringe field correction, using LHC SC cable

field measurement at warm

M. Koratzinos

FCC stage 1: infrastructure and FCC-ee project cost estimate and spending profile

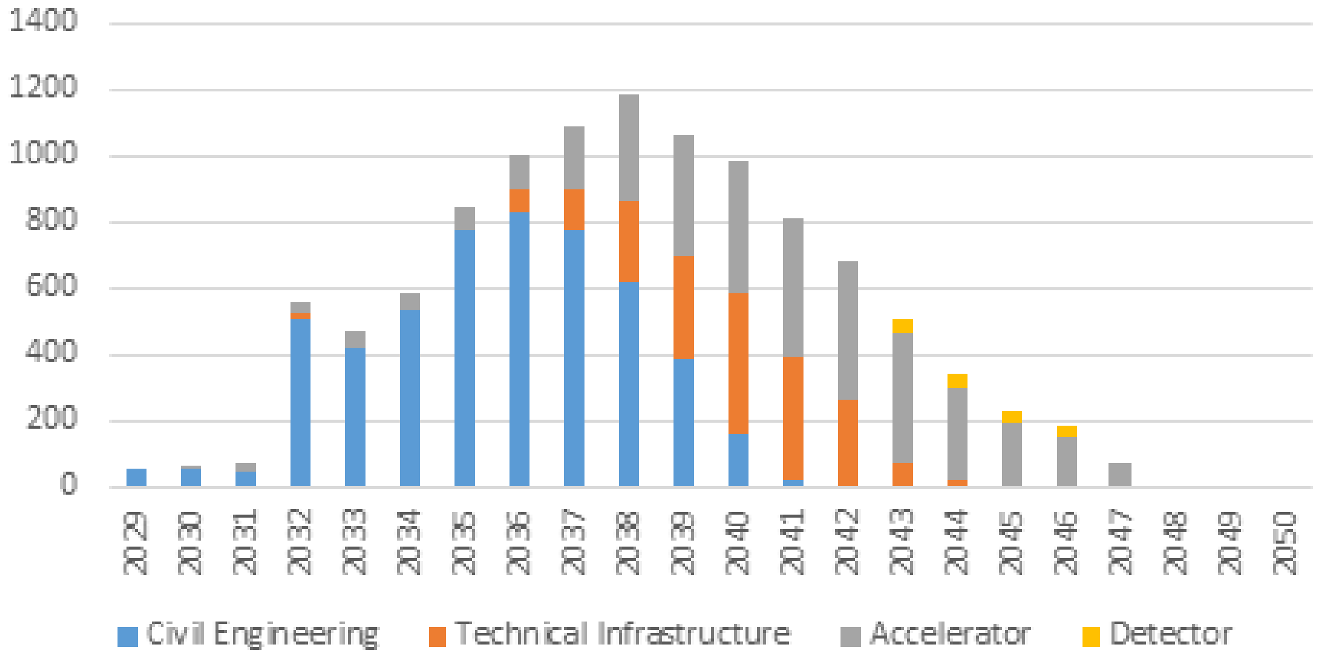
Construction cost estimate for FCC-ee

- Machine configurations for Z, W, H working points included
- Baseline configuration with 2 detectors
- CERN contribution to 2 experiments incl.

cost category	[MCHF]	%
civil engineering	5.400	50
technical infrastructure	2.000	18
accelerator	3.300	30
detector	200	2
total cost (2018 prices)	10.900	100

Spending profile for FCC-ee

- CE construction 2032 - 2040
- Technical infrastructure 2037 - 2043
- Accelerator and experiment 2032 – 2045
- Commissioning and operation start 2045 -2048.



FCC-ee figures of merit

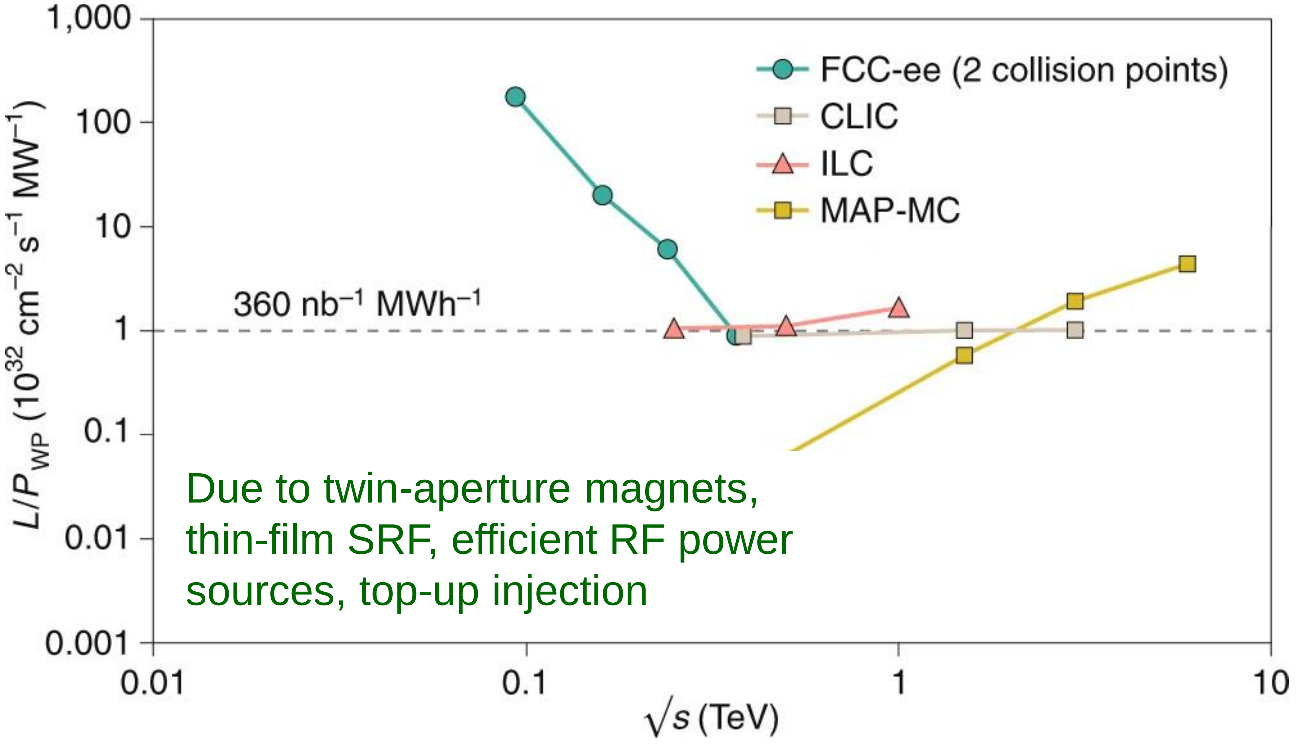
Luminosity vs. capital cost

- for the H running, **with 5 ab^{-1} accumulated over 3 years and 10^6 H produced**, the total investment cost (~10 BCHF) corresponds to
  → 10 kCHF per produced Higgs boson

- for the Z running with **150 ab^{-1} accumulated over 4 years and 5×10^{12} Z produced,** the total investment cost corresponds to
  → 10 kCHF per 5×10^6 Z bosons

This is the number of Z bosons collected by each experiment during the entire LEP programme !

