FCC P&E News
A. Blondel and P. Janot

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S. Jadach, M. Skrzypek (Cracow, INP). Mar 23, 2019. 42 pp.
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review

theory predictions

Papers of direc

Preparing the next steps

1. **STRATEGY PROCESS**

2. **FCC study**

FCC week in Brussels ➔ register asap.
https://fccweek2019.web.cern.ch/

2020 ESPP update: timeline and structures

- The strategy update will be adopted by CERN's Council in May 2020
- It will be drafted by the European Strategy Group (ESG)
- The draft will be based on input from the community (physics results, new projects, national roadmaps, individuals, etc.), to be submitted by end 2018
- Input collected by Physics Preparatory Group (PPG): they will organize an Open Symposium (May 2019) involving the community and summarize the physics input in a "Briefing Book".
- Organizational matters will be handled by Strategy Secretariat

- **September 2017: Strategy Secretariat appointed by Council**
  H. Abramowicz (Chair; also chair of PPG and ESG), J. D'Hondt (ECFA Chair), K. Ellis (SPC Chair), L. Rivkin (Chair of LDG=Laboratory Directors Group)

- **September 2018: appointment of PPG and ESG by Council** → formal start of the ESPP update
  PPG: Strategy Secretariat, 4 members proposed by SPC and 4 by ECFA, 1 CERN representative, 2 representatives from Asia and 2 from Americas
  ESG: Strategy Secretariat, CERN DG, 1 representative per CERN Member State, LDG
  Invited: Council President, 1 rep per Associate Member State and Observer State, PPG, EC representative, Chairs of ApPEC, NuPECC, FALC, ESFRI

- **May 2019: Open Symposium**

- January 2020: Drafting of strategy update by ESG

- **May 2020: approval of the ESPP update by Council**

Preparing the next steps

Strategy process

0.1 strategy secretariat
H. Abramowicz (Chair; also chair of PPG and ESG), J. D'Hondt (ECFA Chair), K. Ellis (SPC Chair), L. Rivkin (Chair of LDG=Laboratory Directors Group)

0.2 preparatory group
Physics Preparatory Group
Halina Abramowicz **(Chair),** Shoji Asai, Stan Bentvelsen, Caterina Biscari, Marcela Carena, Jorgen D'Hondt, Keith Ellis, Belen Gavela, Gian Giudice, Beate Heinemann, Xinchou Lou, Krzysztof Redlich, Leonid Rivkin, Paris Sphicas, Brigitte Vachon, Marco Zito, Antonio Zoccoli

Input collected here https://indico.cern.ch/event/765096/ (160 contributions)

1. **open meeting**

.. GRANADA meeting https://indico.cern.ch/event/813895/

➔ will feature general talks, parallel sessions and **reports from working groups by PPG members**

please let us know who is coming it would be useful to be present in all parallel sessions.

Preparing the next steps

1. STRATEGY PROCESS

this is important: a positive recommendation by the Strategy for going ahead with a large circular facility is now the most important step we need.

there seems to be a consensus that the next step should be an e+e- machine.
generally dubbed Higgs Factory . However
FCC-ee is much more than a Higgs Factory : **FCC-ee = the ELECTROWEAK FACTORY**

BEWARE…

There will be attemps to delay the recommandation to leave more time for the ILC

-- This will delay everybody, including ILC, by 6 years

-- Moreover this will cause a great risk for the future of CERN
as we are not the only ones proposing a circular facility!

Alternative proposals such as HE-LHC and mini-FCC (50 TeV in 100km w LHC magnets)
1. are more expensive than FCC (ee and hh) and cover far less physics
2. go well beyond the '5 Billion' mark indicated by council. (first step of FCC-ee is 3B€)

FCC vs ILC RECOMMANDATION

We had a special FCC Coordination Group Meeting in presence of DG (F. Gianotti) and DA (director for accelerators F. Bordry) Monday 18 March. Here are the main points

-- DG summarized situation with ILC

-- no committment from Japanese governement

-- MEXT declared interest in ILC for the first time (this is new) and will seek discussions with governments (KEK DG charged with contacts)

-- ICFA acknowledges the above, regrets the lack of committment, reiterates support, but also praised the fact that other Higgs factory proposals have matured.(This is new)

-- likely that funding agencies will wait for Japan committment and ESPP conclusions.

-- under these conditions it will be impossible to ignore ILC in the strategy.

NB you can find the latest ICFA statement here:
https://icfa.fnal.gov/wp-content/uploads/ICFA_Tokyo_Statement_March2019.pdf

Directorate invites us to stop discussing ILC and concentrate on FCC!

-- CERN's future (either FCC or CLIC) IS THE FIRST PRIORITY, and should not be jeopardized by non-committal statements

FCC work

-- completing full 'CDR volume 5' write-up

-- publish independently the sections as stand-alone

-- for instance 'FCC-ee Polarization and Centre-of-mass Energy Calibration' -- getting close.
100+ pages, important breakthroughs in the monitoring of E_{beam} , E_{CM} and σ_{ECM}

-- write ups of EW Z and W, Higgs section top etc..

-- precision calculations of EWPOs

-- in preparation: proceedings of workshop on precision from January 2019

-- On request by DG: study possible performance of a 4-IP version of FCC-ee

-- prepare for EC proposals

-- Design study for FCC infrastructure and implementation in view of FCC(ee and hh)

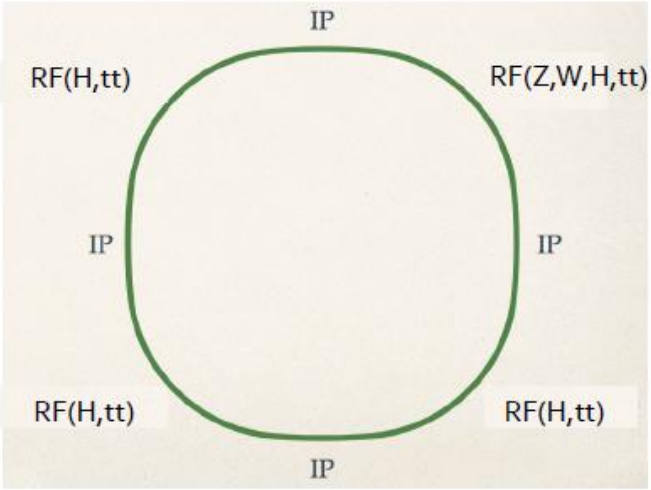
-- ITN or such for the precision calculation community

-- continuation of European Integrated Infrastructure for particle physics detectors AIDA++

-- see talk by Paolo Giacomelli today

-- prepare next step in the study

Studies about 4 IPs started (K. Oide)



- Equal spacing between IPs:
  - Otherwise more than 4 bunches couple together.
- Complete period 4 periodicity, including RF (at least at ttbar):
  - Better beam-beam, dynamic aperture, etc.
- RF must be at the midpoint of 2 IPs:
  - Beams cross over at the RF.

