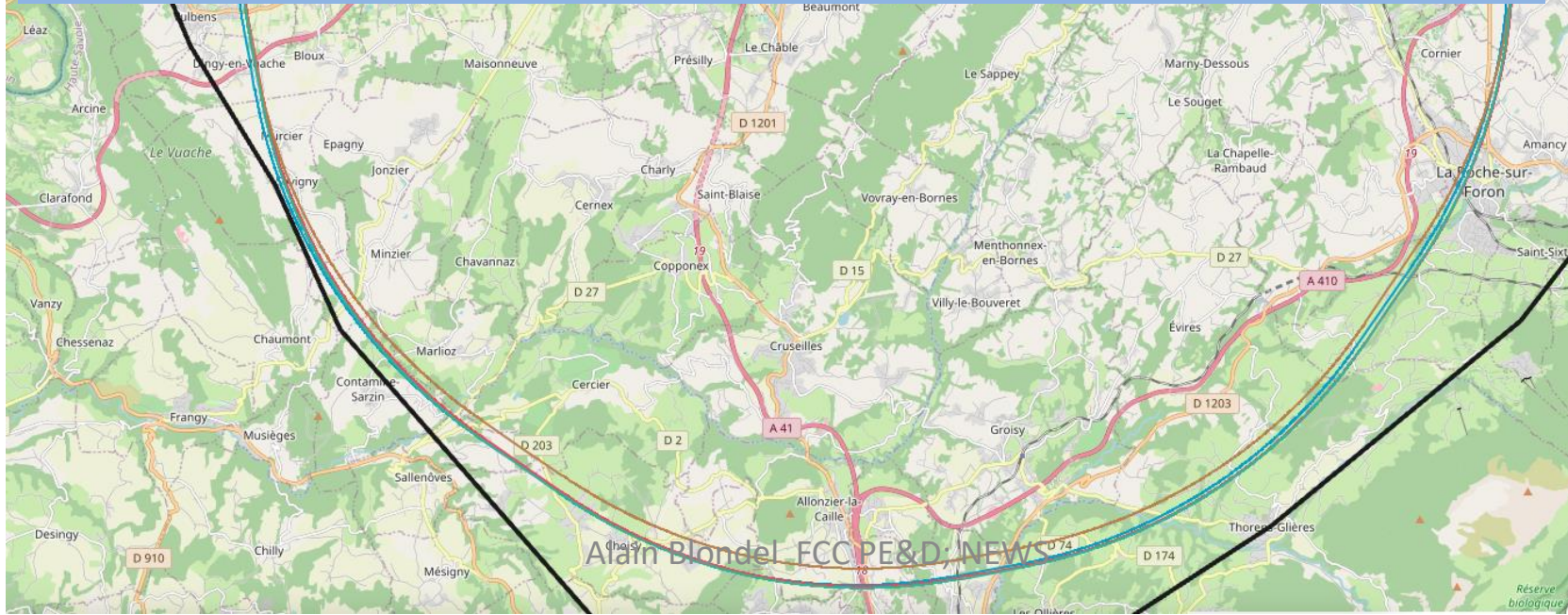


# FCC feasibility study -- NEWS



25.10.2021



## The FCC-IS study is now on its way

**FCC Technical and Financial Feasibility Study (FS) addresses the high level recommendation of the 2020 European Strategy**

**Plans for the study were informed to the CERN council in June 2021 and further reports given in September 2021.**

Main deliverables and timeline of the FCC feasibility study

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

Organisational structure of the FCC feasibility study

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

**FCC-IS Financial study focuses on first stage of the project (Tunnel and FCC-ee) ~10 BCHF  
(indications also on full FCC financial study)**

