Agenda

- Résumé de la journée du 13 Janvier et situation après Bad Honnef

- Objectifs de FCC-Phys

- Tour de Table

IRFU	Saclay
CPPM	Marseille
IJCLab	Orsay
IPHC	Strasbourg
LAPP	Annecy
LLR	Palaiseau
LPC	Clermont
LPNHE	Paris
LPSC	Grenoble
P2IL	Lyon
P2IT	Toulouse

- Agenda de FCC-France

- Organisation locale

Summary of the IN2P3 day on strategy perspectives (13/1/2020)

Based on talks from

Ursula Bassler
Laurent Vacavant
Gauthier Hamel de Montchenault
Reynald Pain

and subsequent discussions

20-25 Janvier 2020 : « Drafting Session » à Bad Honnef

19-20 Mars 2020 : session du Conseil pour la discussion du document pour la stratégie

25 Mai 2020 : session extraordinaire du Conseil à Budapest en vue d'approuver la stratégie

European Strategy Group (ESG)

Groupe en charge de préparer le draft du document de stratégie à Bad Honnef:

- 1 représentant de chacun des 23 pays membre du CERN:
  - France: Reynald Pain
- CERN-DG
- Représentant des laboratoires nationaux européens:
  - IJC: Achille Stocchi
  - Irfu: Anne-Isabelle Etienvre
- Secrétariat de la stratégie

Invités:

- Président du Conseil
- Membres associés européens : Chypres, Slovénie, Lituanie, Turquie, Ukraine
- Etats observatoires : Japon, Russie, Etats-Unis
- Organisations observatoires: Commission européenne, JINR
- Présidents APPEC, ESFRI, FALC, NUPECC
- Physics Preparatory Group

Stratégie l'IN2P3

Organisation pour la physique des particules et hadronique:

- équipe mise en place par Patrice Verdier, autour de 4 thématiques, adossée aux GDR
- contributions (white papers) sollicitées de mars à fin juillet 2018
- synthèse par l'équipe et les RN de projets à l'automne 2018
- document soumis à l'ESPP en déc 2018:
  https://indico.cern.ch/event/765096/contributions/3295776/

Thématiques et contributions:

- **Modèle standard et au-delà**
  - coordination: Ana Teixeira, Dirk Zerwas
  - discussions en mai, 49 p. : https://indico.in2p3.fr/event/16978/sessions/10601/#20180531
- **Physique de la saveur et mesures de précision**
  - coordination: Francesco Polci, Guillaume Pignol
  - discussions en fév 2018, 40 p.: https://indico.cern.ch/event/686737/overview
  - document de synthèse: http://gdrintensityfrontier.in2p3.fr/GDR-InF-ESPP.pdf
  - discussion/sondage en nov 2018, 40 p.: https://indico.in2p3.fr/event/17790/
- **Neutrinos (long-baseline)**
  - coordination: Dominique Duchesneau, Jaime Dawson
  - discussions en juin 2018, 60 p.: https://indico.in2p3.fr/event/17494/
- **Plasma de quarks et gluons**
  - coordination: Frédéric Fleuret, Cynthia Hadjidakis
  - 5 sous-groupes de travail
  - discussions en juillet 2018, 49 p.: https://indico.cern.ch/event/706294/timetable/#all.detailed

Synthèse IN2P3 sur les futures machines

Priorité pour les 15 prochaines années (2020-2035):

- exploiter le LHC, et préparer avec succès la phase HL-LHC

Préparer à plus long terme un futur grand projet de collisionneur au CERN :

- option la plus prometteuse: FCC-hh avec une phase ee intermédiaire
- effort de R&D (aimants) à lancer dès maintenant en priorité

Prochaine machine: consensus large pour une machine e^+e^-

- 4 machines sont maintenant à l'étude :

  2 linéaires: ILC, CLIC *2 circulaires*: FCC-ee, CepC
- priorité pour une « Higgs factory » , de préférence opérable à terme au seuil ttbar

