

FCC-PED Informal Forum of National Contacts

Reminder of our structure GB

Status of the FCC collaboration Alain Blondel

Status in the different countries All

Discussion

Two body structure to enlarge the FCC collaboration

FCC Global Collaboration Working Group and FCC national contacts

Following the recommendations of the ESPP 2020, *Europe, together with its international partners, should investigate the technical and financial feasibility (...) of the colliders and related infrastructure (...) as a global endeavor*, the FCC global collaboration working group has been established. Its current members are:

FGC working group

M. Benedikt(CERN), F. Zimmermann, FCC study leader and deputy
A. Blondel (IN2P3&Geneva), P. Janot (CERN) FCC PED coordinators
J. Ellis (Kings College London), P. Charitos (CERN) from the FCC Coordination group
G. Bernardi(IN2P3), T. Lesiak (Krakow) (dep. M. Chruszcz), conveners of the FCC-PED Informal Forum of National Contacts

FCC-PED Informal Forum of National Contacts

IFNC

As stated in the FCC lepton collider CDR, one of the highest priorities and largest challenges of the FCC study is *the creation of a world-wide consortium of scientific contributors who reliably commit resources to the development and preparation of the FCC-ee science project from 2020 onwards"*

Given the broad and varied nature of the particle physics scientific community, a bottom-up approach has been followed with the creation of an Informal Forum of National Contacts (IFNC), comprising one (sometimes two) contact persons from individual countries susceptible to contribute to the study: CERN member states, associate member states and non-member states.

Common challenges / News

Getting funding

Increase the community w/o weakening HL-LHC

Collaboration building

Ew factory constraints not much studied so far

Merge with LC community

News:

=== **Czech Rep.** rECFA: Marek Tasevsky

Jana Faltova

=== **Serbia** rECFA: Peter Adžic

Lidija Zivkovic

FCC-ee – PE&D Activities in the the different Countries

There have been iterations with the restricted ECFA members about the future colliders situation in their countries, in particular regarding PE&D, so we have a global overview of the situation.

We will briefly review them and see that there are broadly 4 categories,

- FCC-ee effort well started, well supported
- FCC-ee effort getting organized
- No FCC-ee effort started
- Priority FCC/ILC or FCC-hh vs. ee unclear

We have received slides, which will be presented by their authors, from:

- This will be followed by short summary for all other European countries
- Then discussion

FCC-France in 2020-2021

G. Bernardi
R. Aleksan
14/6/2021

Well established ILC-France R&D effort but **FCC is the long term priority of French HEP** hence a complete FCC scientific structure has been set-up in 2020.

- Responsible IN2P3 (Master Project FCC-Phys): **Gregorio Bernardi**
- Responsible IN2P3 (Master Project FCC-Acc.) : **Jean-Luc Biarotte**
- Responsible IRFU : **Roy Aleksan**

IN2P3 and IRFU encourage a participation in FCC-ee in parallel to HL-LHC.

Long term goal is to merge all the existing e+e- expertise (physics and detectors in particular)

1st FCC-France workshop devoted to physics & detectors on 14-15 May 2020, (1.5 day)

138 participants, with a strong foreign component <https://indico.in2p3.fr/event/20792/>

2nd FCC-France workshop for physics-detectors-accelerator on 20-21 Jan 2021 (2 days)

150 participants, with a strong foreign component <https://indico.in2p3.fr/event/23012/>

3rd FCC-France workshop for physics-detectors-accelerator on 30/11-2/12 2021 (3 days).

FCC Activities @IN2P3

FCC-contacts in the **11 IN2P3 participating labs** & in the 2 related **R&D master-projets** meet monthly
APC-Paris, IPHC-Strasbourg, IP2I-Lyon, LAPP-Annecy, LPSC-Grenoble, LPC Clermont, IJCLab-Orsay, CPPM-Marseille, LPNHE-Paris, LLR-Palaiseau, L2IT-Toulouse. **Microvertex for FC, CALICE**

FCC-IN2P3 already involved in several **Case Studies** (Higgs, EW, HF, Top), some will be presented at FCC week (e.g. ZH inclusive cross section, HF study).