**FCC PED objectives cover both the FCC-ee and FCC-hh (with proper emphasis associated with time scale)**

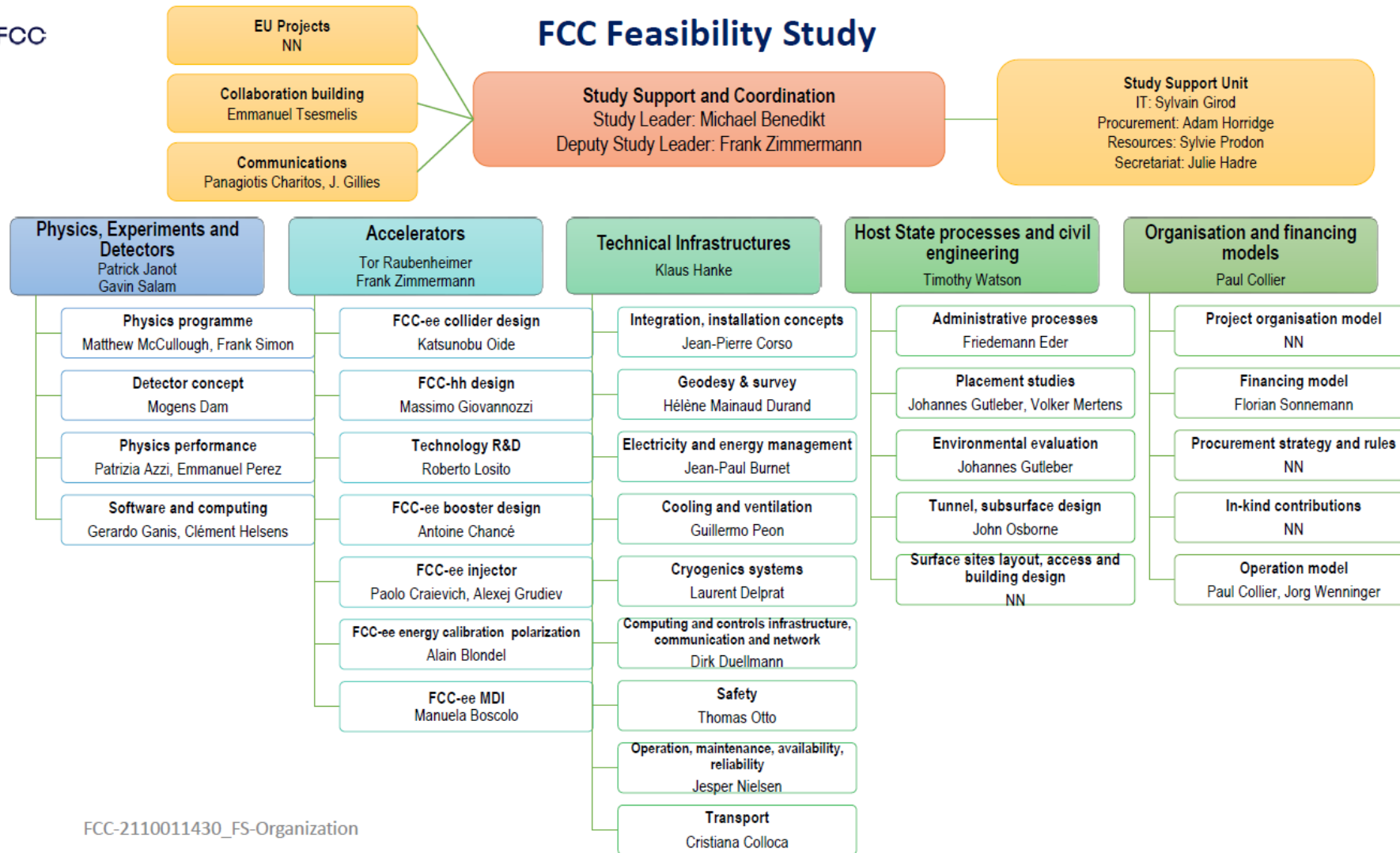
**First discussions between host states for contributions to the infrastructure are taking place**

**Significant efforts being made to broaden the collaboration further**





# FCC-IS organization chart





# Coordination Group Meeting (CGM)

## Proposed membership (Preliminary)

### Study management:

Michael Benedikt  
Frank Zimmermann  
Mike Lamont

### Pillar coordinators:

Patrick Janot  
Gavin Salaam  
Tor Raubenheimer  
Klaus Hanke  
Timothy Watson  
Paul Collier

### Specific advisors

Alain Blondel  
Johannes Gutleber  
Oliver Bruning  
Katsunobu Oide  
Roberto Losito  
Volker Mertens  
Jorg Wenninger  
Julie Hadre  
Michelangelo Mangano  
Max Klein  
Jonathan R. Ellis  
Florian Sonnemann  
Friedemann Eder  
Panagiotis Charitos  
Emmanuel Tsesmelis

## Main topics

- General study organization, overall planning, strategy
- Global parameters and design goals
- Overall work programme management and follow-up
- Collaboration aspects
- Outreach and communication
- Etc.
- **1 meeting / month**