Luminosity vs. electricity consumption

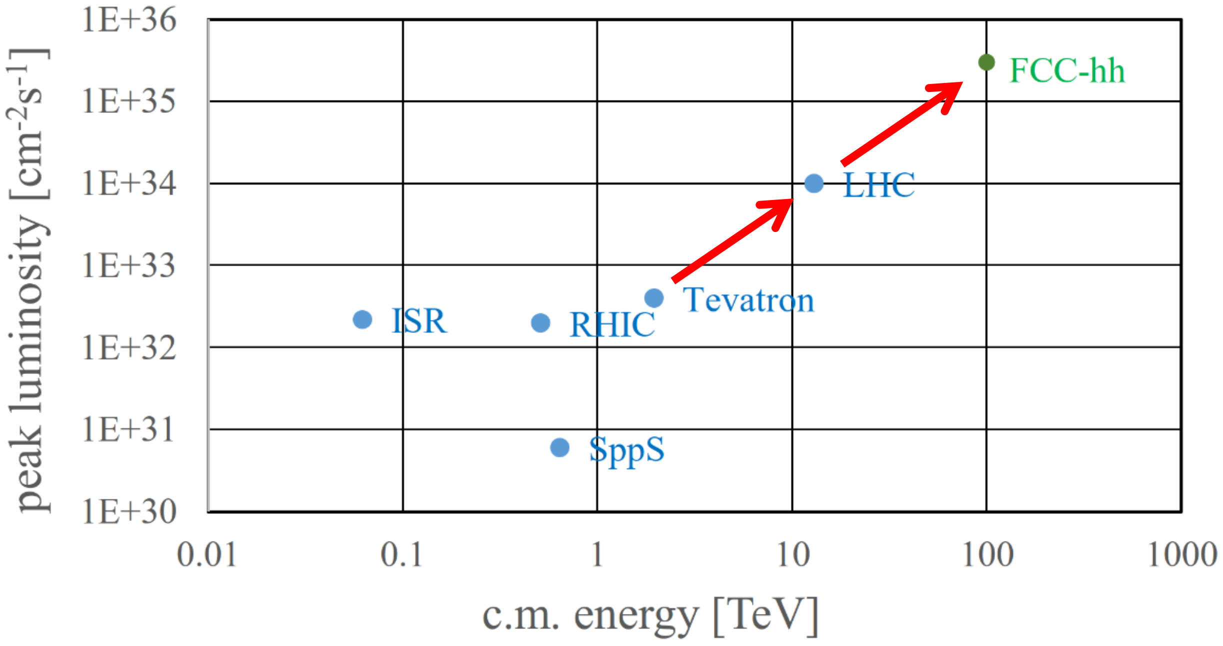


Due to twin-aperture magnets, thin-film SRF, efficient RF power sources, top-up injection

Capital cost per luminosity dramatically decreased compared with LEP !

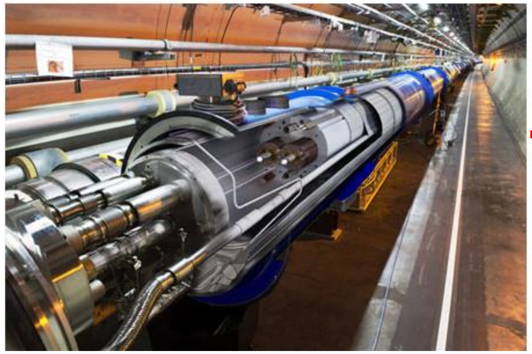
Highest lumi/power of all H fact proposals
Electricity cost ~200 CHF per Higgs boson

FCC-hh: highest collision energies

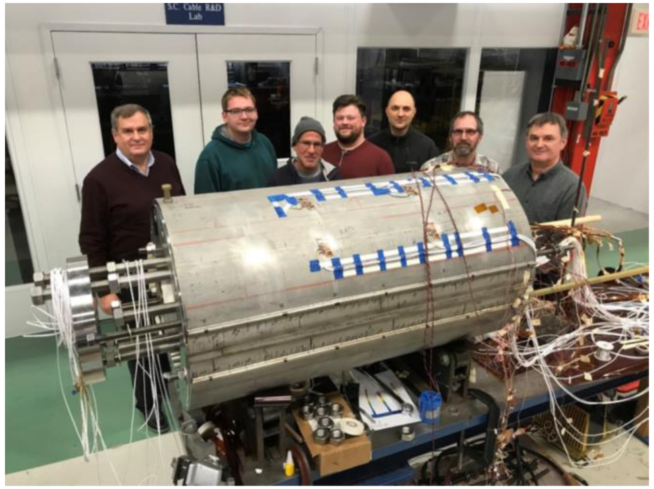


- **order of magnitude performance increase** in both **energy & luminosity**
- **100 TeV cm collision energy** (vs 14 TeV for LHC)
- **20 ab-1 per experiment collected over 25 years** of operation (vs 3 ab^{-1} for LHC)
- similar performance increase as from Tevatron to LHC
- **key technology: high-field magnets**

from
LHC technology
8.3 T NbTi dipole

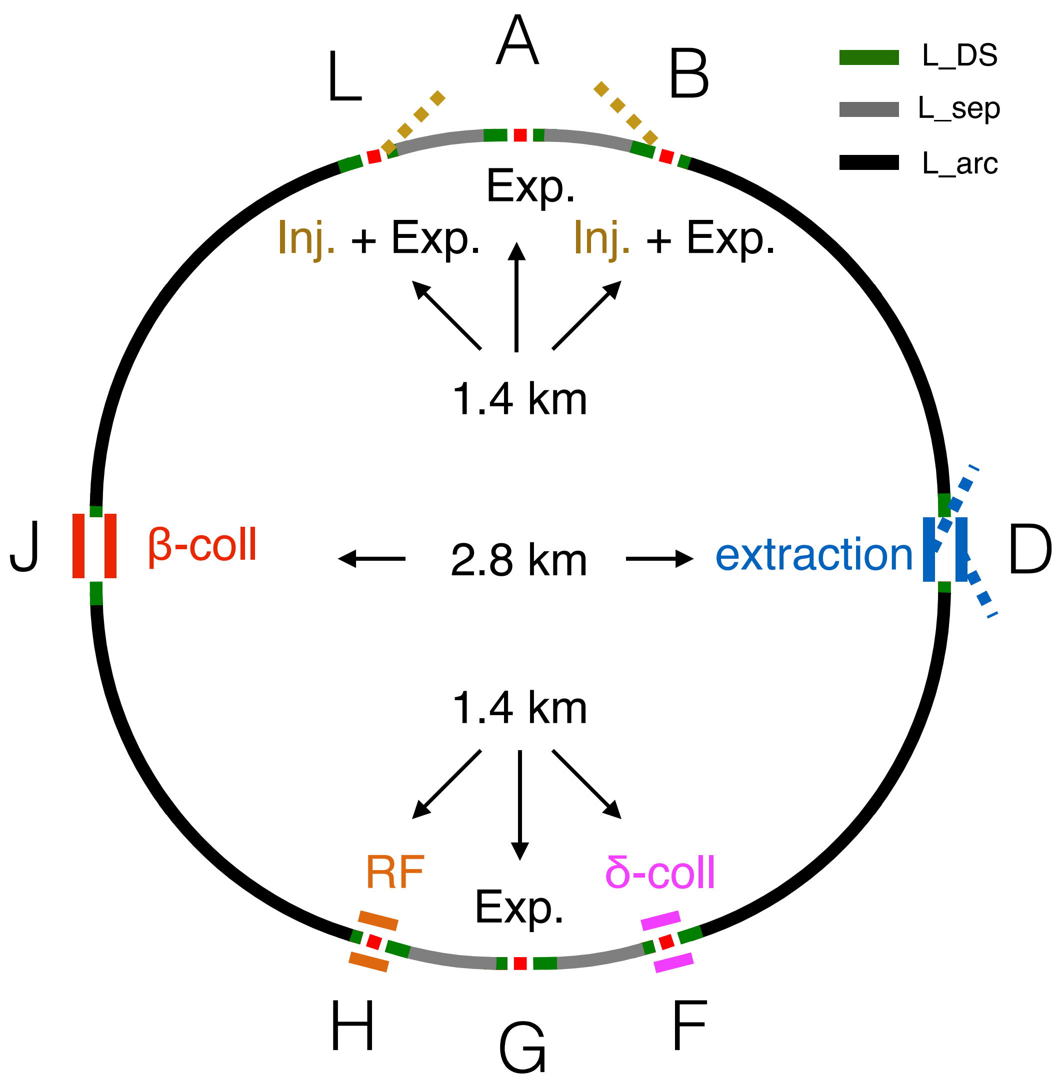


via
HL-LHC technology
12 T Nb_3Sn quadrupole



FNAL dipole demonstrator 4-layer cosϑ 14.5 T Nb_3Sn in 2019

FCC hh basic design choices



- **dual aperture superconducting magnets**
- **two high-luminosity experiments (A & G)**
- **two other experiments (L & B)** combined with **injection upstream** of experiments
- **two collimation insertions**
  - betatron cleaning (J)
  - momentum cleaning (F)
- **extraction/dump insertion (D)**
- **RF insertion (H)**
- **Injection from LHC (~3 TeV) or scSPS (~1.2 TeV)**
- **Alternative layouts under study**