Position par rapport à l'ILC : *(NB: avant la non-décision japonaise)*

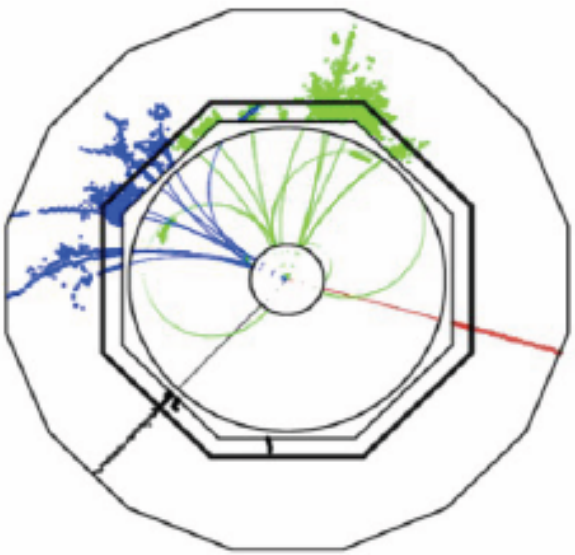
- si décision positive du Japon, participation européenne forte à encourager, dans la limite où cela n'affecte pas la capacité européenne à faire le FCC

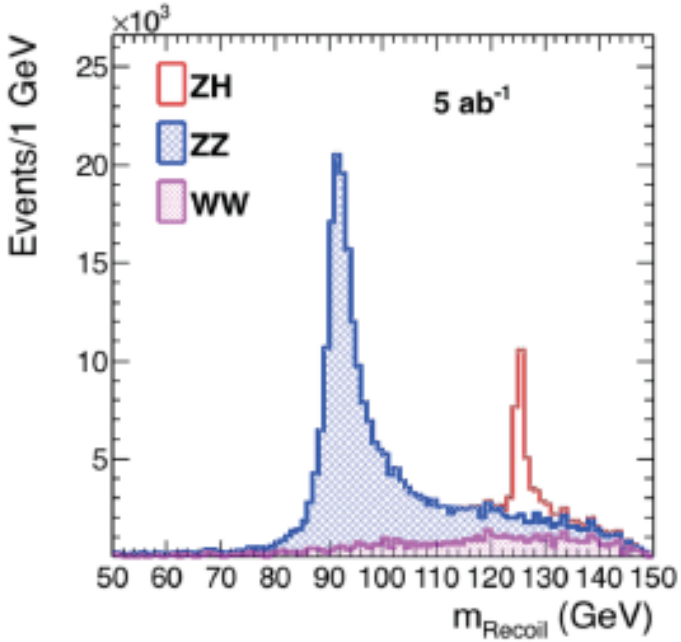
Physique des saveurs:

- exploitation complète de LHCb et Belle-2
- programme à la frontière en intensité: upgrades ? FCC-ee ? cibles fixes, etc
- soutien aux expériences sur: violation de saveur leptonique, moment dipolaire élec.

Priorité #1 : usine à Higgs

We believe that the highest priority in particle physics is the high precision study of the Higgs boson and the electroweak sector. We support the concept of a high-luminosity electron-positron collider (Higgs Factory), to be realised either at CERN or in Asia.