M. Benedikt



# Technical Coordination Meeting (TCM)

## Proposed membership (Preliminary)

### Study management:

Michael Benedikt

Frank Zimmermann

Mike Lamont

### Pillar coordinators:

Patrick Janot or Gavin Salam

Tor Raubenheimer

Klaus Hanke

Timothy Watson

Paul Collier

### Specific advisors

Alain Blondel

Johannes Gutleber

Oliver Bruning

Katsunobu Oide

Roberto Losito

Volker Mertens

Jorg Wenninger

Julie Hadre

John Osborne

Massimo Giovannozzi

Manuela Boscolo

Olivier Brunner

Antoine Chance

Paolo Craievich

Ilya Agapov

## Main topics

- Assure coherent technical design of accelerators, technical infrastructure, civil engineering integrated with territorial and environmental constraints.
- Technical parameter management
- Interfaces between Accel., TI, CE&HS pillars
- **2 meetings per month**

M. Benedikt



# FCC FC meeting structure

## **CGM and TCM for overall study coordination**

- Individual meetings at pillar level as deemed appropriate by pillar coordinators

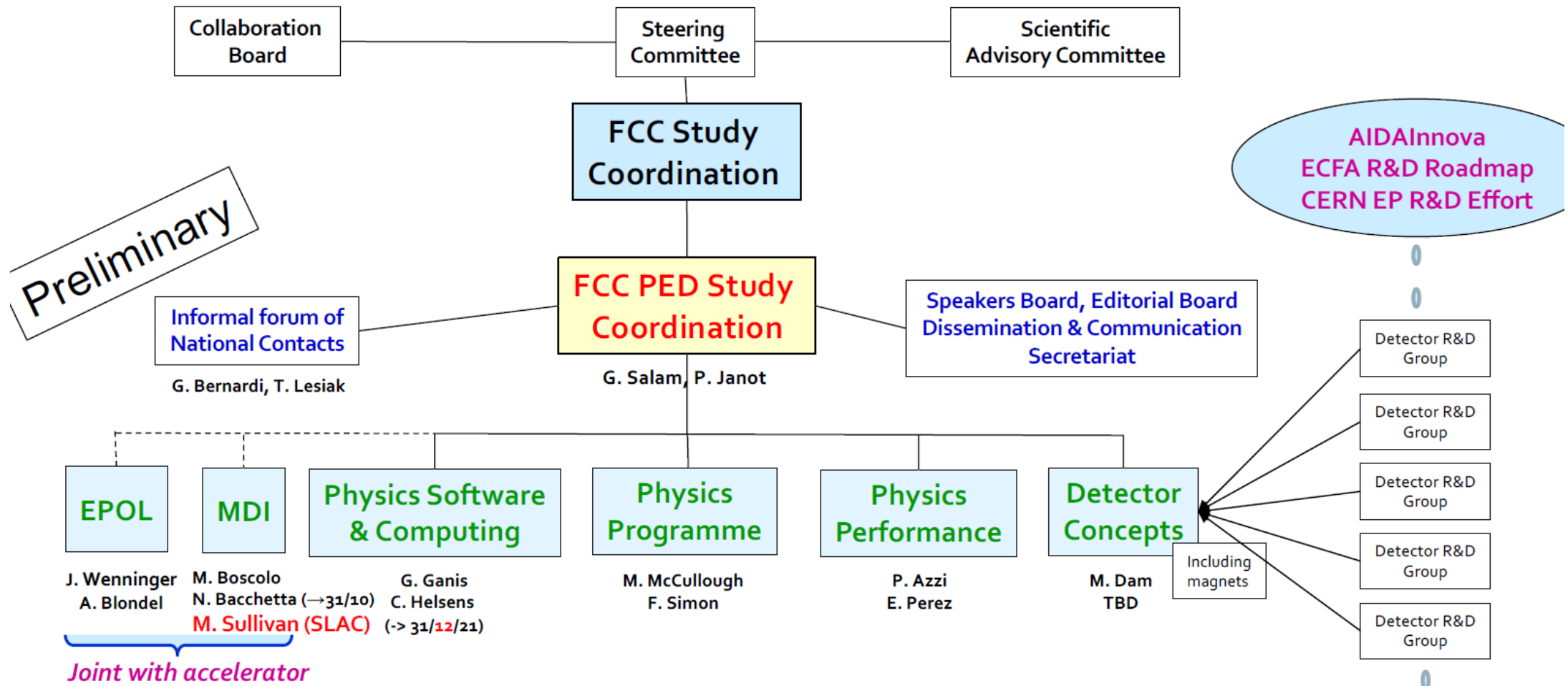


# FCC Global Collaboration WG

recent contacts: Canada, Estonia, Slovenia

- ◆ **Several countries being formally approached**
- ◆ **Engagement meetings being scheduled with some countries**
  - Korea: 3 Sept 2021; Pakistan: 14 Sept 2021; Portugal: Oct/Nov 2021.  
58 participants      165 registered (!)
- ◆ **Current format of engagement meetings (~2h)**
  - Introduction to the FCC Feasibility Study (Michael Benedikt)
  - Presentation on the FCC Physics case and FCC PED Studies (PED representative)
  - Presentation on the FCC Accelerator Science and Technology (Frank Zimmermann)
  - The FCC Global Collaboration (E. Tsesmelis)
  - Presentation(s) from the Country Scientific Community
- ◆ **Web page: <https://fcc-global-collaboration-working-group.web.cern.ch/>**

# FCC-IS PED Organization -- work in progress







# The PED Pillar organisation, in progress

## □ **Work Packages**

- ◆ **Seek and nominate missing co-coordinator, where needed (DC, S&C, MDI)**
- ◆ **Finalise / Update / Initialise the work package structure and coordination body**
  - Identify relevant stake-holders (e.g., working group conveners)
  - May organize mini-review to this aim ?

## ◆ **Mailing lists**

for both:

- Physics Programme
- Physics Performance

## □ **The PED Coordination Group will consist of**

- ◆ **The work package coordinators**
- ◆ **The chairs of the support groups**