Stage 2: FCC-hh (pp) collider parameters

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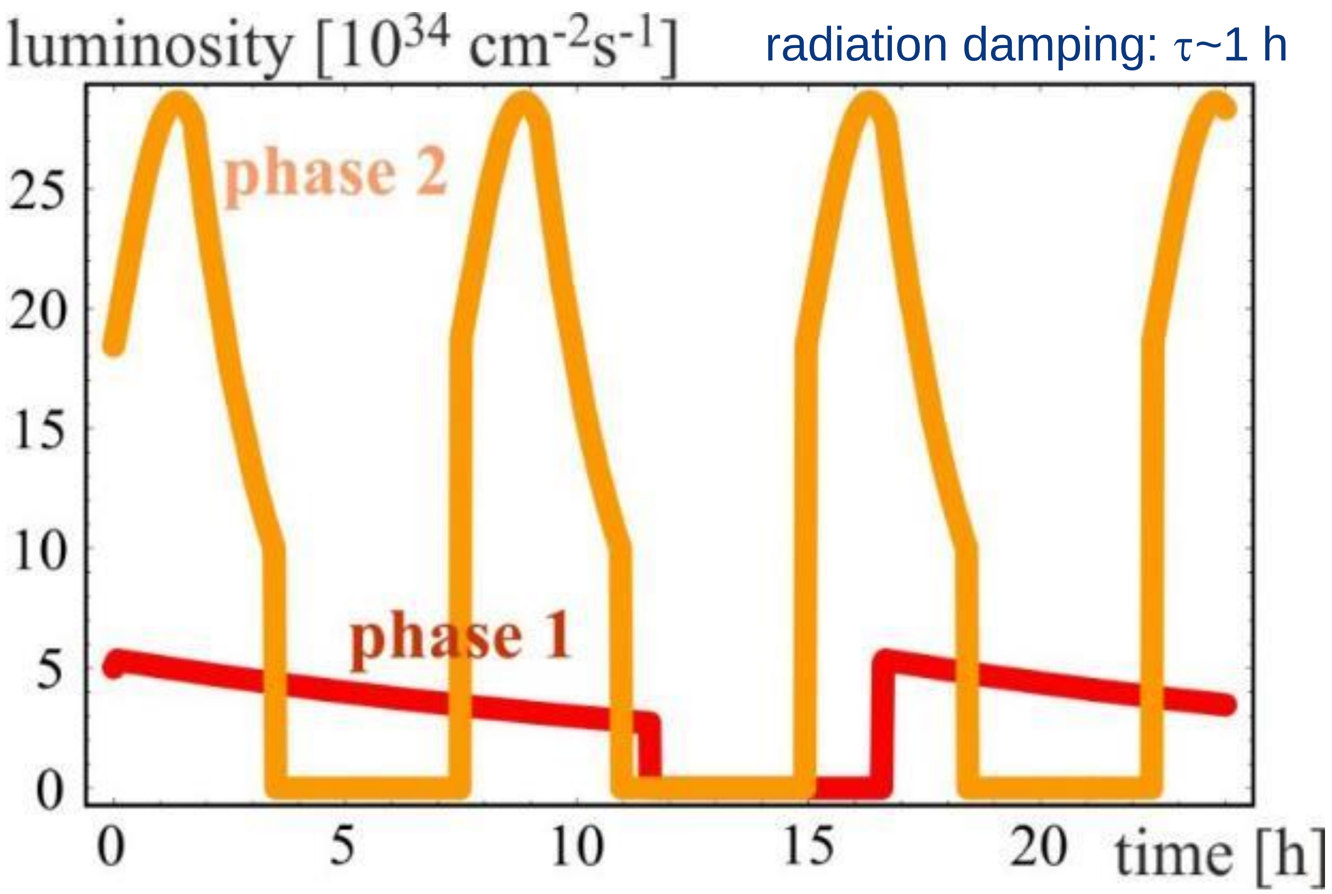
parameter	FCC-hh		HL-LHC	LHC
collision energy cms [TeV]	100		14	14
dipole field [T]	~16		8.33	8.33
circumference [km]	91.2		26.7	26.7
beam current [A]	0.5		1.1	0.58
bunch intensity [10^{11}]	1	1	2.2	1.15
bunch spacing [ns]	25	25	25	25
synchr. rad. power / ring [kW]	2400		7.3	3.6
SR power / length [W/m/ap.]	28.4		0.33	0.17
long. emit. damping time [h]	0.54		12.9	12.9
beta* [m]	1.1	0.3	0.15 (min.)	0.55
normalized emittance [μm]	2.2		2.5	3.75
peak luminosity [10^{34} cm^{-2}s^{-1}]	5	30	5 (lev.)	1
events/bunch crossing	170	1000	132	27
stored energy/beam [GJ]	8.4		0.7	0.36

FCC-hh operation phases and luminosity



Phase 2: Interplay of radiation damping, luminosity burn-off, controlled transvers blow-up

phase 1:
β^*=1.1 m, ΔQ_{tot}=0.01, t_{ta}=5 h
250 fb^{-1} / year

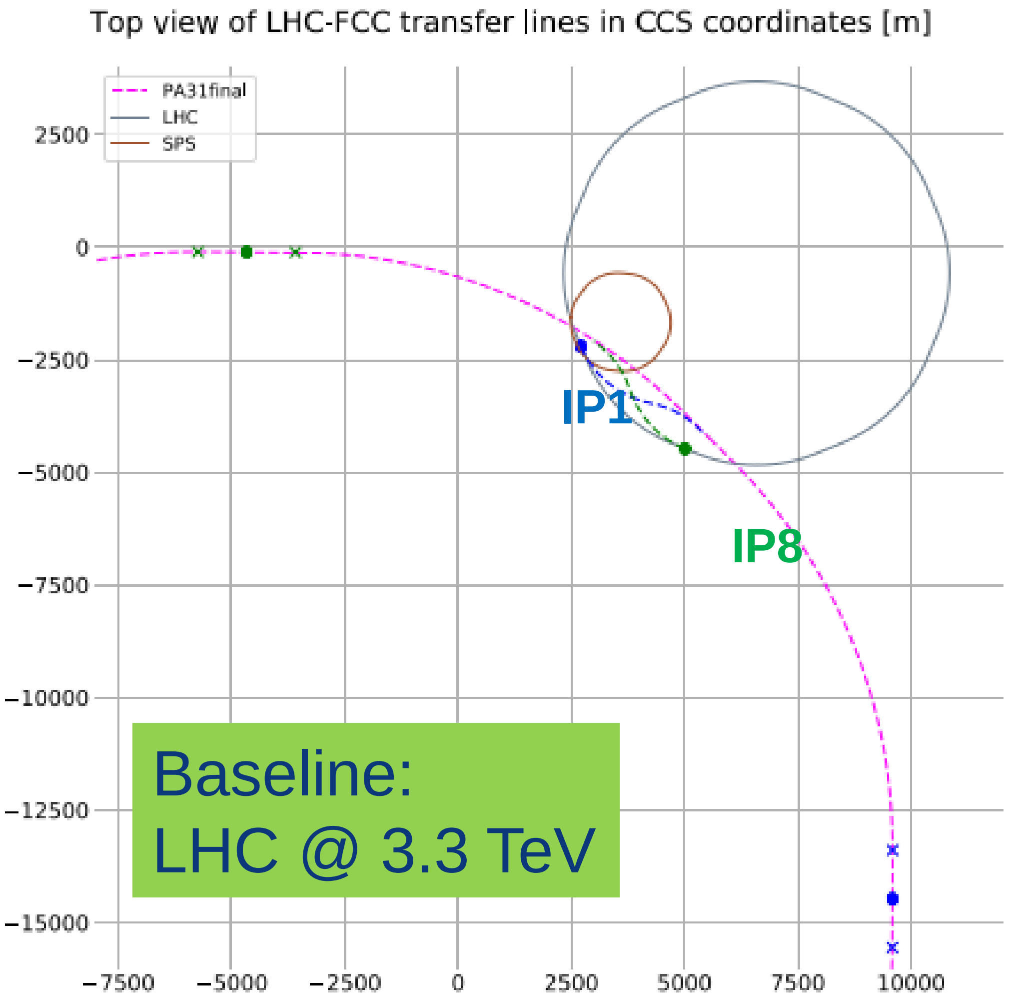
phase 2:
β^*=0.3 m, ΔQ_{tot}=0.03, t_{ta}=4 h
1 ab^{-1} / year