Next in line
- Dynamics full simulation
- Price increase
- Compatibility with FCC-hh
- Compatibility with injection
- …

Rough estimation of luminosity

	Z		tt	
# of IPs	2	4	2	4
Particles/bunch [10^{11}]	1.7		2.3	
Bunches/beam	16640		48	
$\beta^*_{x/y}$ [m/mm]	0.15/0.8		1/1.6	
Long. damping [turns]	1270		40.8	
σ_z (SR/BS) [mm]	3.51/11.4	3.51/13.0	1.96/2.54	1.96/2.80
σ_δ (SR/BS) [%]	0.038/0.123	0.038/0.141	0.150/0.194	0.150/0.215
$\xi_{x/y}$	0.004/0.148	0.003/0.129	0.098/0.141	0.089/0.136
Luminosity/IP [10^{34}/cm^{2}s]	230	201	1.40	1.31

- Above are just geometrical calculations: no dynamics involved.
- Real estimation will be soon given by D. Shatilov & K. Ohmi including flipflop & beam-beam instabilities.

FCC and HL-LHC

Some worries have been expressed that FCC might distract people from HL-LHC construction, commissioning and exploitation.

THIS IS AN IMPORTANT POINT

Certainly we have experienced similar worries and difficulties in LEP2 when LHC was in preparation

This will be unavoidable and even without FCC-ee there will be many other temptations!

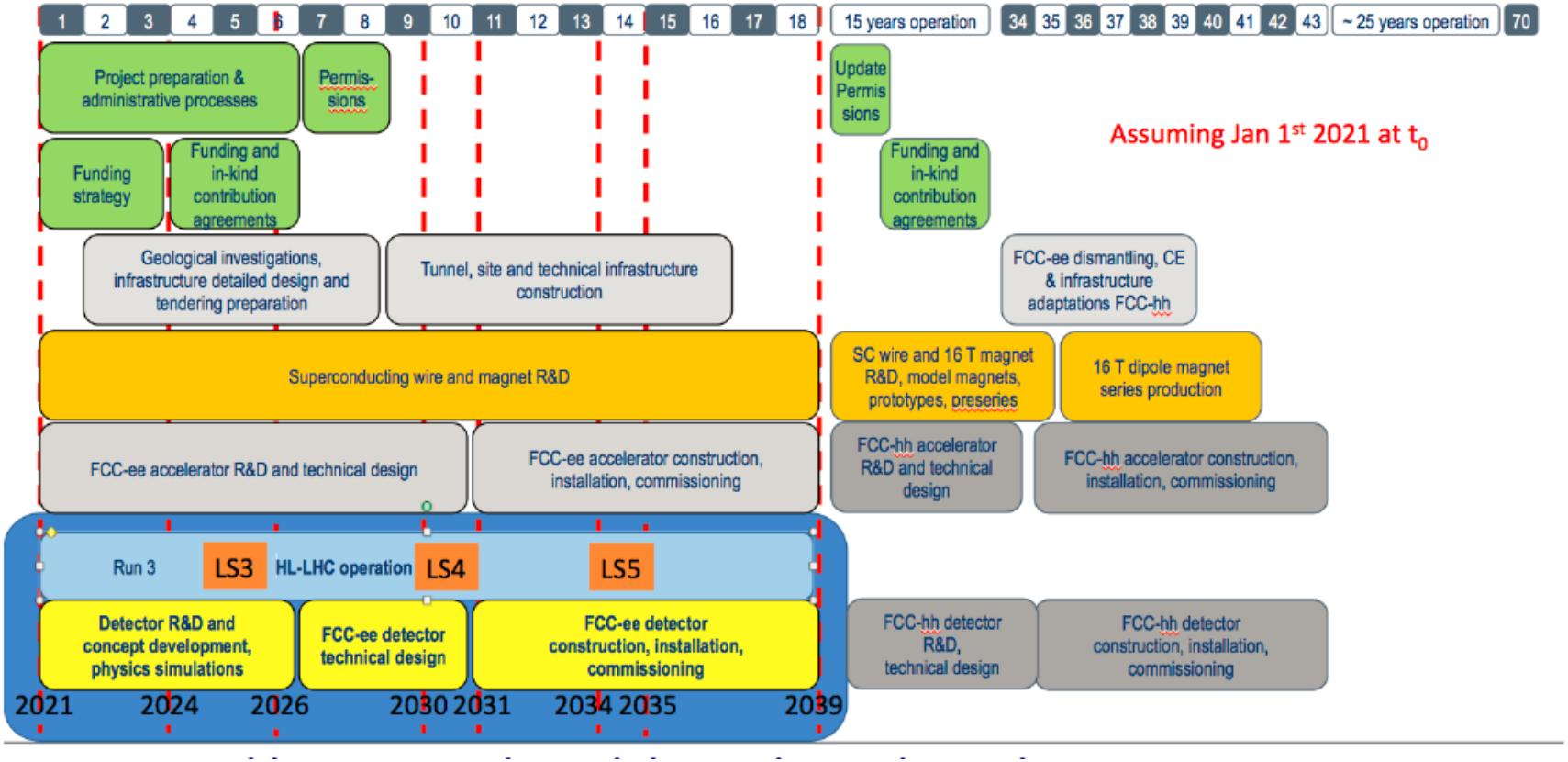
Actually, FCC-ee is the best of all of these evils! it is close geographically and thematically and much easier to manage than another project that is not based at CERN.