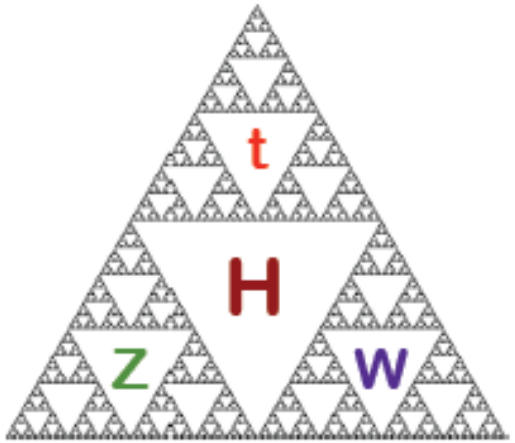


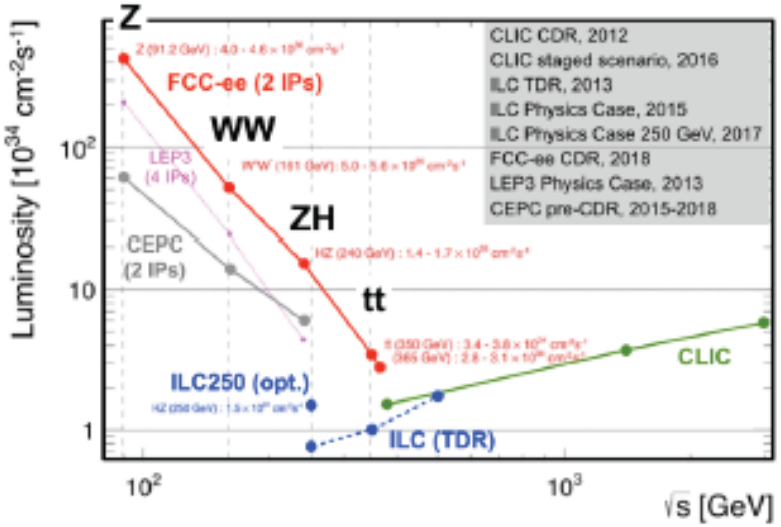


As far as CERN is concerned, we believe that the concept of circular collider (FCC-ee) is far superior to that of linear collider (CLIC).

CERN : soutien au scenario “FCC-all”

We underline the specific importance of the full FCC-ee physics programme, spanning an energy range that covers the Z pole (90 GeV), the WW threshold (160 GeV) and the HZ production maximum (240 GeV) with ultra-high luminosity, and extends up to 360 GeV, allowing top quark and W-fusion Higgs production measurements. From a technological point of view, such an ultra-high intensity electron-positron machine requires a highly efficient radio frequency system that involves substantial R&D effort from CERN and its partners.





We strongly support the FCC option at CERN, starting with an FCC-ee, as considered in the “FCC-all” scenario.

Priorité R&D : aimants haut-champ

We believe that CERN and its partners should pursue with high priority the development of high-field magnets to prepare for the next high-intensity, high-energy proton-proton collider, and intensify the detector R&D for such a machine.

The above recommendations also apply to the last two scenarios ("LE-to-HE-FCC-h/e/A" and "LHeC-FCC-h/e/A"). These scenarios should be seriously considered if a firm decision to build an electron-positron Higgs Factory elsewhere, either the ILC in Japan or the CepC in China, is taken before the next European Strategy Update. Compared to other scenarios, the scenario "LE-to-HE-FCC-h/e/A" has the advantage of significantly reducing the time span between the end of HL-LHC operation and the next high-energy exploratory machine at CERN.

16

5 Scenarios

	2020-2040	2040-2060 1st gen technology	2060-2080 2nd gen technology
CLIC	HL-LHC	CLIC380-1500	CLIC3000
CLIC-FCC-mixed	HL-LHC	CLIC380	FCC-h/e/A (Adv HF magnets)
FCC	HL-LHC	FCC-ee (90-365)	FCC-h/e/A (Adv HF magnets)
LE-to-HE-FCC-h/e/A	HL-LHC	LE-FCC-h/e/A (LF magnets)	FCC-h/e/A (Adv HF magnets)
LHeC+FCC-h/e/A	HL-LHC + LHeC	LHeC	FCC-h/e/A (Adv HF magnets)

Quelle est la position IN2P3 / IRFU ?

We do not support the "CLIC-all" and "CLIC-FCC-mixed" scenarios. We believe that the ILC, with an initial stage at 250 GeV, expandable in energy to above 500 GeV, is a more mature project of linear collider. We do not see a clear enough physics case for a CLIC at 1.5 TeV or 3 TeV in the absence of evidence of TeV-scale new physics at the LHC.