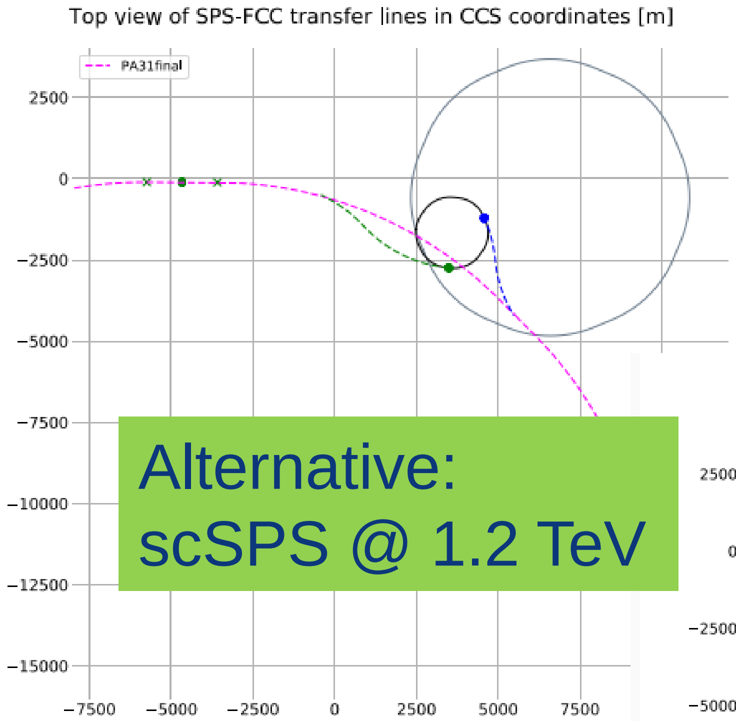
Transition via operation experience, no HW modification

Total integrated luminosity over 25 years operation:
O(20) ab^{-1}/experiment
consistent with physics goals

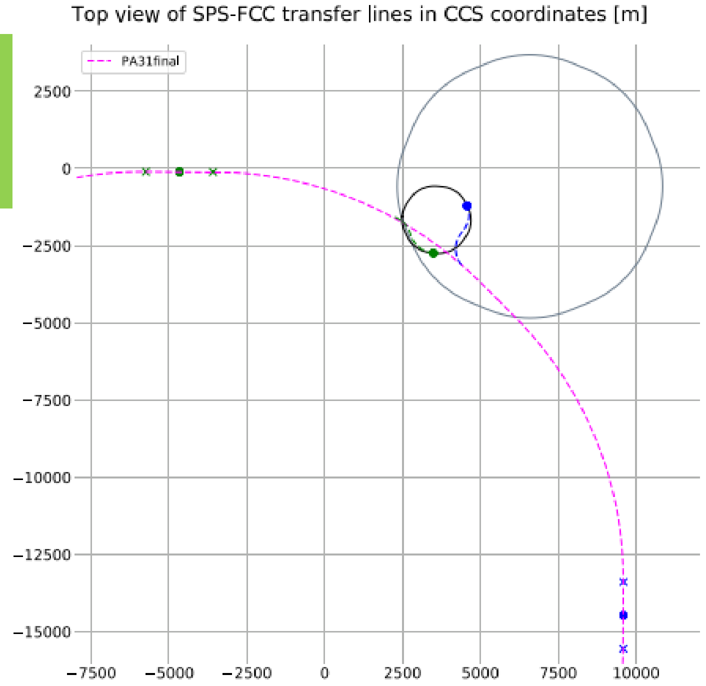
hadron injector lines for new layout

injection from LHC





injection from scSPS
NC (left) or
SC transfer lines (below)

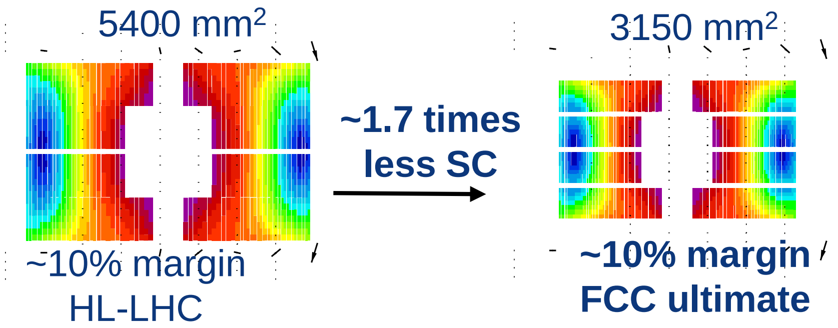


tunnel lengths:

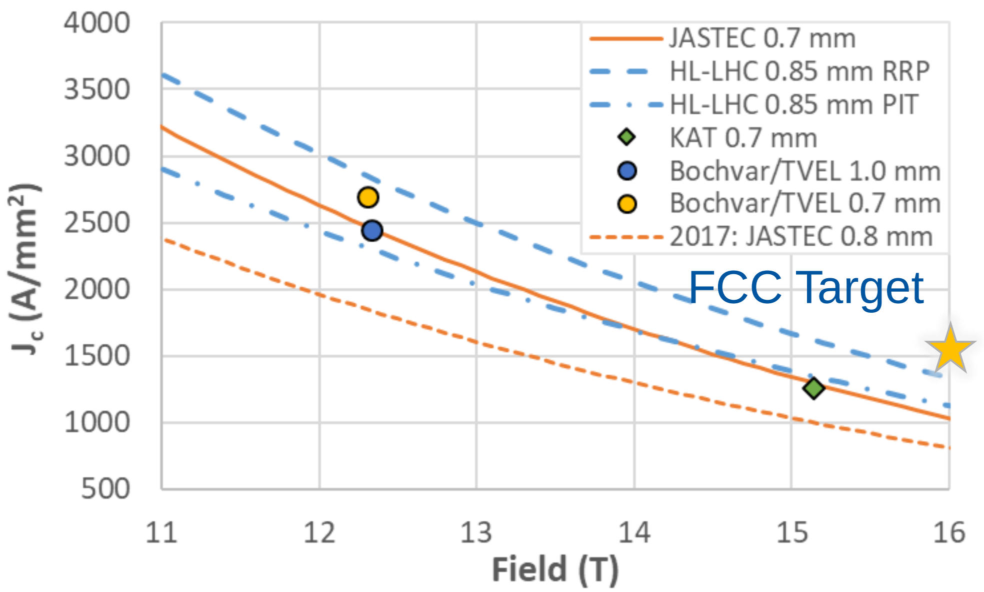
- LHC, SC, 3.2/3.5 km
- SPS, NC, 4.6/3.2 km
- SPS, SC, 1.5/2.1 km

worldwide FCC Nb_3Sn program

Main development goal is wire performance increase:
- **J_c (16T, 4.2K) > 1500 A/mm^2 →50% increase wrt HL-LHC wire**
- **Reduction of coil & magnet cross-section**



After few years development, **prototype Nb_3Sn wires from several new industrial FCC partners already achieve HL-LHC J_c performance**



FCC conductor development collaboration:

- **Bochvar Institute** (production at **TVEL**), **Russia**
- **Bruker, Germany, Luvata Pori, Finland**
- **KEK** (**Jastec** and **Furukawa**), **Japan**
- **KAT**, **Korea, Columbus, Italy**
- **University of Geneva**, **Switzerland**
- **Technical University of Vienna**, **Austria**
- **SPIN**, **Italy, University of Freiberg, Germany**

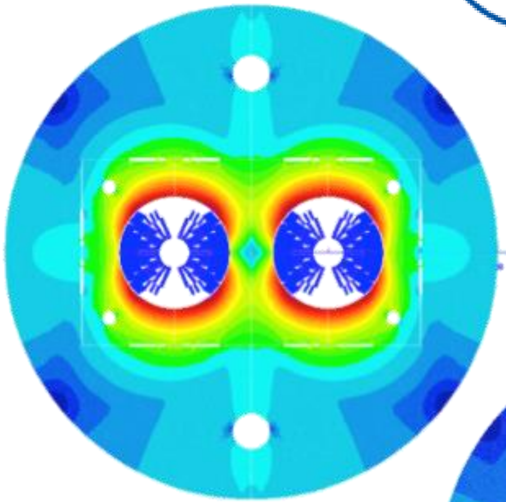
2019/20 results from US, meeting FCC J_c specs:

- **Florida State University:** high-J_c Nb_3Sn via Hf addition
- **Hyper Tech /Ohio SU/FNAL**: high-J_c Nb_3Sn via artificial pinning centres based on Zr oxide.