➔ **Make sure that FCC-ee time line integrates well wit HL-LHC**

FCC and HL-LHC

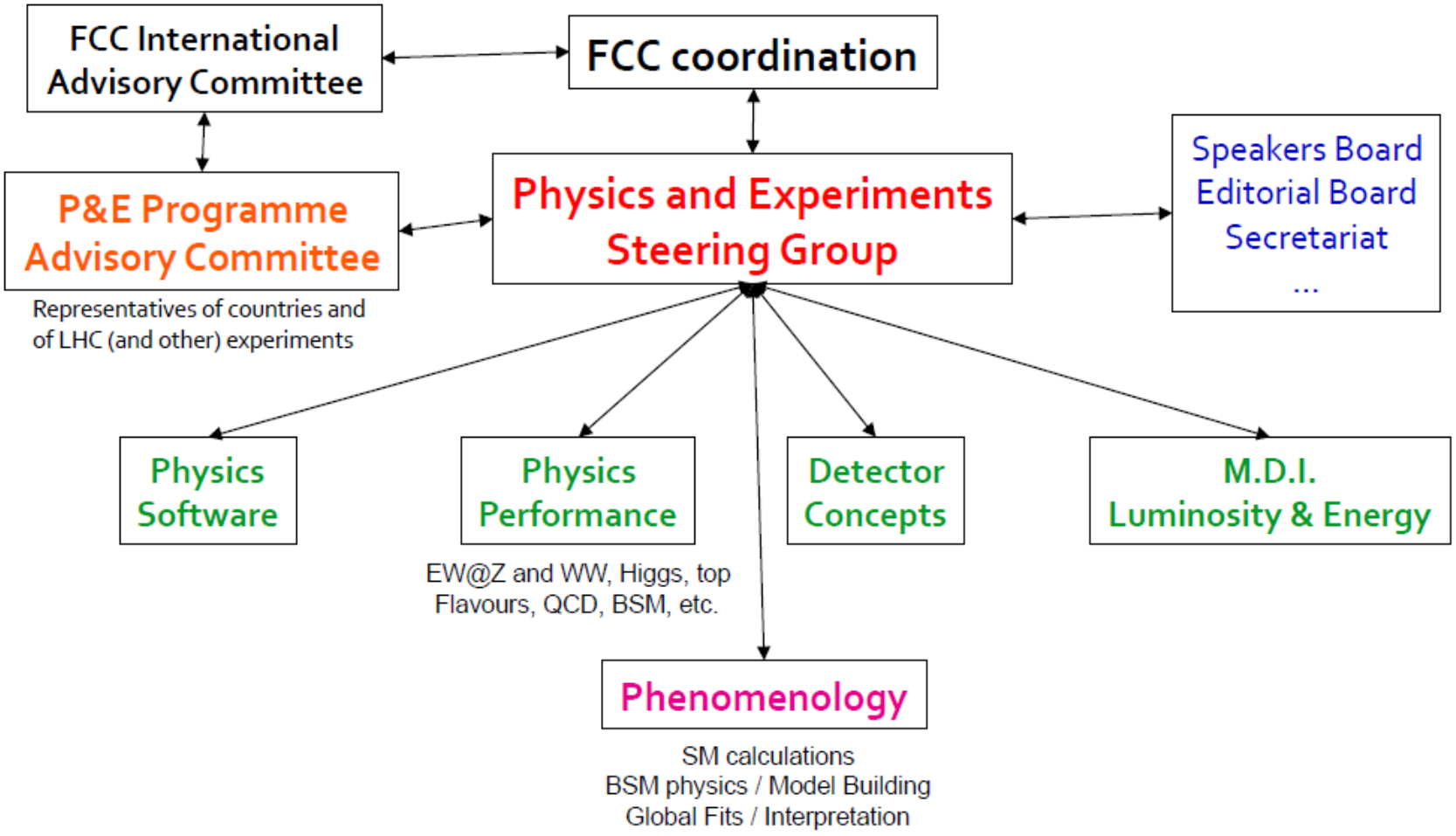
From HL-LHC towards FCC-ee

- Detector collaborations and technical design



The hard work towards FCC-ee (TDRs) to take place after commissioning of HL-LHC upgrades
Also taking data with HL-LHC and FCC-ee on a same year are not necessarily incompatible if needed! … but not foreseen now

FCC Physics and Experiments Study Organization



FCC Physics and Experiments Study Organization

1. **FCC P&E studies will be common to FCC-ee and hh**

2. **first priority → FCC Physics software coordinator**

   Approved by EP/SFT group leader and EP department head (yes!)

   Gerardo.Ganis@cern.ch Girardo Ganis will start 1st may 2019.

3. **Mandates have been drafted for**
   - -- P&E study steering group
   - -- P&E Program Advisory Committee (1st draft submitted to FCC IAC, iterating…)
   - -- FCC software coordinator (done)
   - -- FCC detector working group coordinator(s)

4. **also should move towards more organized FCC collaboration**

ideas, volunteering and comments are welcome.

P&E Steering Group

- **To reinforce the "Physics and Experiments Coordinators"**
  - Chairs: Alain, Patrick. Members being defined, mostly CERN-based to start with.
    - Will include some of the present conveners.
      - Objective: Creation of a worlwide consortium of scientific contributors, who reliably commit resources for the development and preparation of the scientific part of the project from 2020 onwards

        Need to widen the scope of the study in three directions:
        geography, science, and technology.

  - Work likely to involve the following aspects (among others)
    - General organization of the physics and experiments study;
    - Identification of and search for collaborators at CERN and outside, with the preparation of MoUs and addenda (explicit commitment and work definition);
    - Definition and oversight of the desired outputs (technical and scientific papers);
    - Promotion of the participation of study members to conferences;
    - Planning and organization of meetings or workshops as appropriate;
    - Preparation towards the next step of the study, to take place after the ESPP recommendations and following considerations by the CERN management;

P&E Steering Group (cont'd)

- **A draft mandate exists in a preliminary form**

A. Blondel, P. Janot, V0.2, 3 April 2019

FCC Physics and Experiments Steering Group

Present status. The outcome of the FCC design study was presented in the CDR documents and in the contributions to the Strategy process https://fcc-cdr.web.cern.ch/ ; they are summarized in the FCC Integrated Programme (FCC-INT) , with the following timescale (Figure 1).

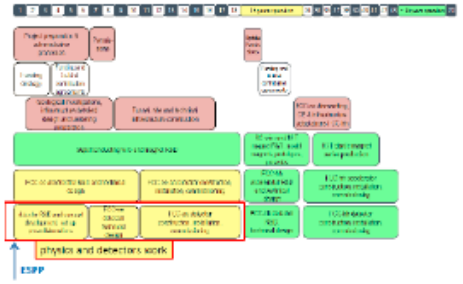


Figure 1 The FCC-INT timeline. The part in the red box concerns the physics and experiments.

The work in the next seven years (2019-2026) is critical for one of the acknowledged challenges:

An immediate challenge is the creation of a worldwide consortium of scientific contributors, who reliably commit resources for the development and preparation of the scientific part of the project from 2020 onwards.

Timewise, a high priority goes to the development and the preparation of the FCC-ee experimental program, while keeping in mind the longer-term goal of the pp (ep) collider.

Next steps

The 'European Strategy process' (ESPP) has just started, and will deliver its conclusions in the early part of 2020. If the ESPP recommendation is favorable to the FCC, a proper readiness will have to be ensured by the time of the possible 'kick-off' event towards the end of 2020 / beginning of 2021. The rest of this document therefore addresses the next ~18 months.

While the "Physics and Experiments" part of the FCC-ee conceptual design study has been able to perform a first detailed mapping of the physics arguments (precision electroweak, Higgs, and top measurements, interpretation in terms of heavy new physics, direct searches for new particles with extremely small couplings or for forbidden phenomena) and of the defining questions for the design of the accelerator (run plan, machine-detector interface issues, centre-of-mass energy calibration and beam polarization), it is still quite superficial in many areas. For example:

1. The study has only addressed the questions of detectors and interaction regions inasmuch as feasibility is concerned. The integration and the systematic optimization of detectors systems with respect of the many experimental challenges remains to be done. It will most certainly involve technologies that are beyond the state of the art;
2. Dedicated work will need to expand for theoretical and phenomenological work (precision calculations, BSM mapping, heavy flavours, etc.) in order to reach the required order(s)-of-magnitude improvements needed to match the expected experimental accuracies;
3. A broader set of people will be needed to uncover the physics capabilities of the facility in its many details, and to apply present technological knowledge to the design of optimal detector systems.

It is therefore proposed to use the transition period of the ESPP update to widen the scope of the study, in three directions: geography, science and technology.

Geography: Active participation of the national communities in all member states (and beyond) will be necessary. To this effect, we have suggested to create a FCC-ee Physics and Experiments Program Advisory Committee that will involve members of each desired community. This proposal has been submitted to the FCC IAC for action.

Science: The theoretical work and the development of experimental studies towards the design of high precision and high sensitivity experiments will involve broadening and/or gathering of the consortium of users, as well as training programs targeting young and talented physicists.

Technology: Experimental challenges as well as new, so far unaddressed, requirements, will need to be mapped onto present and foreseeable technological developments. CERN offers a remarkable pool of expertise and contacts in this domain. A particularly urgent issue is the ability to address the science questions with up-to-date, flexible, and sustainable software tools, integrated in a central software architecture and support.

In order to grapple these issues efficiently, it is proposed to reinforce the present FCC-ee "physics and experiments" coordination with a P&E steering group (or "council"), based at CERN and covering the main aspects of the above. The resulting organigram can be as follows.

FCC P&E steering group

The mission of the steering group is to define a line of action to tackle the challenges listed above, and to see to its execution. The corresponding work is likely to involve the following aspects (among others):

- General organization of the physics and experiments study;
- Definition and oversight of the desired outputs (technical and scientific papers);
- Promotion of the participation of study members to conferences ;
- Planning and organization of meetings or workshops as appropriate;
- Identification of and search for collaborators at CERN and outside, preparation of MOUs and addenda with explicit commitment and work definition;
- Preparation towards the next step of the study, to take place after the ESPP recommendations and following considerations by the CERN management.