  - Editorial Board, Speakers Büro, Dissemination and Communication, IFNC, ...
- ◆ **The organizers of the monthly PED general meetings**
- ◆ **Plus a few add'l members chosen by the pillar coordinators**

nominating conveners for  
EW, Higgs, QCD, H.Flavours, top, BSM

## □ **Some of the support groups will need to be set up**

- ◆ **Editorial Board, Dissemination and communication, ...**



# **European Strategy for Particle Physics**

## **Accelerator R&D Roadmap**

**Interim Report – 20 September 2021**

we have presently received the interim report of the ECFA accelerator road map.  
Noted that FCC-ee (in particular) appears very little so far  
-- prepared a 4-page document to be added stressing the extent of required R&D for FCC-ee  
-- and some comments to adapt the introduction and conclusions accordingly

# FCC FS timeline and main deliverables

main deliverables and timelines of the FCC Feasibility Study	2021				2022				2023				2024				2025			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
technical design work and R&D in all relevant areas																				
progress review on key technology R&D programs																				
development and documentation of implementation scenario																				
design update for preferred implementation variant																				
communications plan development and implementation																				
development of funding models and concepts																				update
development of project organisation and operation models																				update
CDR cost update with external review																				
general coherence review (mid-term)																				
detailed design for Feasibility Study Report																				
environmental evaluation process and impact study with host states								preparation												
high-risk areas site investigations								preparation												
project cost update with external review																				
Feasibility Study Report																				

Feasibility  
Study Report

- ❑ Pre-decision on placement of the ring (geology, surface areas, etc.): mid-2022
- ❑ High-risk area site investigations for selected placement: mid-2023 to mid-2025
- ❑ Design update for preferred placement scenario: mid-2023
- ❑ General coherence review across all work packages: mid-2023 (FS mid-term review)
- ❑ Cost reviews with external expert review committee: 2023 and 2025