16 T dipole design activities and options

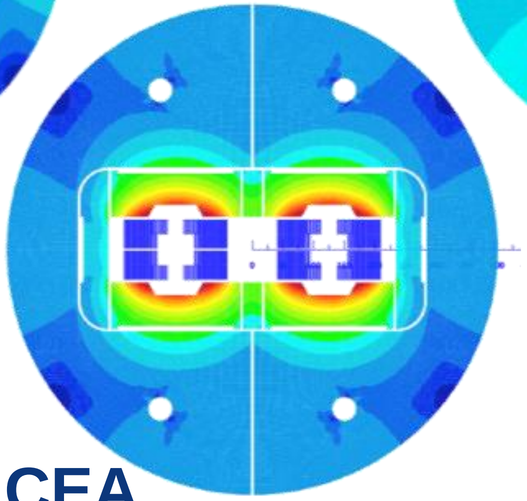
H2020 EuroCirCol A key to New Physics

Cos-theta



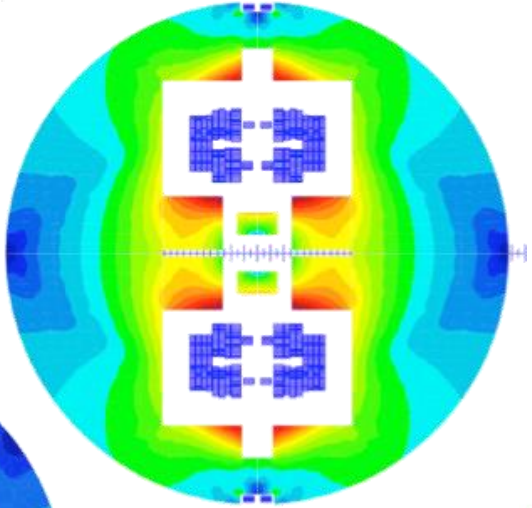
INFN

Blocks



CEA

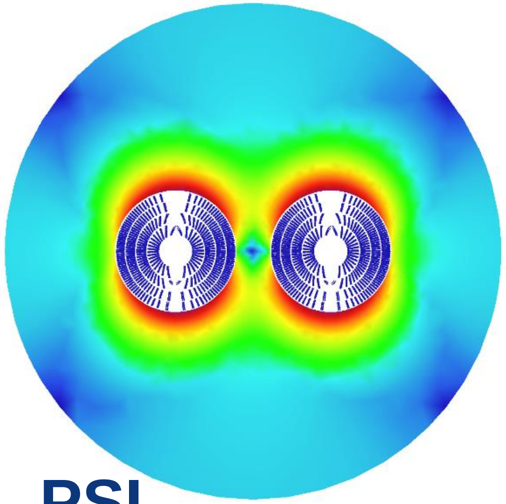
Common coils



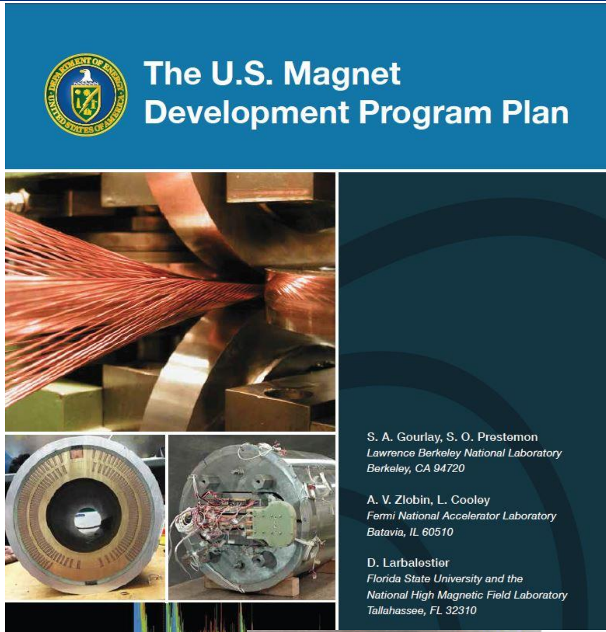
CIEMAT

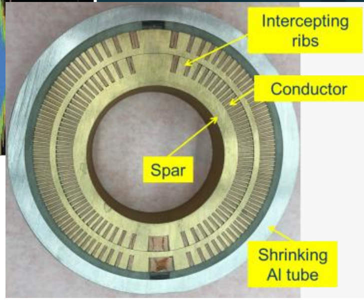
Swiss contribution

Canted Cos-theta

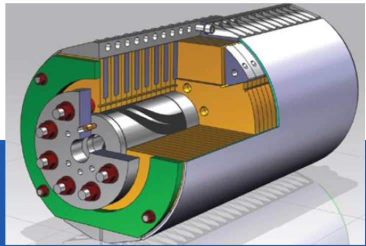


PSI





LBNL



FNAL

Various programs on short model magnets ongoing

High-field magnets R&D: 1st steps towards FCC-hh

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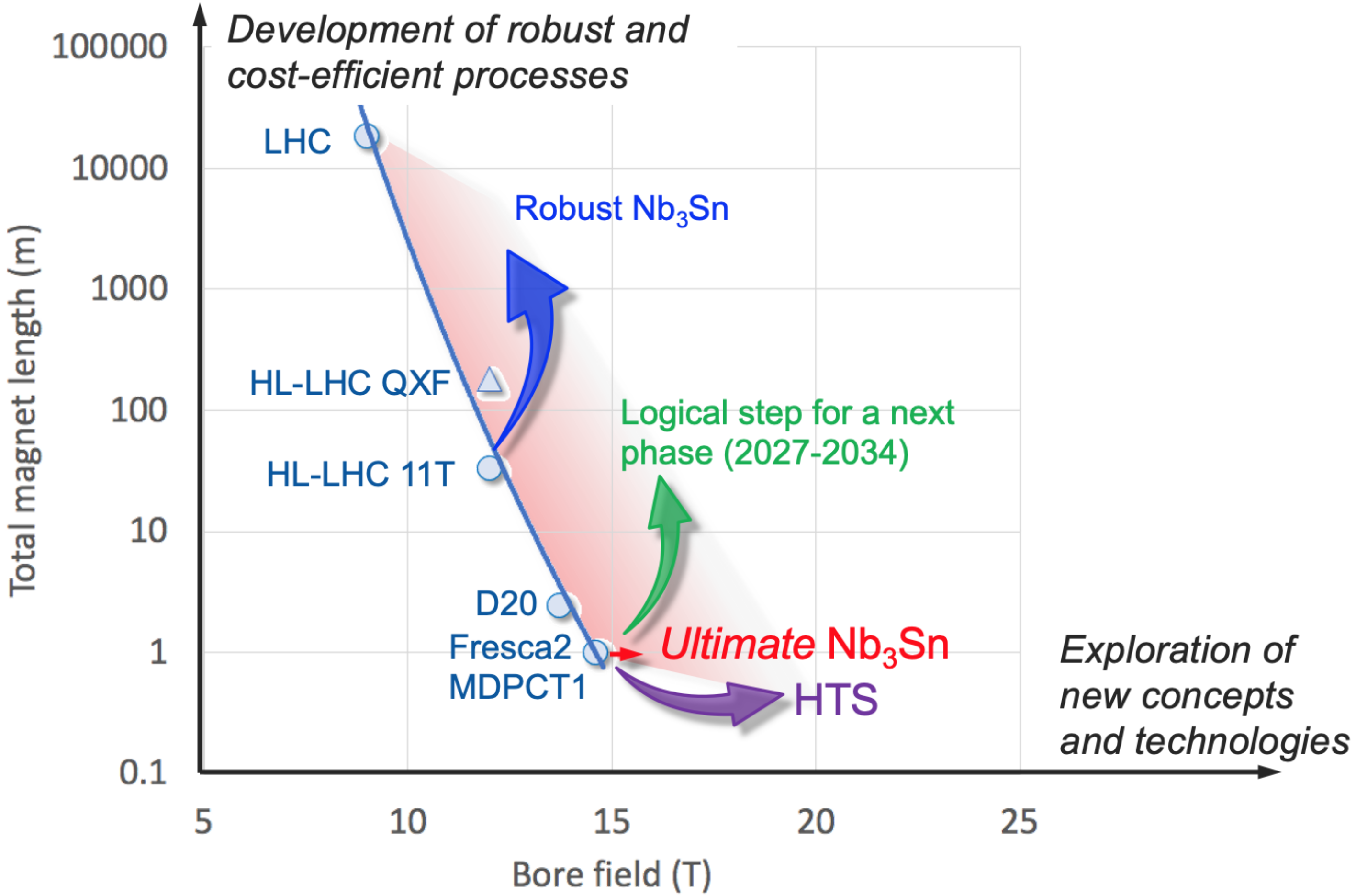
In parallel to FCC Study, HFM development program as long-term separate R&D project