- R&D :**
- Need to get critical masses on new future projects before decision @IN2P3 on their funding
Current discussion, together with ILC'ers on LAr calorimetry vs. Calice vs. Crystals / D.R.
 - Need to update Linear collider studies with higher lumi, in particular for the EW factory part
 - Current Lines on R&D geared towards ILC (which can be converted to FCC) are continued (CALICE, CMOS-microvertex). Allocation of funds will be known end of November.

FCC Activities @IRFU

Physics Studies and related detector constraints

CP violation/Flavour Physics

Z- ν_e coupling measurement

FCC sensitivity to invisible ALPs

W mass measurements @ WW threshold (PhD thesis , now finished)

Detector R&D

TPC (concentrated on IBF studies) : R&D common with ILC

WiFi connections (intra detector)

Large Surface Fast Timing detector for ToF using micromegas

Other topics under investigation (e.g. 4D/5D Calorimetry, Vertex detector...)

Accelerator, strong involvement in :

Beam optics (Arc lattice design)

Booster study

HFM R&D

Note :

- *All people involved are participating to several projects (ATLAS, CMS, D0, T2K, ILC, ...)*
- *All detector R&Ds are generic and involve people interested in several projects (ILC, RD51, T2K/DUNE/hyperK ...)*



FCC in Italy

- ❖ Good support in general from INFN
- ❖ Organization and participation
 - 91 researchers/17 FTE from 15 INFN units/National Labs
 - Increasing since start of activity in 2016
- ❖ Work in progress
 - Software: physics, detector simulation, infrastructure
 - Accelerator R&D: MDI, Magnets
 - Detector R&D: Silicon sensors, Drift chamber, Dual Readout calorimeters, Micro-Rwell chambers
- ❖ Funding:
 - Funding from INFN at few 100 kEuro level for 2021
 - Additional funding from EU grants:
 - AidaInnova, Cremiln+, FEST

FCC-UK group established, with contacts in every institute (summer '20)

Fri 11 September: FCC-UK kickoff meeting

- On zoom; ~75 participants (including ILC & CePC enthusiasts)
- Presentations of physics (mostly in the AM) and R&D (mostly in the PM) opportunities
- Agenda: <https://conference.ippp.dur.ac.uk/event/933/>

Mon 28 September: UK Particle Physics Advisory Panel ("PPAP") "Town Hall" meeting

(community includes no-collider HEP people)

- First such post-European Strategy update meeting
- Not a presentations-type agenda/meeting. Breakout rooms to brainstorm on "strengths & opportunities" for UK groups
- PPAP will use input to produce new roadmap (to be used for providing funding on future collider projects) by early next year?

Fri 16 October: provided written input to PPAP

- Three UK-centric documents (ee, hh, eh), along with a joint "umbrella" statement

Fri 20 November: next scheduled PPAP meeting

- Update on the roadmap process and inputs received

January/February: PPAP update

- Roadmap: rough draft of the first UK plans?

Contacts: Christos Leonidopoulos
Guy Wilkinson

Spanish community and FCC

J. Alcaraz, 15 June 2021

Current status of Spanish FCC

- **Future collider efforts currently centralized in the “Spanish Network on Future accelerators”:**
 - Historical focus on:
 - ILC-related detector R&D: silicon tracking, CALICE
 - **FCC: MoU signed by several institutions, mostly FCC-hh magnet/accelerator developments until now**
 - ILC / CLIC physics+detector studies
 - Small community working on these matters (with basically zero budget); growing it takes time, pandemic status does not help, more urgent priorities (HL-LHC, ...)
- **Agreed plan:**
 - Integrating progressively FCC analysis/detector efforts in the existing network
 - Ensuring synergy with past/current linear collider activities. Everything assumed to happen under an “ee Higgs factory studies” umbrella:
 - **Current ECFA PED initiative and coming CERN structures for future colliders: extremely useful for re-ramping up**
- **General meeting of the Spanish Network planned for the 2nd-3rd week of July 2021 (likely in remote mode again)**