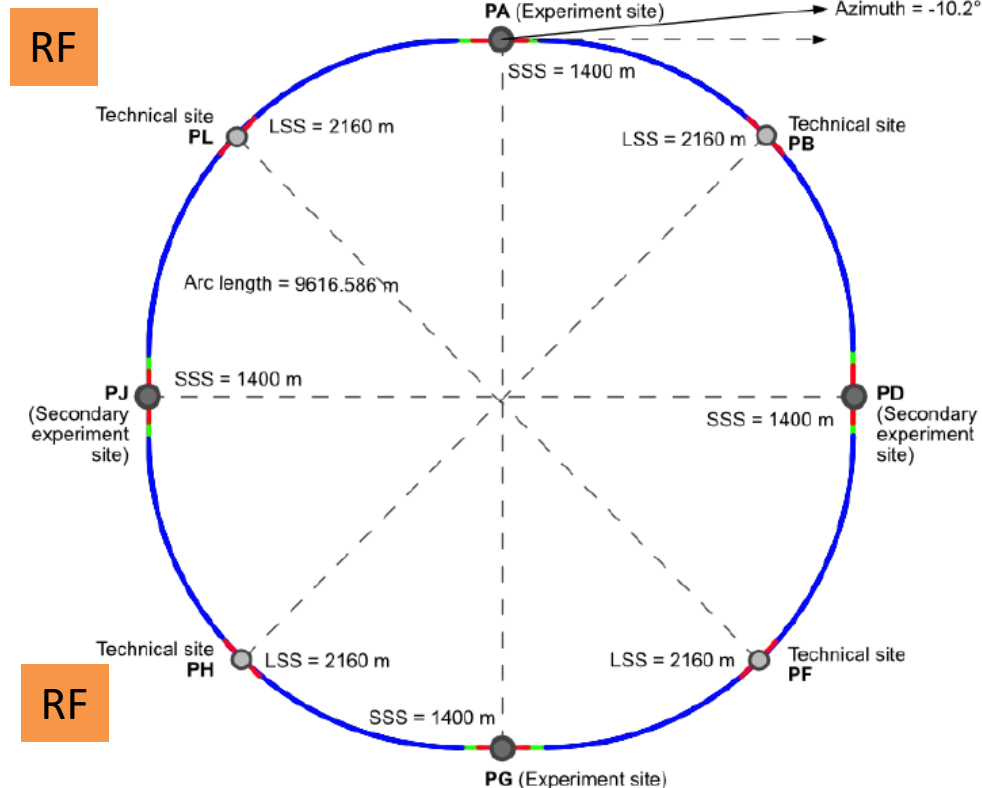
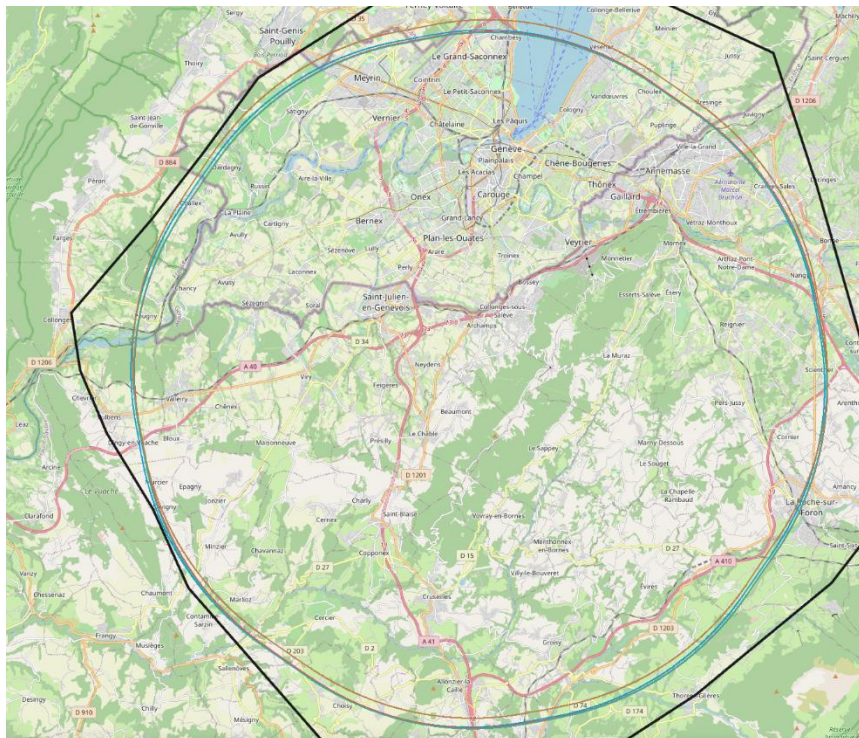


- Council want to be politically involved in the FCC FS throughout the study
  - ◆ They requested a list of items to be reviewed mid-2023 (mid-term review)
    - Goals
    - Scope
    - Milestones
  
  - ◆ Each work package should prepare such a list before the Council meeting in December
    - A good exercise (and good practice) anyway, also for us
  
  - ◆ It is also a unique opportunity to inform the Council
    - About the needed participation from the Member States (budget and personnel) to PED
      - If our goals and milestones are to be met





# New FCC Layout



- Study has converged on **1 baseline layout** (and 2 fallback solutions)
- total circumference of 91.173km (was 97km in CDR) → cost savings. Will lead to luminosity smaller by 10% (or more SR MW)
- Consistent with 4IP. Optimization of 4IP parameters under study for realistic machines – stay tuned !
- Placement of RF stations also under study. PL and PH proposed
  - point has been made that for Z and WW a single RF point is better wrt ECM calibration

**Description** The FCC technical and financial feasibility study comprises a work package (EPOL) on precision determination of the centre of mass energy at FCCee. using resonant depolarisation of the beams, in conjunction with precise measurement of the energy spread and other parameters using physics events in the detectors, and other beam diagnostics in particular to control the collision parameters. Specific equipment involves polarimeters for both beams, polarisation wigglers, and depolarising RF kickers. The possible mono-chromatization of the beams in view of a measurement of the  $e^+ e^- \rightarrow H$  (125) process will also be studied and special requirements investigated.