The P&E steering group will report to the FCC coordination meeting and to the P&E PAC.

Meetings and composition

The steering group will meet at regular intervals (typically every two weeks) to be tuned according to requirements. (It can decrease once things are rolling.) The composition of the steering group is mostly CERN based for a start.

Alain Blondel, Patrick Janot (co-chairs)

Members being assembled, will include some of the current conveners who want to actively engage in the steering group.

First ideas for an organizational chart

Not a proposal – for discussion

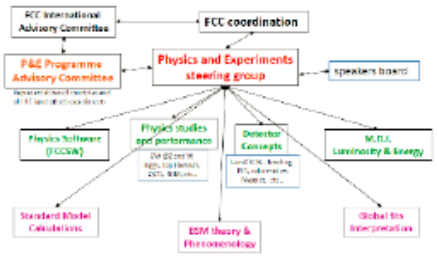


Figure 2 Possible organigram for the FCC physics and experiments studies.

Submitted to Michael Benedikt, awaiting comments.

FCC-ee Physics Software

- **Highest priority: Draft mandate for the coordinator(s) completed**

Mandate for the FCC-ee Software Coordinator(s)

Present Status and Opportunity for Improvement

In the five years of the FCC conceptual design studies (2014-2019), the FCC offline software group – under the coordination of Benedikt Hegner, assisted by Colin Bernet for FCC-ee, and by Clément Helsens for FCC-hh – has established the base for an end-to-end (i.e., from MC generators to physics analysis) software framework for the FCC (ee and hh) physics studies. It started with a review of the frameworks used by the LHC collaborations and in the linear collider studies, and an evaluation of the specific needs of FCC, including the use parallel computing, modern languages, compact data formats, etc.

A first round of development has successfully taken place for the FCC CDR. It has allowed fast simulation with DELPHES for physics studies and dedicated full simulation of sub-detector prototypes with GEANT4, mostly by FCC-hh, and a few parameterized FCC-ee Higgs studies with PAPAS. The mandate of the present team has come to an end and the next step of development is starting now. This new phase should take stock of the achievements so far, in order to continue and expand to more detailed studies, in particular for the e^+e^- machine.

As a result of the FCC conceptual design study, the FCC integrated programme is now proposed: the FCC-ee will start running in 2038/39 for about 15 years, followed by a 100 TeV pp collider (FCC-hh), both using a new 100km tunnel in the Geneva area. The FCC-ee studies are becoming a CERN priority, towards making quantified letters of intent for several (at least four) detector concepts by the time of the next-to-next European Strategy update (2026). In parallel, the FCC software framework is also seen as the prototype for a "turnkey software stack" for future experiments, as envisioned in the CERN/EP Detector R&D document submitted to the 2019-2020 update of the European Strategy for Particle Physics.

Given these positive developments and perspectives, a new effort has to be launched within the next few weeks/months, with motivated coordinators based at CERN, fostering and supporting substantial participation from all FCC institutes worldwide, for software development and use in physics studies, detector concept optimization, and machine-detector interface design.

Scope of the project

Areas of work

1. Review the current status of the software framework (e.g., the event data model), and establish a road map for the rapid development of the parts that are missing, in view of quickly enabling FCC-ee physics studies, FCC-ee detector optimization, and FCC-ee machine-detector interface design. This step involves generator-level, fast or full simulation (or a mix thereof). Initial contact with the previous coordinators of the project is encouraged.
2. Integrate the Monte Carlo event generators needed for physics studies, in their latest and most precise implementation. Initial contact with linear collider experts is encouraged. Because the precision aimed at by the FCC-ee is orders of magnitude smaller than at linear colliders, contact with the dedicated FCC-ee theory precision effort will be mandatory.
3. Integrate the programs for beam-background simulation (synchrotron radiation, photons, incoherent e^+e^- pairs and hadron production from beamstrahlung, beam-gas interactions), for beam-beam effects (GuineaPig), and for collision properties (energy spread, crossing angle, ...), and develop an efficient tool for overlaying background with collision simulation data.
4. Provide software stacks ready to be used by detector developers and data analysts with very low usability thresholds and fast/easy learning curve.
5. Integrate the geometry, material, and magnetic field description of the interaction region (focusing quadrupoles, compensating solenoids, shielding, pumps, masks, beam pipe, detector magnets...), of a number of possible detector parts (luminosity calorimeters, vertex detectors, trackers, calorimeters, muon detectors ...) as proposed by the detector concept group, and of experiment magnet systems. This integration ought to be flexible enough to allow users to easily switch from one sub-detector to another, or to change basic dimensions (e.g., the radius of the beam pipe and of the vertex detector layers) or layout (e.g., coil inside or outside the calorimeter) in view of detector optimization studies in GEANT and fast simulations.
6. Integrate code for particle signal digitization in each of the detector parts, with various degrees of accuracy.
7. Integrate code for vertexing, tracking, clustering, ... in view of establishing individual particle identification in complex events for each of the detector designs.
8. Integrate software tools needed for physics analysis (particle-flow reconstruction, particle clustering in jets, heavy-flavour (b and c) tagging, etc.)
9. Ensure computing support and adequate CPU and storage resources (CERN-hosted and distributed) for the simulation and analysis of trillions of Z and Bhabhas, billions of W, and millions of Higgs and top, in addition to all backgrounds.
10. Provide extensive documentation for all available tools and methods, with regular tutorial sessions and tools to facilitate collaborative developments.

Areas of management

1. Evaluate quantitatively (number) and qualitatively (profiles) the composition of the team needed for the tasks described above.
2. Establish milestones with clear deliverables and timelines.
3. Determine (and nominate conveners for) the working groups in charge of completing these tasks. Establish a mandate for each of the working groups (which should include the task of finding/motivating adequately skilled people).
4. Organize regular software coordination meetings with the working group conveners, and report to the "Physics and Experiments" coordination meetings.
5. Liaise with the other areas of "Physics and Experiments" coordination ("theory" for generators, "detector concepts" for simulation and reconstruction, "physics performance" for reconstruction and analysis, and "machine-detector interface" for interaction region, beam backgrounds, beam-beam effects, and collision properties simulation.
6. Liaise with experts in other lepton collider projects (ILC, CLIC, BELLE II,...) in particular for generators, as well as with experts in LHC experiments for reconstruction tools.
7. Liaise with AIDA representatives and look for possible synergies (money, experts, code). Liaise with the turnkey software stack coordinator(s).
8. Personally welcome and guide beginners and more advanced users and developers through the documentation and the software. A kick-off workshop, followed by regular workshops, is a possibility to get the community on board and make it grow.

FCC-ee Physics Software (cont'd)

Success-oriented timescales of the project

The mandate for the FCC-ee software physics coordinators starts in Spring 2019 and runs until the next-to-next European Strategy update (~2026).

Spring 2019: Establish a grand plan and a priority list, together with the "Physics and Experiments" coordination, and start gathering interested and competent people (conveners and developers), in time for the FCC Week in Brussels (24-28 June 2019).

Summer/Fall 2019: Have a first prototype of software stack usable for FCC-ee physics simulation, with (for example) the beam pipe, a vertex detector, and tracking/vertexing algorithms.