FCC - Sweden

Contact:
Rebeca Gonzalez Suarez

- **1st FCC Nordic day** in March this year
 - <https://indico.uu.se/e/fccnordic>
 - Co-chaired with Denmark
 - Including Denmark, Finland, Norway and Sweden
 - Estonia also invited
 - Potential Nordic funding options to be explored
 - Lines of communication opened
 - 67 people connected, good feedback, to be followed-up
- **Interest increasing from different groups**
- Since last meeting of the national contacts
 - Work continues in Uppsala University in long-lived particles
 - <https://indico.cern.ch/category/5664/>
 - Project and master students continuously trained
 - Heavy Neutral Leptons at the FCC-ee as benchmark
 - Interest from FREIA laboratory (accelerators)
 - superconducting magnets and accelerating cavities

**Latest master
thesis, defended
this month**



Fostering CH collaboration towards a FCC(ee)

Florenca Canelli & Anna Sfyrla

1

Registration open!



7 September 2021

<https://indico.cern.ch/event/1040241/>



Physics, detectors and accelerators: status of existing efforts within the FCC study and explorations of Swiss interests & expertise applicable to a future high-energy circular collider



Introduction to international FCC efforts and identification of common grounds of activities within Switzerland

Host:



**UNIVERSITÉ
DE GENÈVE**

2



26-28 January 2022

<https://indico.cern.ch/event/1041452/>



Physics, detectors and accelerators: expressions of interest for participation to concrete projects



Identification of interested parties for collaborative activities; potentially also participating to common efforts for fund raising (e.g. FLARE)

Host:



**University of
Zurich^{UZH}**

Workshops sponsored by the UniGe and the UZH; supported by CHIPP;

Attendance open to all! Please join!

Czech Republic

Charles University (CUNI) is a member of FCC Collaboration since 2017

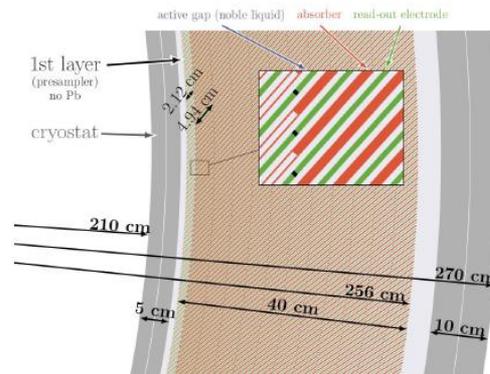
Involvement in the high granular noble liquid calorimeter

High granular noble liquid calorimeter

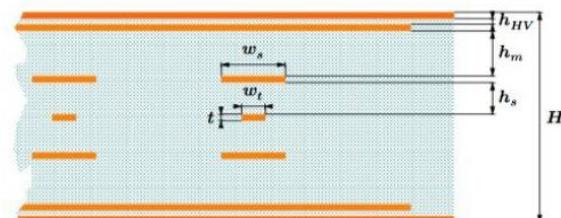
- A benchmark option for FCC-hh detector, considered also as an option for FCC-ee
 - Promising results based on MC simulations, several R&D projects started recently (low material cryostat, design of the feed-throughs, read-out electrodes)
 - Results of Monte Carlo simulations for FCC-hh summarised in FCC Conceptual design report, Volume III. Detailed report in CERN-FCC-PHYS-2019-0003.
-
- Optimisation of the detector design for FCC-ee based on the MC simulations
 - **Work in progress:** Electronic noise, energy leakage, energy resolution
 - **Plan:** Optimisation of the geometry of the detector (e.g. material, thickness of absorber and sensitive gap, plate inclination angle, cell sizes)
 - R&D project on design of the read-out electrodes
 - **Plan:** Monte Carlo simulations of physics events to determine the optimal granularity, timing performance
 - Supported by H2020/AIDAinnova
 - Development of the reconstruction software in FCCSW
 - **Work in progress:** Corrections for the energy reconstruction
 - **Plan:** Clustering, object reconstruction & particle flow

1.0 FTE dedicated to FCC in 2021

1.5 FTE planned in 2022



Calorimeter read-out, side view (perpendicular to the signal traces)