Short group meetings are foreseen at 16:30 on Thursday typically every two weeks.

**Videoconference**


zoom  FCC-FS EPOL group meeting 1 ▶ Join

**16:30 → 16:50 Welcome, Introduction** 🕒 20m 

Speakers: Alain Blondel (Universite de Geneve (CH)), Jorg Wenninger (CERN)

**16:50 → 17:05 short discussion on RF locations and ECM** 🕒 15m 

Speaker: Alain Blondel (Universite de Geneve (CH))

**17:05 → 17:35 Spin and energy simulations using BMAD** 🕒 30m 

Speaker: David Sagan

**17:35 → 18:05 Implementation of polarimeters and wigglers in the FCCee lattice** 🕒 30m 

Speaker: Michael Hofer (CERN)

**18:05 → 18:25 Status of participating groups (around the table)** 🕒 20m 

Speakers: Angeles Faus-Golfe (IJClab IN2P3 CNRS-Universit  Paris-Saclay (FR)), Eliana Gianfelice-Wendt, Frank Zimmermann (CERN), Ivan Koop (BINP), Tatiana Pieloni (EPF Lausanne)

**18:25 → 18:45 Actions, agenda for next meetings** 🕒 20m 

## Highlights:

- 27 participants
- notes taken by Mike K.
- issue with RF locations explained **w.i.p.**
- BMAD is a good prototype of a code with spin and orbit and collisions simulated together in real machine with energy losses and depolarization kicker (**good news... CPU?**)
- present layout of wigglers
  - in the  $D_{xy}=0$  point in bends near the IPs
  - expect monochromatization scheme thereabout (**maybe issue**)
- present layout of polarimeter
  - does not allow for  $\gamma$ -e collision before the dipole – **must be modified.**
- finally: good prospect for collaboration
  - CERN, BINP, EPFL, IJClab (Orsay)
  - USA: Cornell, BNL (for EIC)
  - Germany (KIT) etc.. **w.i.p.**

**more coming, next meeting 18 November**



## PED Events of Interest

- **Snowmass 21** <https://indico.fnal.gov/category/1098/>  
regular meetings of interest in the Energy Frontier, Rare processes and precision Frontier  
We can use higher FCC people attendance (please let us know!)
- **Linear collider workshop 26-29 Oct.** <https://agenda.linearcollider.org/event/9211/>
- **CEPC international Workshop, 8-12 Nov. China** <https://indico.ihep.ac.cn/event/14938/>
- **ECFA “topical workshop” on Generators for “Future H/Ewk/top factories”, 9-10 Nov.** **see next slides**  
At CERN, with physical rooms <https://indico.cern.ch/event/1078675/> **Register by Nov 3**
- **ECFA Plenary Meeting: 18-19 November (Patrick invited to present the FCC-ee in Plenary session)**
- **Next FCC France workshop (Annecy): 30 Nov – 2 Dec**  
LAPP Annecy <https://indico.in2p3.fr/event/22887/>
- **FCC Physics, Experiments & Detectors workshop** in Liverpool 7-11 Feb 2022  
<https://indico.cern.ch/event/1066234/> **see next slides**
- **FCC Week 2022, Paris, 30/5-3/6 2022 (note the date)**



## Current steps in ECFA PED WG1 (Physics Potential)

- Contacting experts to “**identify thematic areas on specific topics where concrete work should be organized in the context of the ECFA Working Group...**” . Tentative division:
  - EFT and BSM (above the EW scale)
  - Precision requirements (theory and experiment)
  - Heavy Flavours
  - FIPs and “direct new physics” in general
  - HL-LHC connection (under discussion, potential “next workshop”)
- This will help us to identify the final conveners in charge of the different subgroups and who will:
  - identify crucial to-do items, build community around them,
  - report and organize parallel session at the central ECFA workshops,
  - define/organize small topical workshops,
  - contribute to overall seminar series,
  - deliver the corresponding chapter of the final Yellow Report