Fall/Winter 2019: Organize a kick-off workshop in order to present the current status to the community, to refine the priorities for development, and to start gathering/engaging collaborators from CERN and from the FCC institutes worldwide. Commitments from new institutes should be formalized with FCC MoUs and Addenda.

Until end 2020 (period of the European Strategy update): Take advantage of this "quiet" period to significantly progress on all priority tasks, towards at least one complete detector implementation with event (fast/full) simulation and reconstruction prototype, for detector optimization and physics simulations.

Between 2021 and 2026: Conclude the detector concept development and physics simulations; the software stack will have to progressively include all new necessary developments, in order to get ready for the technical design studies that will start after the 2026 European Strategy update.

Not included in the project

The common turnkey software stack is not a direct responsibility of the FCC-ee software coordinator, although the coordinator(s) must ensure that the FCC software (ee+hh) is a part-and-parcels of this common software.

Summary: Objectives of the FCC-ee software coordination project.

- With high priority, gather a team of developers and, as needed, subgroup conveners, in view of delivering the FCC-ee software with clear priorities, for use in physics studies, detector concept optimization, and machine-detector interface design.
- With high priority, deliver a first working and usable prototype.
- Throughout the development, make sure that the software system is properly architected to encourage and manage the contributions of a large pool of software users. Educate and guide the FCC-ee software users, and keep the community aware of the progress.
- Have the software complete and ready for detector technical design studies in different experiment collaborations by the next European Strategy update (in ~2026).

- Submitted to EP/SFT Group Leader
  - Mandate approved
  - First coordinator identified
    - Needs approval from EP Head
  - With the hope to start end of April ?
    - Review of what exists
    - Organization of the work
    - Gathering of people
- Submitted to Michael Benedikt

Approved , Girardo Ganis nominated

- Clear timescales and objectives
- Will work closely with physics, detectors, and MDI groups.

Send your comments and suggestions to Alain and myself !

FCC-ee Detector Concepts

- **Mandate for the Detector coordinator(s) is the next-to-highest priority**
  - If you have opinions / ideas, please send your input to Alain and myself about
    - Opportunities for improvements
    - Areas of work
    - Areas of management
    - Timescales
    - Objectives
    - Coordinators
  - The mandate should cover
    - The period of the European Strategy update (until end 2020)
    - The five years that follow (2021-2026)
      - Which is supposed to prepare the next period

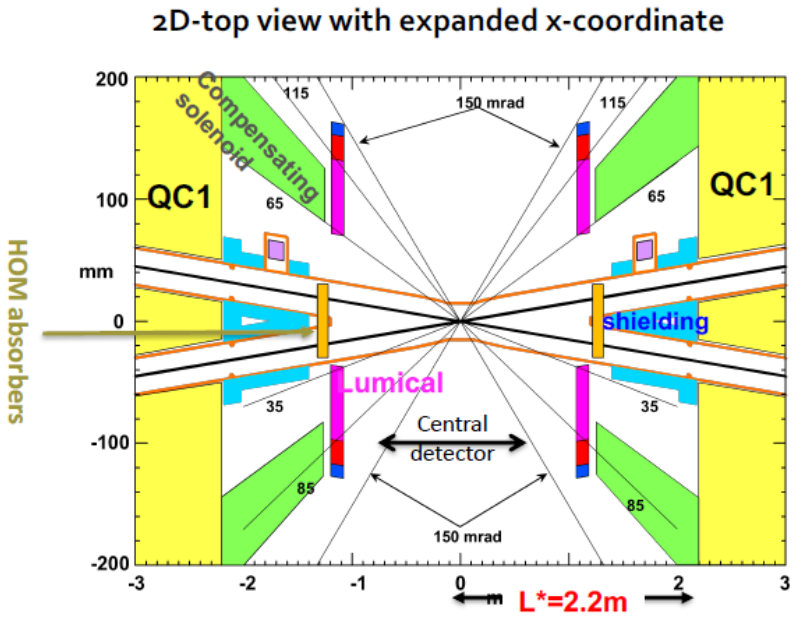
        With proto-collaborations

        Detector technical design studies
  - We hope to have a draft for the next physics coordination meeting

FCC-ee detector challenges…

No pileup, no underlying event, and demonstrated to be feasible but:

- Extremely large statistics / statistical precision
- …need small systematics (10^{-5} !) to match
- Physics event rates up to 100 kHz
- Bunch spacing down to 20 ns
- Continous beams, no power pulsing
- Complex interaction region
- beam pipe ∅ 2-3 cm



Optimization to be done for extremely rich physics capabilities, especially at the Z pole

10^{12} bb, cc, 2 10^{11} ττ, etc…

-- search for rare processes → excellent acceptance closure, sensitivity to displaced vertices

-- luminosity measurement at 10^{-4} (rel), 10^{-5} (abs)

-- acceptance definition at $\leq 10^{-5}$

-- optimal b/c/gluon separation

-- PID (TOF, dE/dx, Ckov?)

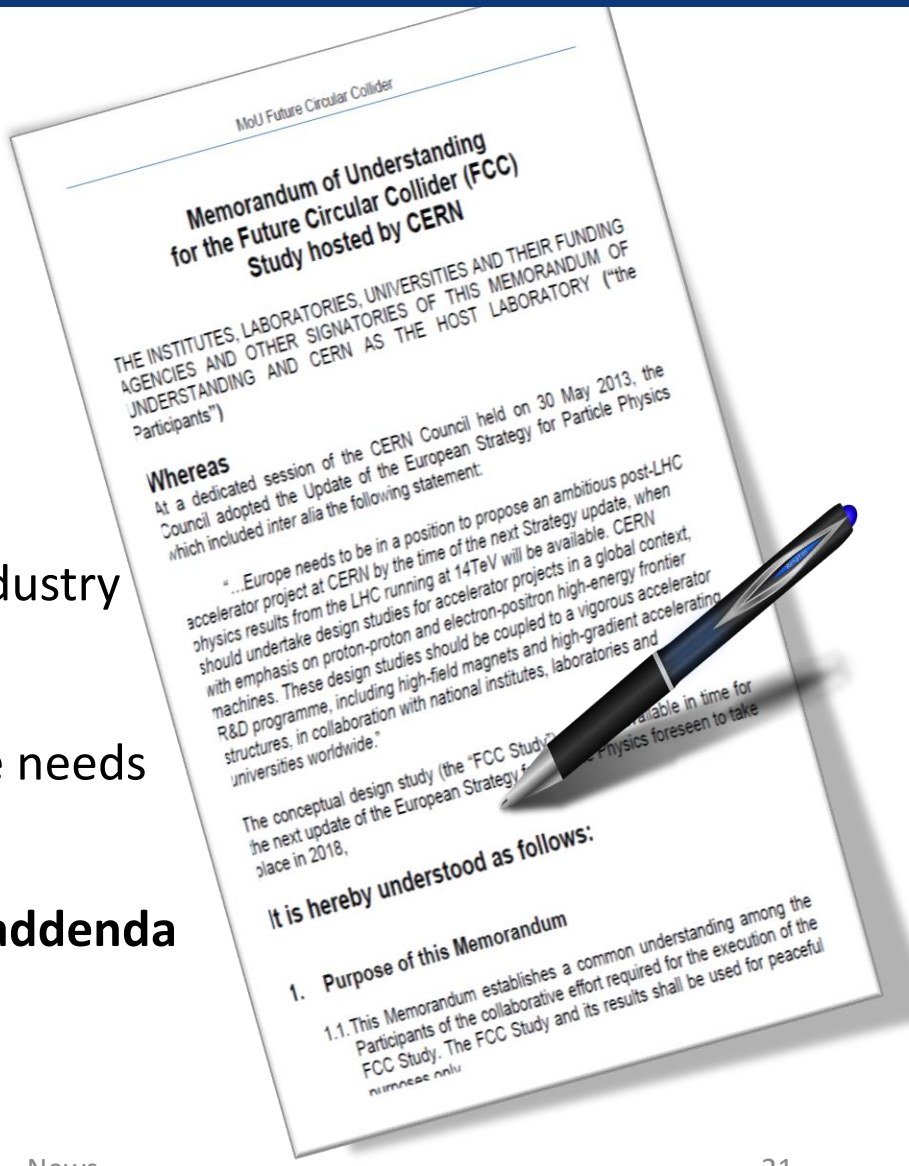
-- determination of point-to-point scan energies at 10 keV level