ESPP : CONTRIBUTION FROM THE FRENCH COMMUNITY - 1/3

2 highest priorities

- High precision study of Higgs boson and EW sector. New physics through precision
  - FCC-ee physics potential most appealing than CLIC, allowing for Higgs, W, Z, top quark sectors studies, and flavour physics
  - Several detectors will enhance the overall scientific involvement and feedback
- High energy frontier, exploration for new physics
  - Ultimate goal – CERN leadership
  - FCC-hh (eh) is the most ambitious and promising machine
  - Requires a strong, immediate R&D effort on high field magnets

What about scenarios ?

- Scenario 5 -namely running LHeC in the '30 - is not an independent scenario since compatible with scenario 3,4
- Scenarii 3+4 (no immediate choice required) answer to the above priorities

ESPP : CONTRIBUTION FROM THE FRENCH COMMUNITY - 2/3

important considerations

- If an **e+e- machine is decided in Asia**, this could allow having e^+e^- and pp machines running at the same time (in parallel). A clear strategy for Europe could then be to **express now a priority for FCC-hh, which can be rediscussed in case Asia is not moving forward on with e^+e^- (scenario 4) or express now a priority for FCC-ee and jump** or not **directly to FCC-hh if Asia moves forward with e+e+ (scenario 3)**

- **HE-LHC** should be kept as an open possibility by supporting strong R&D on magnet (compatible with scenarios 3 and 4 as is LHeC)

- **LHeC**: detailed study (financial and technical aspects, community interest) to be pursued. An ambitious bridge (>2030) project, fitting on the different scenarios and exploiting further the LHC investment. Vigorous R&D on ERL machines is needed.

ESPP : CONTRIBUTION FROM THE FRENCH COMMUNITY – 3/3

Other important aspects

- **FCC-all option should be immediately explored in depth**
  - *technical feasibility (tunnel, machine)*
  - *financial aspects (what can be expected from non member states, from other partners,…)*
  - *(social) acceptability*

  - *will allow us to be ready for a decision at the next strategy update*

- It is mandatory to have a strong, **coordinated action on high field magnets**, starting from what is demonstrated up to HTS, with intermediate milestones

  - *a key ingredient for the next decisions to be taken*

- **Prepare for future possible accelerator technologies**, such as ERL (through a PERLE-like demonstrator) or, on longer time scale, muon colliders and laser/plasma acceleration, through a coordinated effort.

  - *Important role to be played by national communities.*

Current Conclusions

- FCC ee then pp is now a realistic scenario

- FCC effort must be structured now in the different countries to increase the community, and to write the TDR in the next 4-5 years, hence make a definite decision at the next European strategy.

- In 2020 : Choice to push forward FCC rather than CLIC (TBC)

- At the next strategy : Decide to build the tunnel and what will be running in it :

  → ee if no ee machine in Asia
  → probably pp if ee machine in Asia

Let's see what comes out of Bad Honnef

Conclusions de l'IN2P3

Mise en place d'un Master-Projet IN2P3

FCC-Phys

Un master-projet permet d'obtenir des ressources humaines et financières

- Pas de budget R&D à court terme
- Missions physiciens pour les activités FCC sur les budgets des équipes d'origine, ou sur un budget dédié du laboratoire (solution préférée)
- IN2P3 encourage participation des physiciens LHC à FCC à hauteur de 10-20%, car la route vers HL-LHC est longue, et il faut soutenir FCC pour qu'on arrive à convaincre le monde exterieur de financer le tunnel !

Objectifs de FCC-Phys

Il existe déjà deux Master-projets reliés à la R&D pour futures machines e+e- (ILC)

- Calice — J-C. Brient
- Collisionneur linéaire - détecteur de vertex — M. Winter

Et un Master-projet accélérateur relié :

- FCC accélérateur — J-L. Biarotte

Nouveau Master-projet

- FCC-Phys — G. B.