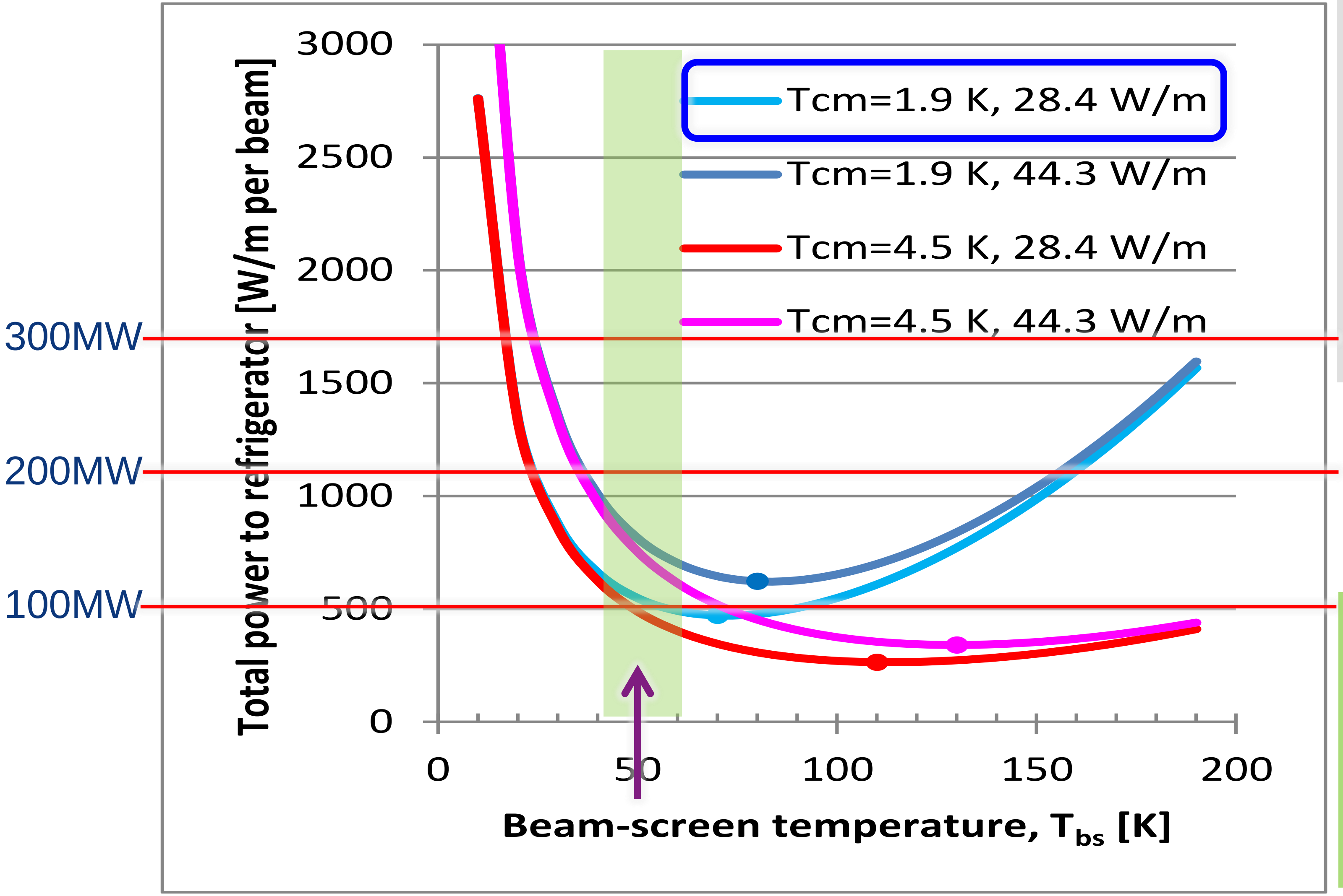


Main R&D activities:

- ❑ materials: goal is ~16 T for Nb_3Sn, at least ~20 T for HTS inserts
- ❑ magnet technology: engineering, mechanical robustness, insulating materials, field quality
- ❑ production of models and prototypes: to demonstrate material, design and engineering choices, industrialisation and costs
- ❑ infrastructure and test stations: for tests up to ~ 20 T and 20-50 kA

Global collaborations already established during FCC CDR phase.

Cryoplants – energy efficiency



BS temperature choice is overall optimisation of:

- **Cryoplant power consumption**
- **Vacuum system performance**
- **Impedance and beam stability**

Ideal Carnot process:

$\Delta W = \Delta Q \cdot (T - T_{lowT}) / T_{lowT} =$

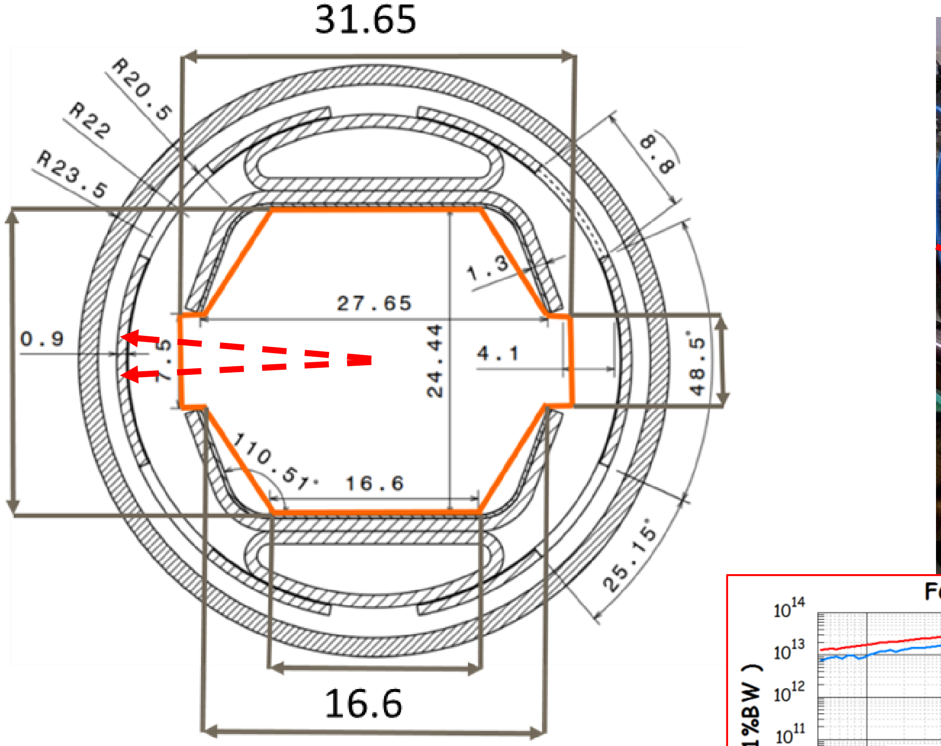
$= \Delta Q \cdot (300 - 1.9) / 1.9 \sim 155 \cdot \Delta Q$

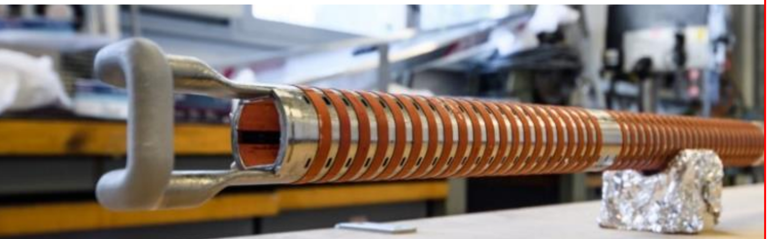
- **Optimum beam screen operation temperature 40 - 60 K**
- **Electrical power for beam screen cooling ~100 MW .**

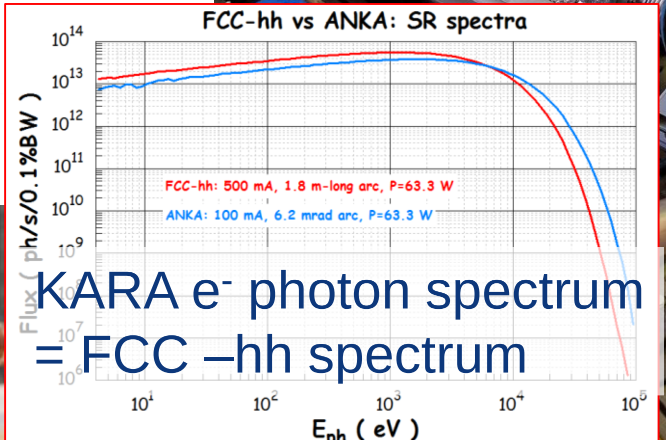
Succesful test of FCC-hh beam screen

synchrotron radiation (~ 30 W/m/beam (@16 T field) (cf. LHC <0.2W/m) **~ 5 MW total load in arcs**

- **absorption of synchrotron radiation at higher temperature (> 1.8 K)** for cryogenic efficiency
- provision of beam vacuum, suppression of photo-electrons, electron cloud effect, impedance, etc.