NEW challenges in design, technology, metrology, stability, monitoring

FCC collaboration framework

- A **consortium** of partners based on a Memorandum Of Understanding (MoU)
- Working together on a **best effort basis**
- Pursuing the same **common goal**
- **Self governed**
- **Incremental & open** to academia and industry

- **Light general framework**, adapted to the needs during a conceptual design study
- Detailed project descriptions in **specific addenda**


MoU Future Circular Collider

Memorandum of Understanding for the Future Circular Collider (FCC) Study hosted by CERN

THE INSTITUTES, LABORATORIES, UNIVERSITIES AND THEIR FUNDING AGENCIES AND OTHER SIGNATORIES OF THIS MEMORANDUM OF UNDERSTANDING AND CERN AS THE HOST LABORATORY ("the Participants")

Whereas

At a dedicated session of the CERN Council held on 30 May 2013, the Council adopted the Update of the European Strategy for Particle Physics which included inter alia the following statement:

"...Europe needs to be in a position to propose an ambitious post-LHC accelerator project at CERN by the time of the next Strategy update, when physics results from the LHC running at 14TeV will be available. CERN should undertake design studies for accelerator projects in a global context, with emphasis on proton-proton and electron-positron high-energy frontier machines. These design studies should be coupled to a vigorous accelerator R&D programme, including high-field magnets and high-gradient accelerating structures, in collaboration with national institutes, laboratories and universities worldwide."

The conceptual design study (the "FCC Study") ... available in time for the next update of the European Strategy ... Physics foreseen to take place in 2018,

It is hereby understood as follows:

1. **Purpose of this Memorandum**

1.1. This Memorandum establishes a common understanding among the Participants of the collaborative effort required for the execution of the FCC Study. The FCC Study and its results shall be used for peaceful purposes only

Towards a FCC collaboration

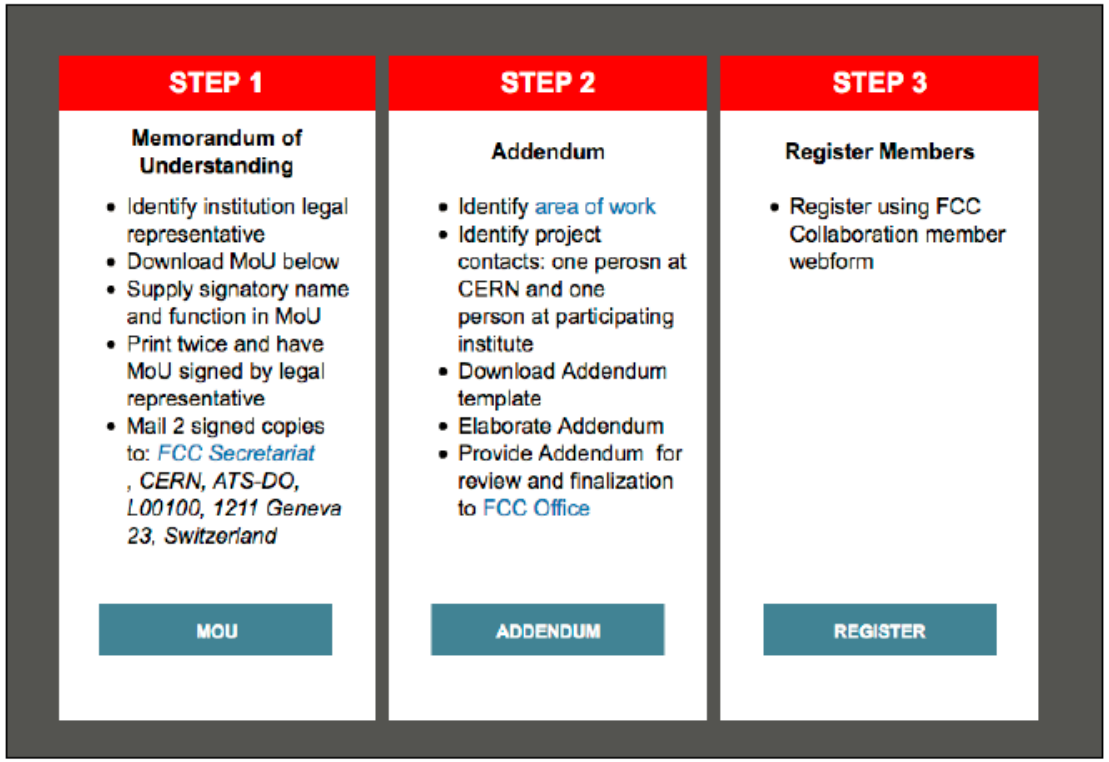
- **Guidelines for the FCC Collaboration have been shown here a few times**
  - It comes with the protection of our intellectual property, our computing resources, etc.
  - … and with the need of defining a "FCC Collaborator"
    - Until today, a FCC-ee Collaborator had just to subscribe to one of the FCC-ee mailing lists, without serious control
    - In the future, a FCC-ee collaborator will most likely have to
      - Be part of an institute that has signed a MoU with the FCC

        e.g., IN_2P_3, INFN, …
      - Be part of a lab that has engaged into a series of tasks via an Addendum

        New tasks can be added at any time
      - Subscribe to a "FCC Collaborator" mailing list
    - The current mailing lists will be used for communication, but will not give access to the computing resources or to work in progress
  - We understand that the FCC office is working on a centralized procedure
    - See https://fcc.web.cern.ch/Pages/Join.aspx/
  - You may encourage your national institutes / labs to go through the MoU and Addendum steps (if not already the case).