- **Nous avons un nouveau Master-Projet en physique des particules, "FCC-Phys".**
- **Il s'agit de coordonner les activités liées aux études prospectives de physique et des détecteurs pour FCC (ee comme hh).**
- **C'est un projet complémentaire du projet "FCC" dans le portefeuille de Jean-Luc, qui est focalisé sur les études côté accélérateurs.**

Tour de Table

IRFU	Saclay	Roy Aleksan
CPPM	Marseille	Steve Muanza
IJCLab	Orsay	
IPHC	Strasbourg	Jeremy Andrea
LAPP	Annecy	Thibault Guillemin
LLR	Palaiseau	Roberto Salerno
LPC	Clermont	Stéphane Monteil
LPNHE	Paris	Luc Poggioli
LPSC	Grenoble	Fairouz Malek (via mail)
P2IL	Lyon	Suzanne Gascon
P2IT	Toulouse	Jan Stark
Projet microvertex		Auguste Besson
Projet Calice		Vincent Boudry

Backup

High-priority large-scale scientific activities (2013)

the following four activities have been identified as carrying the highest priority.

- The discovery of the Higgs boson is the start of a major programme of work to measure this particle's properties with the highest possible precision for testing the validity of the Standard Model and to search for further new physics at the energy frontier. Europe's top priority should be the exploitation of **the full potential of the LHC, including the high-luminosity upgrade of the machine and detectors** with a view to collecting ten times more data than in the initial design, by around 2030. This upgrade programme will also provide further exciting opportunities for the **study of flavour physics** and the **quark-gluon plasma**.
- To stay at the forefront of particle physics, 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 14 TeV 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.
- There is a strong scientific case for an electron-positron collider, complementary to the LHC, that can study the properties of the Higgs boson and other particles with unprecedented precision and whose energy can be upgraded. The Technical Design Report of **the International Linear Collider (ILC)** has been completed, with large European participation. The initiative from the Japanese particle physics community to host the ILC in Japan is most welcome, and European groups are eager to participate. Europe looks forward to a proposal from Japan to discuss a possible participation.
- CERN should develop a neutrino programme to pave the way for a **substantial European role in future long-baseline experiments**. Europe should explore the possibility of major participation in **leading long-baseline neutrino projects in the US and Japan.**

2020 mise à jour de la stratégie européenne

Décembre 2016 : établissement du calendrier pour la stratégie européenne par le Conseil du CERN

Septembre 2017 : mise en place du secrétariat pour la stratégie européenne

Chair: Halina Abramowicz, SPC chair, ECFA chair, Lab-Dir chair

➔ organisation de l'exercice de stratégie

Septembre 2018 : lancement de la stratégie européenne

Décembre 2018 : date limite pour la soumission de contributions

➔ 160 contributions reçues https://indico.cern.ch/event/765096/contributions/

13-16 Mai 2019 : symposium ouvert à Grenade

- 13/7/2019 EPS-conférence Gand : session commune EPS/ECFA sur la stratégie européenne

Septembre 2019 : publication du « Briefing Book »