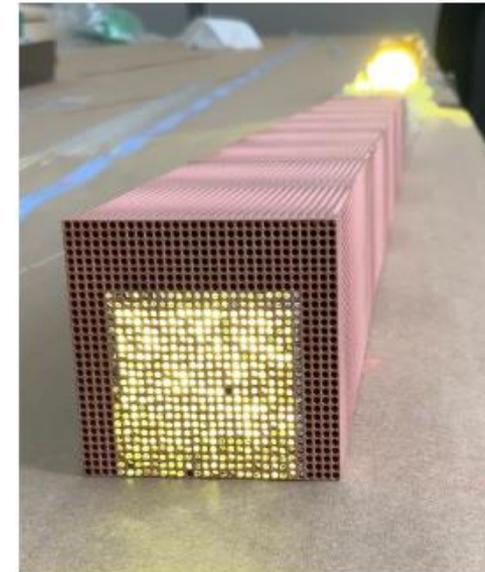


FCC Activity in Korea

- Organization: Prof. Pyungwon Ko (KIAS), Prof. Hwidong Yoo (Yonsei Univ., deputy)
 - Korea Future Collider Consortium (KFCC) has been organized ([homepage](#))
 - More than 30 physicists (both theorists and experimentalists) are participating the consortium
 - First workshop was held at last Feb. with various invited speakers ([indico](#)) successfully
 - Plans for regular meeting and workshops are under discussion
 - Discussion to add the FCC R&D (both TH and EXP) to Korea-CERN program
Detector R&D has been started



- Detector R&D
 - Dual-Readout Calorimeter R&D is on-going (5 year R&D funding: \$2M)
 - First two regular-size modules are being built
 - Various prototype module including 3D metal-printing is being tested for engineering aspects
 - Test-beams experiments with low energy beams are planned at domestic facilities
 - Start the participation of EIC project to design forward calorimeter
 - More R&D programs (FPGA-based electronics with ML integration, high speed data link etc.) are under discussion



US FCC-ee Efforts

FCC-ee and the Snowmass'21 Process

The Snowmass Process is organized by the Division of Particles and Fields (DPF) of the American Physical Society. Snowmass is an opportunity for the entire HEP community to come together to **identify and document a vision for the future of particle physics** in the U.S. and its international partners. Process started early in 2020 and will conclude next Summer.

Coordinated the submission of **FCC-ee LOIs** to inform and engage community. Work on LOIs is ongoing. Paper expected by March '21.

Under the leadership of Sarah Eno, formed of group (O(30) US PIs) interested in e+e- physics. Organized lecture series to inform this group more broadly and share expertise.

We see this group as a seed for a future US - FCC-ee group. Considering an in-person workshop during the Fall 2021.

US funding agencies have expressed support for CERN and its future projects

More countries (1)

National contact

=== **Germany** rECFA: Peter Schleper

Frank Simon

Work is currently done to set up a “Future Collider Forum” in Germany, which will serve as a platform to bring together people working on various aspects of physics and detector questions for any kind of future energy-frontier collider (primarily ILC, CLIC, FCC-ee, FCC-hh, Muon Collider), to exploit commonalities and synergies. This forum has evolved out of the “Linear Collider Forum” present for more than a decade, which has worked quite successfully.

=== **Netherlands** rECFA: Stan Bentveltsen

Only stripped version of a strategy so far due to covid. Real discussions about future accelerators postponed until post-covid. However very interested in an e+e- collider. It may be difficult to get the funding for a FCC tunnel, especially after the world has changed due to covid. There are not only the instrumentation challenges, but also the motivation of young people. The recognition of individuals in large collaborations is becoming increasingly important in the coming years.

More countries (2)

National contact

=== **Denmark** rECFA: Mogens Dam

Mogens Dam

Denmark has a rather small community of high energy physicists contributing mainly to ATLAS and ALICE. **There is support in the community for the ESPP and the integrated FCC project.**

=== **Norway** rECFA: Alex Read

There are no significant new actions in Norway toward a future accelerator and program since the preparation of input to the ESU. Given the efforts on the Phase 2 upgrades, new significant R&D programs and efforts for physics preparation for a future collider is at lower priority

=== **Finland** rECFA: Kati Lassila-Perini

Katri Huitu

Finland contributes to the CERN-based developments of the next generation particle colliders **(CLIC and FCC) R&D programmes**. We emphasize that CERN, as the European Particle Physics Laboratory, should play a key role in any international post-LHC high-energy facility.