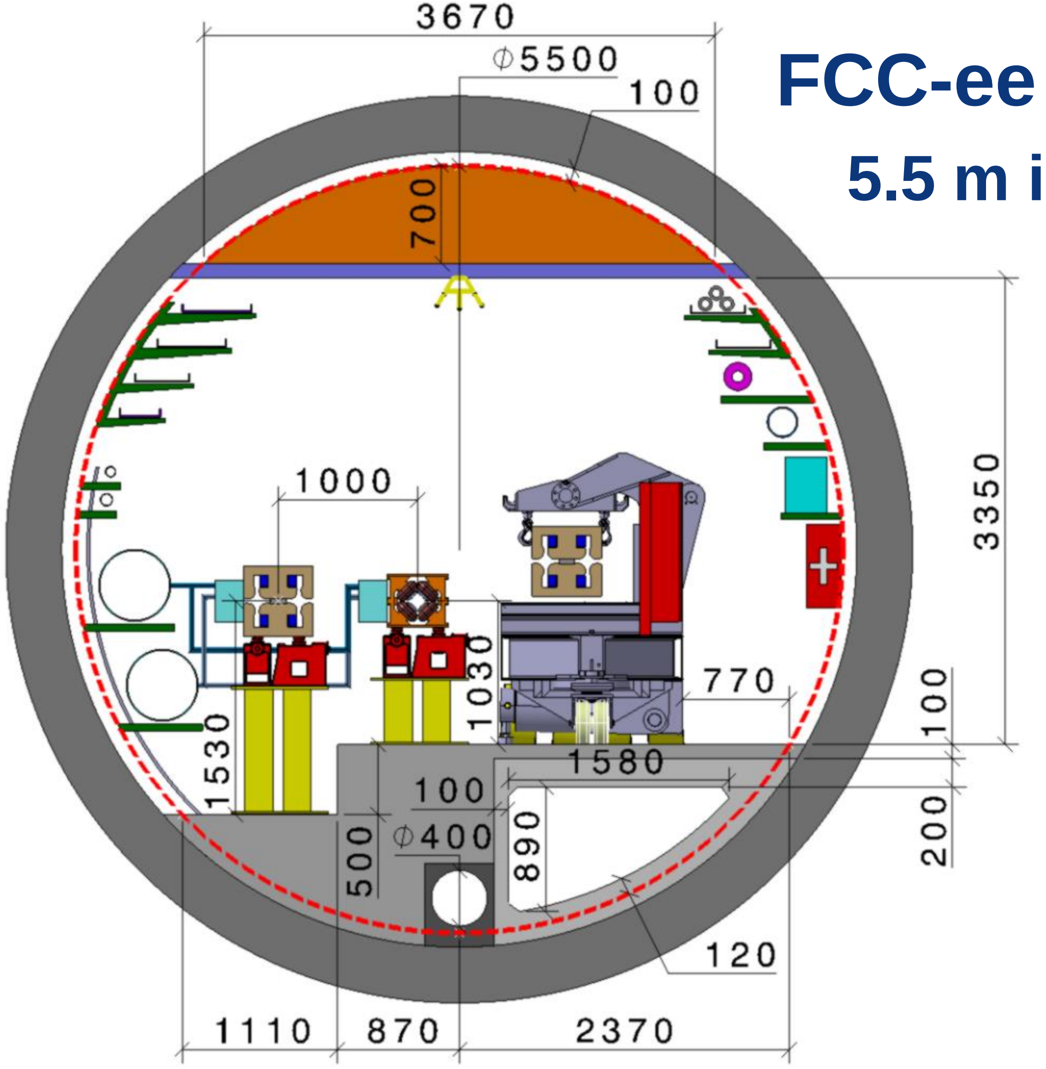


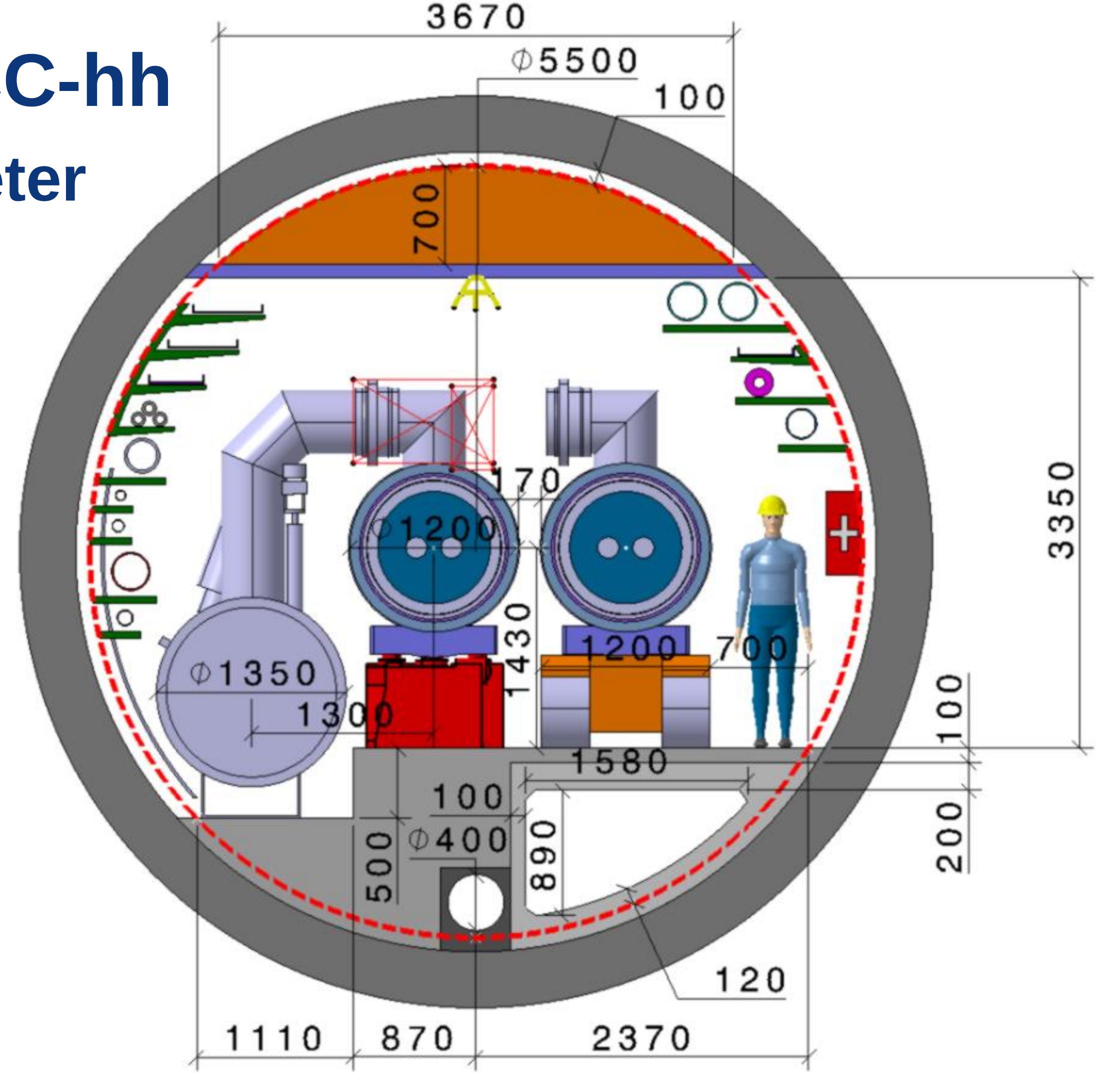


FCC-tunnel integration in the arcs

FCC-ee | FCC-hh

5.5 m inner diameter





Status of Global FCC Collaboration

FUTURE CIRCULAR COLLIDER

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

EC H2020

FCC Week 2022

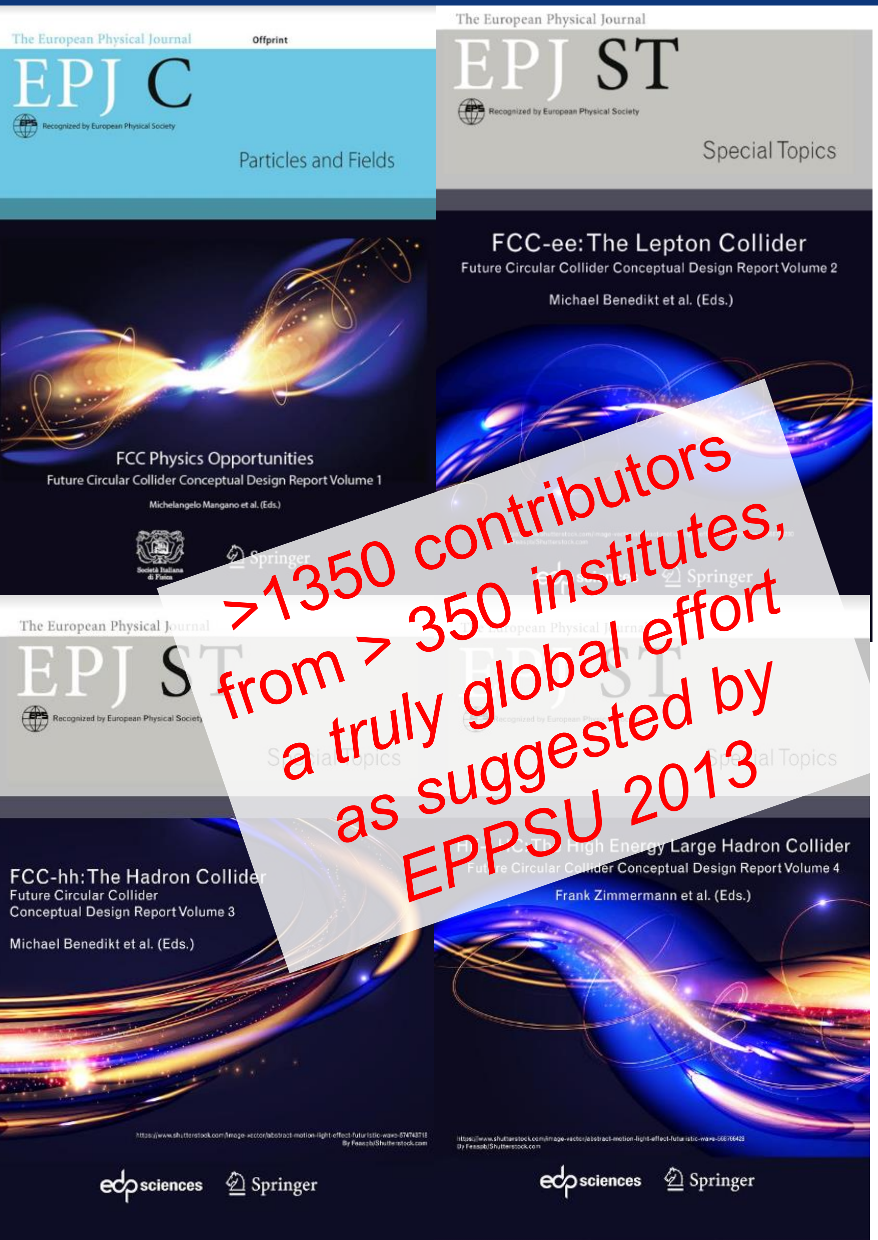
FUTURE CIRCULAR COLLIDER

In Paris 30 May to 3 June 2022, planning for a hybrid event.

We are looking forward to seeing you there !

Day	Monday	Tuesday				Wednesday			Thursday				Friday
Room / Time	Plenary Campus Cordeliers room 470 p.	Parallel 1 Jussieu CICSU room 80 p.	Parallel 2 Jussieu CICSU room 80 p.	Parallel 3 Jussieu CICSU room 80 p.	Parralel 4 Jussieu CICSU room 30 p.	Parallel 1 Campus Cordeliers room 155 p.	Parallel 2 Campus Cordeliers room 75 p.	Parallel 3 Réfectoire Cordeliers room 100 p.	Parallel 1 Campus Cordeliers room 470 p.	Parallel 2 Campus Cordeliers room 155 p.	Parallel 3 Campus Cordeliers room 75 p.	Parallel 3 Réfectoire Cordeliers room 100 p.	Plenary Campus Cordeliers room 470 p.
09:00-09:30 09:30-10:00	**Plenary session**	FCCee accelerator FCCIS WP2	PED	Organisation Model		FCC hh accelerator	PED	FCCIS WP3 Placement	WS Economy of Science	FCCee EPOL	Technical infrastruct.	Technology	**Plenary session**
10:00-10:30	Chairperson	Chairperson	Chairperson	Chairperson		Chairperson	Chairperson	Chairperson	Chairperson	Chairperson	Chairperson	Chairperson	Chairperson
10:30-11:00	**Break**	**Break**				**Break**			**Break**				**Break**
11:00-11:30 11:30-12:00	**Plenary session**	FCCee accelerator FCCIS WP2	PED	Technical infrastruct.	*Dialogue group CLOSED*	Technology	PED	Civil Engineering	WS Economy of Science	FCCee MDI	Technical infrastruct.	Technology	**Plenary session**
12:00-12:30	Chairperson	Chairperson	Chairperson	Chairperson	F. Eder	Chairperson	Chairperson	Chairperson	Chairperson	Chairperson	Chairperson	Chairperson	Chairperson
12:30-13:00 13:00-13:30	**Break**	**Break**				**Break**			**Break**				**Break**
13:30-14:00													**Plenary session** (optional)
14:00-14:30 14:30-15:00	**Plenary session**	FCCee injector FEB	PED	Technology SRF	*SC meeting CLOSED*	FCCee accelerator	PED	FCCIS WP5 Collaboration	WS Economy of Science	FCCee MDI	Technical infrastruct.		Chairperson