# WG2-WG1 Generator Workshop at CERN (9-10 Nov): tentative program

<https://indico.cern.ch/event/1078675/>

the preliminary program for the Generator workshop is here:

Nov 9:

9:00	10	Intro
9:10	20	Herwig
9:30	20	Pythia
9:50	20	Sherpa
10:10	20	Discussion

11:00	20	Madgraph
11:20	20	Powheg
11:40	20	Whizard
12:00	10	Discussion

14:00	20	KKMC
14:20	20	BabaYaga
14:40	20	Phantom
15:00	20	Geneva
15:20	10	Discussion

16:00	15	CIRCE
16:15	15	GuineaPig
16:30	20	Tauola, Photos
16:50	20	HEP SW Foundation (Vectorrized C++, GPUs with Madgraph)

Nov 10:

9:00	20	Ecosystem
9:20	30	Discussion on interface
9:50	30	Discussion on benchmarks
11:00	15	Production experience LC
	15	Production experience FCC
	15	Production experience LHC
11:45	30	Testing/Defining/Setups/Help from outsiders.....
14:00	20	LHE: Status and Developements
	10	Discussion LHE/Standards
14:30	30	Discussion on Road ahead

The "standard set" of question to ask each group is:

1. Beamstrahlung FCC, CLIC, ILC: internal or external or???
2. Beamspot/crossing angle internal/external
3. polarization: available, foreseen, not foreseen/full matrix
4. interface to KEY4HEP: available, not doable, foreseen, need modifications in KEY4HEP (library or file)
5. Supported Output format(s)?
6. code management/availability or source code (website or gitlab/hepforge...../is there a user feedback loop?)
7. testing: interest in comparisons with other generators
8. LHE: irrelevant, need it, need an extension
9. Which hadronization model(s)? Pythia/herwig/whizard/....
10. External decays/FSR? Tauola/Photos/EvtGen
11. NLO corrections : EW/QCD/none/planned

2



Feb 7 – 11, 2022

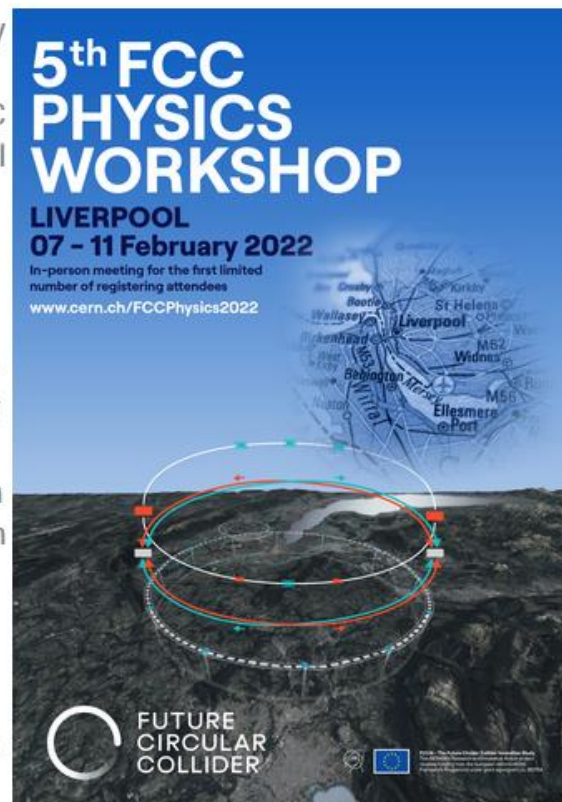
Europe/London timezone

Enter your search term

Welcome to the 5th FCC Physics workshop in Liverpool!

**For sanitary reasons, the event will be held in hybrid mode, with a limited number of participants allowed on site. All plenary and parallel sessions will be accessible for remote participants by a zoom link.**

Following the recommendations from the European Strategy for Particle Physics, CERN has now launched the FCC technical and financial Feasibility study (FCC-FS), of the FCC colliders (ee and hh) as a global project with its international partners[1]. The study goals include optimization of the placement and layout of the ring and related infrastructure, and demonstration of the geological, technical, environmental and administrative feasibility of the tunnel and surface areas, as well as the preparatory administrative processes required for a potential project approval, together with the Host States. The study will deepen the design of FCC-ee and FCC-hh and their injectors, supported by R&D on key technologies. The financial feasibility study will focus on the first stage (tunnel and FCC-ee)[2]. One of the pillars of the FCC-FS organization is the Physics Experiments and Detectors (PED) study, in which the physics case and detector concepts will be consolidated for both colliders (FCC-ee and FCC-hh, with its heavy ion programme and with the e-p option)[2].