More countries (3)

National contact

=== **Czech Rep.** rECFA: Marek Tasevsky

Jana Faltova

Regarding the future ee collider, the Czech community preferences may be ordered this way: FCC-ee, ILC, CLIC. We have a long and fruitful tradition of cooperating and delivering to CERN. No strong roots in CLIC. **The priority is FCC-ee.**

=== **Slovakia** rECFA: Pavol Stríženec

No strong preference about ee collider in Slovakia. Groups are too small, and oriented more on proton/HI physics. It is not clear if any involvement in ee collider will be possible in the near future

=== **Poland** rECFA: Tadeusz Lesiak

Marcin Chrzaszcz

FCC effort being organized. The Epiphany conference on Future of Particle Physics <https://epiphany.ifj.edu.pl/> on 7-10 January 2021 will mostly focus on FCC.

=== **Bulgaria** rECFA: Plamen Laydjiev

Bulgarian community is small and mainly focused on the CMS experiment, with also groups in neutrino physics, nuclear physics (Isolde) and fixed target experiments (rare kaon decays). So far, no group has expressed particular interests in the field of ee collider.

=== **Romania** rECFA: Mario Bragadireanu

The outcome of HL-LHC early runs, might tell if the next CERN based accelerator should be an e+e- or hh collider, hence **the construction of a circular tunnel with a circumference of about 100 km**, that can accommodate an hh or e+e- **collider is the most appropriate approach.** The R&D for high temperature superconducting (HTS) magnets should be pursued with high priority.

More countries (4)

=== Croatia

rECFA: Mirko Planinic

Past experience has shown that measurements at the limit of precision and sensitivity often provide clues of new physics before the latter can be revealed directly by high-energy collisions. There is also a need for precision measurements of the Higgs boson properties and of EW interactions above the weak scale. In Croatia, **no strong opinions about future ee-collider except that we would like it to be at CERN if possible.**

=== Serbia

rECFA: Peter Adžic

Lidija Zivkovic

High Energy physicists from Serbia are strongly oriented to the CERN projects (presently ATLAS and CMS) and this will be also the case in the future. **We generally support FCC** and our interest will go to this direction. Although there is a formal (not significant) connection of a few people with CLIC, this project is not the option, particularly if ILC gets approved.

=== Slovenia

rECFA: Marko Mikuž

30 physicists altogether, in Atlas / Belle 2. Pretty muck booked with the upgrade. No group on FCC. If there is a Z factory, b-physics will be our interest. Wherever it will be, but rather ILC go forward, and CERN focus on hh aspect. FCC-ee if ILC does not happen, but it will imply much larger scale / timelines.

More countries (5)

=== **Greece** rECFA: Paris Sphicas

The only future collider that Greek physicists are involved in is the FCC(ee/hh). So the question of other options, like ILC is not on the table. People assume that CLIC is not a good long-term solution.

=== **Cyprus** rECFA: Panos Razis

Mostly involved with the search for physics Beyond the Standard Model **we favor the construction of the FCC** (where also Higgs physics can be explored initially), as it can provide a long-term future for particle physics.

=== **Turkey** rECFA:Mehmet Zeyrek

Turkey is not attached to any of the future projects, **but our community supports FCC.** Turkish groups are mainly active in ATLAS/CMS. A small-scale experimental group is also active in Belle II. Similarly, a small group of physicists have been involved to CLIC in connection to ILC.

=== **Israel** rECFA: Eilam Gross

Israel is part of the CERN community and will keep acting like that. It has the infrastructure for both detector studies and construction and will join future experiments on a physics merit basis. There is an ongoing activity in various detector related fields. There is also a related activity in the theoretical frontier investigating how can new physics models be probed with HL-LHC and future colliders.

Different situations in Different Countries

- FCC-ee effort well started
- FCC-ee effort getting organized
- No FCC-ee effort started
- Priority FCC/ILC or FCC-hh vs. ee unclear

For the next strategy, a much larger consensus must be reached on the future machine, namely FCC-ee (followed by hh), since FCC-hh is out of reach without the ee first step.

➔ How long will it take to all converge to bullet 1 ?

➔ What would be the procedure ?

Common R&D ?

Common workshops of the different ee-collider communities?

Other approach ?