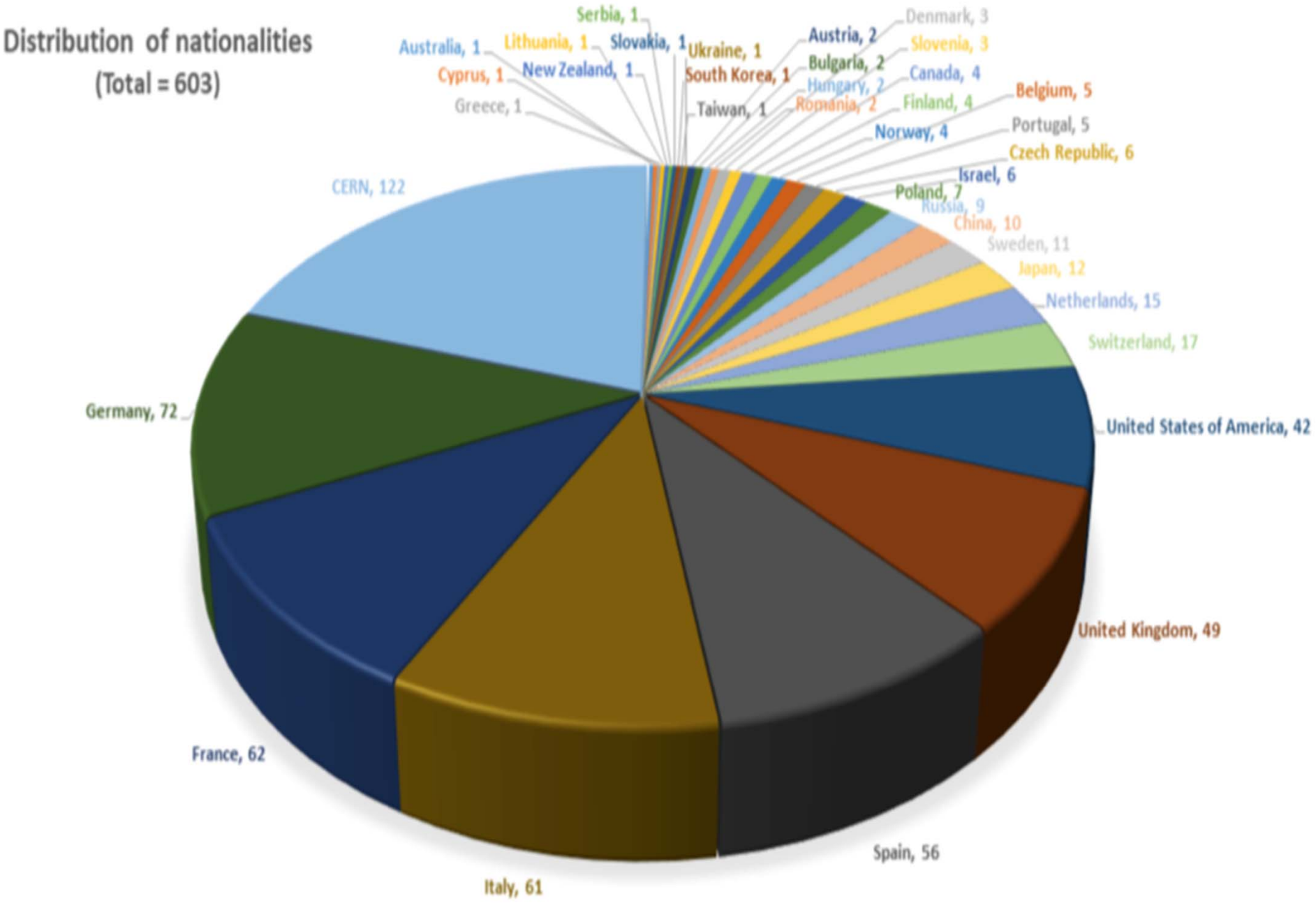
- 14-16/10/2019: JENAS conférence (ECFA, APPEC, NUPPEC) à Orsay
- 14-15/11/2019: plennary ECFA meeting CERN: nouvelles technologies pour des accélérateurs
- 14/11/2019: Symposium des jeunes physiciens organisés par l'ECFA (6 auteurs français/≈110)

20-25 Janvier 2020 : « Drafting Session » à Bad Honnef

19-20 Mars 2020 : session du Conseil pour la discussion du document pour la stratégie

25 Mai 2020 : session extraordinaire du Conseil à Budapest en vue d'approuver la stratégie

Participation à Grenade



CERN-ESU-004
1 October 2019

Physics Briefing Book

Input for the European Strategy for Particle Physics Update 2020

Electroweak Physics: Richard Keith Ellis[1], Beate Heinemann[2,3] *(Conveners)*
Jorge de Blas[4,5], Maria Cepeda[6], Christophe Grojean[2,7], Fabio Maltoni[8,9], Aleandro Nisati[10], Elisabeth Petit[11], Riccardo Rattazzi[12], Wouter Verkerke[13] *(Contributors)*