Towards a FCC collaboration (cont'd)

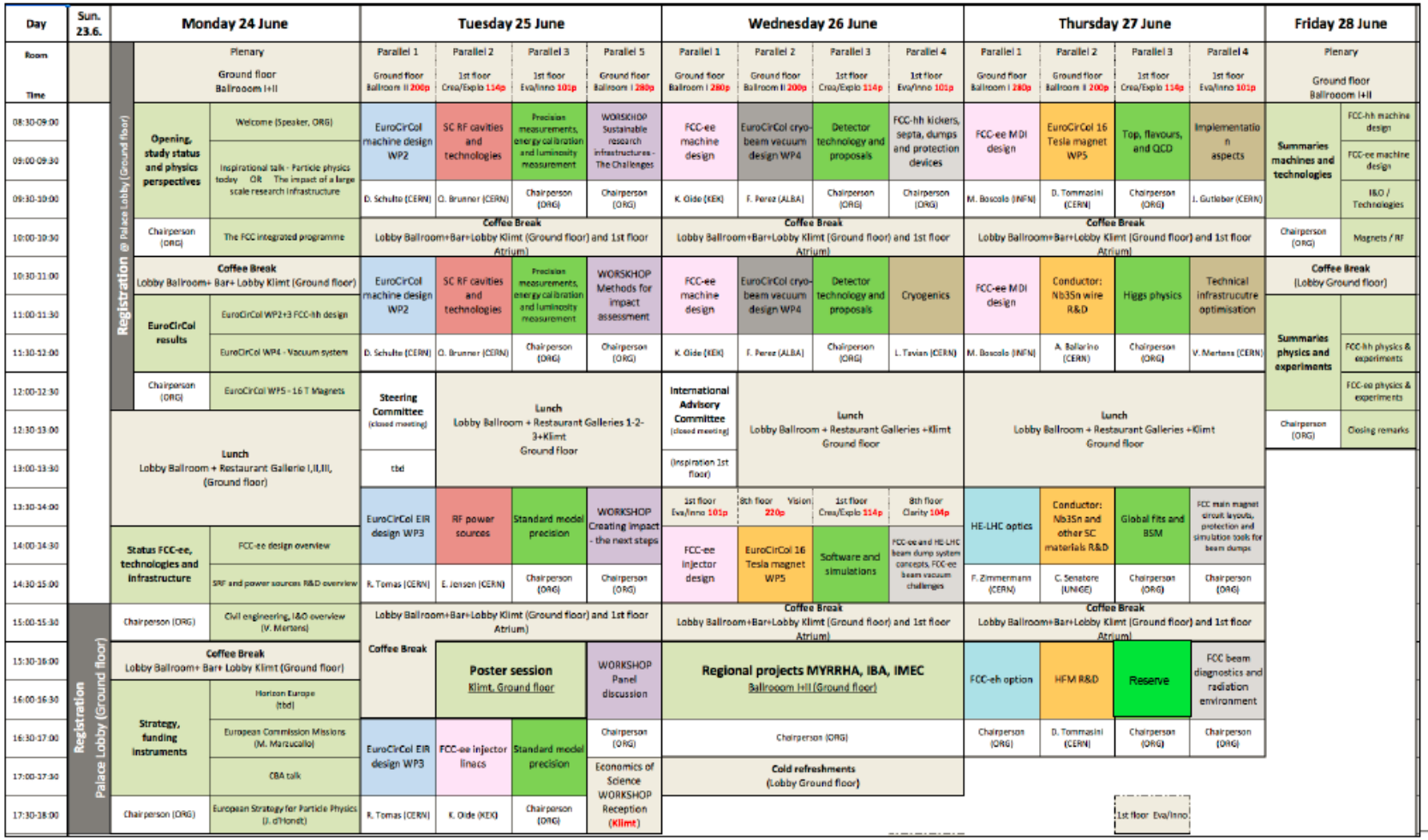
- https://fcc.web.cern.ch/Pages/Join.aspx/
  - Page under development, do not use STEP 3 for now
    - STEPS 1 and 2 can be processed independently



FCC week in Brussels ➔ register asap.
https://fccweek2019.web.cern.ch/

FCC Week Agenda (proposal)

- **See** https://indico.cern.ch/event/727555/page/13629-programme-at-a-glance



Day	Sun. 23.6.	Monday 24 June		Tuesday 25 June				Wednesday 26 June				Thursday 27 June				Friday 28 June	
Room / Time		Plenary, Ground floor, Ballroom I+II		Parallel 1, Ground floor, Ballroom II 200p	Parallel 2, 1st floor, Crea/Explo 114p	Parallel 3, 1st floor, Eva/Inno 101p	Parallel 5, Ground floor, Ballroom I 280p	Parallel 1, Ground floor, Ballroom I 280p	Parallel 2, Ground floor, Ballroom II 200p	Parallel 3, 1st floor, Crea/Explo 114p	Parallel 4, 1st floor, Eva/Inno 101p	Parallel 1, Ground floor, Ballroom I 280p	Parallel 2, Ground floor, Ballroom II 200p	Parallel 3, 1st floor, Crea/Explo 114p	Parallel 4, 1st floor, Eva/Inno 101p	Plenary, Ground floor, Ballroom I+II	
08:30-09:00		Registration @ Palace Lobby (Ground floor)	Opening, study status and physics perspectives: Welcome (Speaker, ORG)	EuroCirCol machine design WP2	SC RF cavities and technologies	Precision measurements, energy calibration and luminosity measurement	WORSKHOP Sustainable research infrastructures - The Challenges	FCC-ee machine design	EuroCirCol cryo-beam vacuum design WP4	Detector technology and proposals	FCC-hh kickers, septa, dumps and protection devices	FCC-ee MDI design	EuroCirCol 16 Tesla magnet WP5	Top, flavours, and QCD	Implementation aspects	Summaries machines and technologies	FCC-hh machine design
09:00-09:30			Opening, study status and physics perspectives: Inspirational talk - Particle physics today OR The impact of a large scale research infrastructure														FCC-ee machine design
09:30-10:00				D. Schulte (CERN)	O. Brunner (CERN)	Chairperson (ORG)	Chairperson (ORG)	K. Oide (KEK)	F. Perez (ALBA)	Chairperson (ORG)	Chairperson (ORG)	M. Boscolo (INFN)	D. Tommasini (CERN)	Chairperson (ORG)	J. Gutleber (CERN)		I&O / Technologies
10:00-10:30			Chairperson (ORG): The FCC integrated programme	Coffee Break: Lobby Ballroom+Bar+Lobby Klimt (Ground floor) and 1st floor Atrium				Coffee Break: Lobby Ballroom+Bar+Lobby Klimt (Ground floor) and 1st floor Atrium				Coffee Break: Lobby Ballroom+Bar+Lobby Klimt (Ground floor) and 1st floor Atrium				Chairperson (ORG)	Magnets / RF
10:30-11:00			Coffee Break: Lobby Ballroom+ Bar+ Lobby Klimt (Ground floor)	EuroCirCol machine design WP2	SC RF cavities and technologies	Precision measurements, energy calibration and luminosity measurement	WORSKHOP Methods for impact assessment	FCC-ee machine design	EuroCirCol cryo-beam vacuum design WP4	Detector technology and proposals	Cryogenics	FCC-ee MDI design	Conductor: Nb3Sn wire R&D	Higgs physics	Technical infrastrucutre optimisation	Coffee Break (Lobby Ground floor)	
11:00-11:30			EuroCirCol results: EuroCirCol WP2+3 FCC-hh design													Summaries physics and experiments	FCC-hh physics & experiments
11:30-12:00			EuroCirCol WP4 - Vacuum system	D. Schulte (CERN)	O. Brunner (CERN)	Chairperson (ORG)	Chairperson (ORG)	K. Oide (KEK)	F. Perez (ALBA)	Chairperson (ORG)	L. Tavian (CERN)	M. Boscolo (INFN)	A. Ballarino (CERN)	Chairperson (ORG)	V. Mertens (CERN)		FCC-ee physics & experiments
12:00-12:30			Chairperson (ORG): EuroCirCol WP5 - 16 T Magnets	Steering Committee (closed meeting)	Lunch: Lobby Ballroom + Restaurant Galleries 1-2-3+Klimt, Ground Floor			International Advisory Committee (closed meeting)	Lunch: Lobby Ballroom + Restaurant Galleries +Klimt, Ground floor			Lunch: Lobby Ballroom + Restaurant Galleries +Klimt, Ground floor				Chairperson (ORG)	Closing remarks
12:30-13:00			Lunch: Lobby Ballroom + Restaurant Galleries I,II,III, (Ground floor)														
13:00-13:30				tbd				(Inspiration 1st floor)									
13:30-14:00				EuroCirCol EIR design WP3	RF power sources	Standard model precision	WORKSHOP Creating impact - the next steps	1st floor Eva/Inno 101p	8th floor Vision 220p	1st floor Crea/Explo 114p	8th floor Clarity 104p	HE-LHC optics	Conductor: Nb3Sn and other SC materials R&D	Global fits and BSM	FCC main magnet circuit layouts, protection and simulation tools for beam dumps		
14:00-14:30			Status FCC-ee, technologies and infrastructure: FCC-ee design overview					FCC-ee injector design	EuroCirCol 16 Tesla magnet WP5	Software and simulations	FCC-ee and HE-LHC beam dump system concepts, FCC-ee beam vacuum challenges						
14:30-15:00			SRF and power sources R&D overview	R. Tomas (CERN)	E. Jensen (CERN)	Chairperson (ORG)	Chairperson (ORG)	F. Zimmermann (CERN)	C. Senatore (UNIGE)	Chairperson (ORG)	Chairperson (ORG)						
15:00-15:30		Registration Palace Lobby (Ground floor)	Chairperson (ORG): Civil engineering, I&O overview (V. Mertens)	Lobby Ballroom+Bar+Lobby Klimt (Ground floor) and 1st floor Atrium				Coffee Break: Lobby Ballroom+Bar+Lobby Klimt (Ground floor) and 1st floor Atrium				Coffee Break: Lobby Ballroom+Bar+Lobby Klimt (Ground floor) and 1st floor Atrium					
15:30-16:00			Coffee Break: Lobby Ballroom+ Bar+ Lobby Klimt (Ground floor)	Coffee Break	Poster session: Klimt, Ground floor		WORKSHOP Panel discussion	Regional projects MYRRHA, IBA, IMEC: Ballroom I+II (Ground floor)				FCC-eh option	HFM R&D	Reserve	FCC beam diagnostics and radiation environment		
16:00-16:30			Strategy, funding instruments: Horizon Europe (tbd)														
16:30-17:00			European Commission Missions (M. Marzucallo)	EuroCirCol EIR design WP3	FCC-ee injector linacs	Standard model precision	Chairperson (ORG)	Chairperson (ORG)				Chairperson (ORG)	D. Tommasini (CERN)	Chairperson (ORG)	Chairperson (ORG)		
17:00-17:30			CBA talk				Economics of Science WORKSHOP Reception (Klimt)	Cold refreshments (Lobby Ground floor)									
17:30-18:00			Chairperson (ORG): European Strategy for Particle Physics (J. d'Hondt)	R. Tomas (CERN)	K. Oide (KEK)	Chairperson (ORG)								1st floor Eva/Inno			