15:00-15:30	Chairperson	Chairperson	Chairperson	Chairperson	F. Gianotti	Chairperson	Chairperson	Chairperson	Chairperson	Chairperson	Chairperson		
15:30-16:00	**Break**	**Break**				**Break**			**Break**				
16:00-16:30 16:30-17:00	**Plenary session**	FCCee injector FEB	PED	Technology SRF	*SC meeting CLOSED*	FCCee accelerator	PED	FCCIS WP5 Communication	**France special plenary session** (Campus Cordeliers, room 470 p.)				
17:00-17:30	Chairperson	Chairperson	Chairperson	Chairperson	F. Gianotti	Chairperson	Chairperson	Chairperson	Chairperson				

FCC CDR & Study Documentation



- **FCC-Conceptual Design Reports:**
  - **Vol 1 Physics, Vol 2 FCC-ee, Vol 3 FCC-hh, Vol 4 HE-LHC**
  - CDRs published in **European Physical Journal C (Vol 1) and ST (Vol 2 – 4) [Springer]**

    EPJ C 79, 6 (2019) 474 , EPJ ST 228, 2 (2019) 261-623 ,

    EPJ ST 228, 4 (2019) 755-1107 , EPJ ST 228, 5 (2019) 1109-1382

- EPJ is a merger and continuation of *Acta Physica Hungarica, Anales de Fisica, Czechoslovak Journal of Physics, Fizika A, Il Nuovo Cimento, Journal de Physique, Portugaliae Physica* and ***Zeitschrift für Physik***. 25 European Physical Societies are represented in EPJ, including the DPG.

- **Summary documents provided to EPPSU 2019/20**
  - **FCC-integral, FCC-ee, FCC-hh, HE-LHC**
  - Accessible on http://fcc-cdr.web.cern.ch/

Summary

- The European Strategy Update 2019/20 issued the **request for a feasibility study of the FCC integrated programme to be delivered by end 2025.**
- **The main activities of the FCC Feasibility Study are:**
  - **concrete local/regional implementation scenario** in collaboration **with host state authorities**,
  - accompanied by **machine optimization, physics studies and technology R&D**,
  - performed **via global collaboration**
  - in parallel **High Field Magnet R&D program** as separate line, to prepare for FCC-hh.
- Long term goal: **world-leading HEP infrastructure for 21st century** to push the particle-physics **precision and energy frontiers** far beyond present limits. **Success of FCC relies on strong global participation.**