Strong Interactions: Jorgen D'Hondt[14], Krzysztof Redlich[15] *(Conveners)*
Anton Andronic[16], Ferenc Siklér[17] *(Scientific Secretaries)*
Nestor Armesto[18], Daniël Boer[19], David d'Enterria[20], Tetyana Galatyuk[21], Thomas Gehrmann [22], Klaus Kirch[23], Uta Klein[24], Jean-Philippe Lansberg[25], Gavin P. Salam[26], Gunar Schnell[27], Johanna Stachel[28], Tanguy Pierog[29], Hartmut Wittig[30], Urs Wiedemann[20] *(Contributors)*

Flavour Physics: Belen Gavela[31], Antonio Zoccoli[32] *(Conveners)*
Sandra Malvezzi[33], Ana M. Teixeira[34], Jure Zupan[35] *(Scientific Secretaries)*
Daniel Aloni[36], Augusto Ceccucci[20], Avital Dery[36], Michael Dine[37], Svetlana Fajfer[38], Stefania Gori[37], Gudrun Hiller[39], Gino Isidori[22], Yoshikata Kuno[40], Alberto Lusiani[41], Yosef Nir[36], Marie-Helene Schune[42], Marco Sozzi[43], Stephan Paul[44], Carlos Pena[31] *(Contributors)*

Neutrino Physics & Cosmic Messengers: Stan Bentvelsen[45], Marco Zito[46,47] *(Conveners)*
Albert De Roeck [20], Thomas Schwetz[29] *(Scientific Secretaries)*
Bonnie Fleming[48], Francis Halzen[49], Andreas Haungs[29], Marek Kowalski[2], Susanne Mertens[44], Mauro Mezzetto[5], Silvia Pascoli[50], Bangalore Sathyaprakash[51], Nicola Serra[22] *(Contributors)*

Beyond the Standard Model: Gian F. Giudice[20], Paris Sphicas[20,52] *(Conveners)*
Juan Alcaraz Maestre[6], Caterina Doglioni[53], Gaia Lanfranchi[20,54], Monica D'Onofrio[24], Matthew McCullough[20], Gilad Perez[36], Philipp Roloff[20], Veronica Sanz[55], Andreas Weiler[44], Andrea Wulzer[4,12,20] *(Contributors)*

Dark Matter and Dark Sector: Shoji Asai[56], Marcela Carena[57] *(Conveners)*
Babette Döbrich[20], Caterina Doglioni[53], Joerg Jaeckel[28], Gordan Krnjaic[57], Jocelyn Monroe[58], Konstantinos Petridis[59], Christoph Weniger[60] *(Scientific Secretaries/Contributors)*

Accelerator Science and Technology: Caterina Biscari[61], Leonid Rivkin[62] *(Conveners)*
Philip Burrows[26], Frank Zimmermann[20] *(Scientific Secretaries)*
Michael Benedikt[20], Pierluigi Campana[54], Edda Gschwendtner[20], Erk Jensen[20], Mike Lamont[20], Wim Leemans[2], Lucio Rossi[20], Daniel Schulte[20], Mike Seidel[62], Vladimir Shiltsev[63], Steinar Stapnes[20], Akira Yamamoto[20,64] *(Contributors)*

Instrumentation and Computing: Xinchou Lou[65], Brigitte Vachon[66] *(Conveners)*
Roger Jones[67], Emilia Leogrande[20] *(Scientific Secretaries)*
Ian Bird[20], Simone Campana[20], Ariella Cattai[20], Didier Contardo[68], Cinzia Da Via[69], Francesco Forti[70], Maria Girone[20], Matthias Kasemann[2], Lucie Linssen[20], Felix Sefkow[2], Graeme Stewart[20] *(Contributors)*

Editors: Halina Abramowicz[71], Roger Forty[20], and the Conveners

- *Compilation des contributions reçus et des discussions à Grenade sur 250 pages*
- *Excellent résumé des questions et défis en physique des particules aujourd'hui !*

Discussions au DPhP

Le DPhP, avec des participations du DEDIP et du DACM, s'est réuni le **22 octobre 2019** pour débattre des différents scenarii. Les discussions sont synthétisées dans un document

Input of IRFU/DPhP on EPPSU future collider scenarios

dont des **extraits** sont exposés dans la suite. Cette **position** — en cohérence avec la contribution de l'Irfu à la Stratégie européenne en décembre 2018 — a **été consolidée au niveau de l'Irfu** pour nourrir le *statement* national présenté à l'ESG en **novembre 2019**.