- Overview
- Call for Abstracts
- Participant List
- Scientific Programme Committee
- Venues
  - The University of Liverpool
    - How to get there
  - ACC Liverpool
    - How to get there
  - Hotels near ACC
- Things to see and do in Liverpool
- Reception and formal Dinner
- Excursion options - Wednesday afternoon
- Online Payment



## Important points for the 5th Physics workshop

### 1. The workshop registration will soon open

-- number of in-person participants is limited to ~150 (first come -- first served)

-- registration fee is 300€

(It was found that leaving this number open in COVID times would lead to huge climb of costs)

-- all sessions will be broadcast in zoom, and all slides on indico but of course not:

the poster session, collaboration dinner, excursion and private discussions, coffees/tea breaks etc.

### 2. Preliminary workshop agenda follows.

-- There will be parallel sessions corresponding to the PED main work-packages

-- There will be a poster session

### 3. Abstract submission:

-- single abstract for parallel/poster session.

-- **submitter or one of the authors must be in person at the meeting to present it.**

-- it is highly desirable that parallel session presentations also have a poster so that everyone can benefit from it.

time	title	speaker	duration /status
9:00-10:30	session chair		
9:00	Welcome to Liverpool University		
9:15	Welcome and CERN vision		
9:35	FCC feasibility study, High Field Magnet R&D		
10:10	ECFA and the FCC		
10:30	coffee break		

time	title	speaker	duration /status
10:45-12:30	session chair		
10:45	PED study introduction and goals of meeting		
11:05	Plans for MDI WG [15+5]		
11:25	Plans for EPOL		
11:55	Plans for Software [15+5]		
12:15	reserve, discussion		



time	title	speaker	duration /status
14:00-16:00	session chair	TBD	
14:00	-- recap of the FCC-ee physics potential and open questions (20+5)	TBD	20
14:20	-- recap of the FCC-hh physics potential and open questions (20+5)	TBD	20
14:40	-- recap of the FCC-ep physics potential and open questions (10+5)	TBD	10+5
14:55	Plans for Physics Programme WP [15+5]	TBD	15+5
15:15	Plans for Physics Performance WP [15+5]	TBD	15+5
15:35	Plans for Detectors Concepts WP [15+5]	TBD	15+5
16:00	coffee break		

time	title	speaker	duration /status
16:30-18:00	session chair	TBD	
16:30	Software talk	TBD	15+5
17:00	Physics keynote 1	TBD	25+5
17:30	Physics keynote 2	TBD	25+5
18:00			



	Monday 7 Feb	Tuesday 8 Feb	Wednesday 9 Feb	Thursday 10 Feb	Friday 11 Feb
morning	plenary	1. Physics Performance 2. Detector concepts// 3. Physics programme 1 4. Physics programme 2	1. Detector concepts 2. Software 3. Machine detector interface (MDI) 4. Physics Programme 4	plenary	plenary (ending 1pm)
afternoon	plenary	14:00-15:30 1. Physics Performance 2. Detector concepts 3. Beam Energy calibration (EPOL) 4. Physics programme 3  16:00-18:00 1+2 Joint Performance and detectors: "joint tutorial on "Benchmarks to Detector requirements, software, case studies" 3. Beam Energy calibration (EPOL) 4. Physics programme 3	excursion	plenary	UK meeting
evening	drinks & posters		workshop dinner		
All plenary and parallel sessions to offer remote connection. Public lecture TBD					



	Monday 7 Feb	Tuesday 8 Feb	Wednesday 9 Feb	Thursday 10 Feb	Friday 11 Feb
morning	plenary	parallel 1 parallel 2 parallel 3 parallel 4 (up to 4 //)	parallel 1 parallel 2 parallel 3 parallel 4 (up to 4 //)	plenary (up to 6 presentations) <b>Software</b> <b>Physics Presentations</b>	plenary (ending 1pm) <b>Summary talks from parallel sessions</b> <b>Overall summary &amp; outlook</b>
afternoon	plenary	parallel 1 parallel 2 parallel 3 parallel 4 (up to 4 //)	excursion	plenary (up to 8 presentations) <b>Special physics, EPOL, MDI</b> <b>detector concepts</b>	
evening	drinks & posters		workshop dinner	18:30 The FCC global collaboration and international forum (TBC)	
All plenary and parallel sessions to offer remote connection. Public lecture TBD					



**It is really exciting to see our dream become reality!**