FCC Week Agenda (Proposal)

- First thoughts for 12 sessions of 90 mins each (Tue, Wed, Thu)
  - Precision measurements, Beam energy, Luminosity : 2 sessions on Tuesday morning
    - Conveners: R. Tenchini, J. Wenninger
  - Theory precision SM : 2 sessions on Tuesday afternoon
    - Croposed conveners: J. Gluza, A. Freitas
  - Detector technologies and proposals (ee/hh) : 2 sessions on Wednesday morning
    - Conveners: M. Dam, W. Riegler
  - Software and simulations : 1 session on Wednesday afternoon
    - Conveners: C. Helsens, P. Mato
  - Machine-Detector interface : 2 sessions on Thursday morning
    - Conveners: M. Boscolo, N. Bacchetta
  - Flavour, QCD, top : 1 session on Thursday morning
    - Conveners: P. Azzi, S. Monteil, F. Moortgat
  - Higgs : 1 session on Thursday morning
    - Conveners: C. Grojean, K. Peters, M. Selvaggi
  - Theory BSM and global fits : 1 session on Thursday afternoon
    - Conveners: M. McCullough, J. de Blas, F. Moorgat

Essentially full. If you would like to give talk– there *might* be a way – poster easier

TOPICS FOR WORK (LIST = WORK IN PROGRESS) – 2 --

Machine-Detector Interface and Energy calibration

- Mechanical design for beam-pipe + luminosity calorimeter + vertex detector
- Beam background studies in the IDEA drift chamber
- Possibility of a smaller beam pipe up to 240 GeV - impact on flavour tagging
- Progress with MDI-Sim
- Final focus system (sextupoles)
- Z gamma at 160 GeV (calibration) and 240 GeV with detector simulation
- Use of muon momentum measurement for the point-to-point energy error

Contributions to the "turn-key" software, FCCSW

- Develop the IDEA simulation and reconstruction in FCCSW
  - Vertex detector + vertexing
  - Drift Chamber + tracking
  - Dual readout calorimeter + clustering
  - b- and c-tagging
  - Particle Flow reconstruction
- Port some of the LCSoft software tools to FCCSW
- Port CLD simulation to FCCSW (could this be done by CLIC people?)
- Start simulation of new detector concepts
  - Liquid Argon calorimeter from FCC-hh
  - Start developing or use algorithm developed for IDEA

TOPICS FOR WORK (LIST = WORK IN PROGRESS) – 3 --

Theoretical calculations (see long list in https://arxiv.org/abs/1809.01830)

Physics studies (exp. + th.)

- Electroweak physics at the Z pole
  - Influence of IFI on forward backward asymmetry and alphaQED
  - Space like measurement of alphaQED with low angle Bhabha
  - Effective mixing angle from tau polarization measurement
    - Starting with the tau -> rho nu channel
  - Rb with realistic b tagging
  - b asymmetry with the simpler lepton channel
  - Phenomenology: WWgamma TGC in the e+e- nue nue gamma channel
- Diboson physics
  - Systematic uncertainties on TGC measurements
  - EFT fit beyond TGC dominance assumption
- Higgs studies
  - Measurement of Higgs boson to b, c, g with detector simulation
  - CP studies in tau lepton decays
- Global EFT fit (EWPO, diboson, Higgs) to emphasize the correlations and the importance of Z pole run in Higgs coupling extraction.
- Top quark studies
- QCD

TOPICS FOR WORK (LIST = WORK IN PROGRESS) – 4 --

Flavours

CKM Physics - NP in DF = 2
Bs to tau tau
Bc to tau nu
CPV in B mixing
…
tau physics branching ratios and tests of universality

BSM physics

neutrinos
Axion-Like-ParticleS
…

Communication

Maintenance and development of the FCC-ee web site

???

-- Collaboration guidelines are being drafted

main points:

-- world wide effort to study and design the circular e+e- electroweak factory

-- transition : {Information & good-will} → {MOU + committment}

- **-- important to levy resources and real work**
- **-- ensure real support and committment from institutes**
- **-- also this will allow use of latest, supported software, algorithms etc..**

some boundary conditions

-- do not give numbers or results in public if they are not documented!
-- may need to protect indico pages for meetings etc…
-- need volunteers for web site, repositories etc…

-- Program Advisory Committee for FCC-ee physics and experiments studies
as body of the International Advisory committee chaired by **G. Dissertori**

LET US WORK ON FCC TOWARDS A SUCCESSFUL REALITY!