Although diverse opinions were expressed, some consensus emerged on the following statements and recommendations.

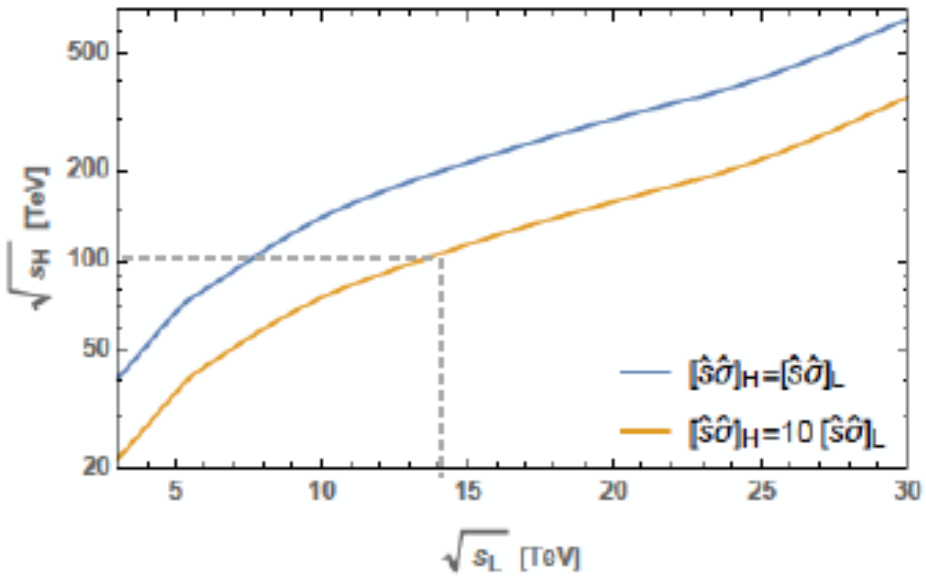
*As a preamble, we want to stress that research in **particle physics is a worldwide activity**. The European strategy in particle physics is essential insofar as it forms the basis of a **global strategy**. In that spirit we look forward to **better collaboration between the main regions**, to ensure that the challenges in our field are addressed in a foreseeable future. As no major collider project has yet been confirmed in other regions, **Europe is compelled to conceive the most ambitious programme** that encompasses these challenges, while fostering a constructive and collaborative spirit with the rest of the world.*

CERN : circulaire, pas linéaire

We do not support the "CLIC-all" and "CLIC-FCC-mixed" scenarios. We believe that the ILC, with an initial stage at 250 GeV, expandable in energy to above 500 GeV, is a more mature project of linear collider. We do not see a clear enough physics case for a CLIC at 1.5 TeV or 3 TeV in the absence of evidence of TeV-scale new physics at the LHC.

We believe that CERN should focus on the technical and financial feasibility of the FCC tunnel and on the production of Technical Design Reports for the FCC-ee and FCC-hh machines to be delivered by the next European Strategy Update.

Une alternative à long terme : le collisionneur à muons



We believe that muon colliders are the best hope to reach multi-TeV energies in lepton collisions, with well-defined initial state and reasonable power consumption. We consider that a multi-TeV muon collider would offer a better potential as an exploratory lepton collider than the CLIC@3-TeV on similar time scales.

We recommend to intensify the conceptual studies on the various muon collider designs in order to converge on a proposal for a large-scale test facility by the next European Strategy Update.