FCC-contacts / October 21st 2022

- Tour de table
- News FCC / ECFA / IN2P3
- Status FCC-Lyon / Where in 2023 ?
- Discussion ressources
- Proposition d'organisation pour la mid-term review du feasibility study
- AOB / Calendrier des prochaines réunions

Tour de table (cf slides sur l'agenda)

APC
CPPM
IJC Lab
IPHC
IP2I
LAPP
LLR
LPC
LPNHE
LPSC
L2IT

Concluding Remarks

- Snowmass process was very productive
  - Despite of COVID
- 2014 P5 continuing construction projects are strongly supported
  - And will require substantial funding for the coming 5+ years
- Higgs factory is considered as the next preferred option for the energy frontier collider
  - 10 options are presented with FCCee among mostly discussed
- We expect no “decision” about next Higgs factory during this P5 process
  - Rather to emphasize the importance of R&D for accelerators, detectors, physics
- Next Snowmass/P5 might be sooner vs 8-10 years from now
  - Depends on new scientific results, convergence with existing projects (funding) and interest around the world to host Higgs factory
- If CERN will decide to build FCCee US will participate and contribute

News du ECFA workshop

2022 ECFA e^+e^- Workshop in Hamburg 5 – 7 October 2022

- Status of Working Group activities
- Discussion of future plans
- Interaction between theory and experiments
- "Public Talk" on importance of future e^+e^- collider / new era
  Speaker: Hitoshi Murayama
  + panel discussion
  (involving Fabiola Gianotti, ..)

https://indico.desy.de/event/33640/

J. Mnich's message

- Warning: we are living in uncertain times: global economy, energy, politics,…
- Today financial and human resources (in Europe) are bound by the HL-LHC and the detector upgrades
- Timeline towards a future Higgs factory depends on progress on R&D and projects studies:
  - FCC: CERN feasibility study
  - ILC: political & administrative progress in Japan, is there interest elsewhere?
  - CLIC: potential plan B for Europe/CERN?
  - CEPC in China?

- Particle physics has a big asset: CERN
- Europe has big asset: CERN

A few final words

Why do we want a Higgs (and EW) Factory and how we can justify the required resources?

- ❑ Particle physics is in competition with other fields (bio sciences, climate, energy, ...)
- ❑ They have also very appealing stories to tell, often much easier to understand by the general public and politics than ours

I strongly believe that we have to strengthen and sharpen our physics arguments

- ❑ Just higher precision is not enough!
- ❑ What are the connections to the really big fundamental questions and miracles of the Universe?
- ❑ We have to strengthen our efforts to convince public and politics provide very strong motivation: societal, technological and scientific arguments

Particle physics still enjoys high interest and strong support from the public

I'm sure that there will be a Higgs (and EW) factory, even if today we are living in very difficult and challenging times

ECFA Report

Looking ahead to the final report

- **Study will be documented as an ECFA Report**
- Initiating this now, to help planning and to stimulate activity
- Vision for the report:
  - a major input to the next European Strategy Update
  - building on extensive body of previous studies
    - most recently:
      - ILC report to Snowmass
      - FCC CDR
      - CLIC Yellow Reports
      - …etc

  => **this report should focus on new work**

  –> brief 'summary of current state' also to be included
  - **emphasise what is added:**
    - what can the ECFA Higgs Factory study add beyond the current state-of-the-art?
    - what will a Higgs Factory add beyond the state-of-the-art at the end of HL-LHC?
- Hope that by starting this now, whole community can start to plan contributions, over the next 1–2 years.

All contributions are welcome

- **Community-driven activity:**
  As with previous studies generated by e^+e^- community,
  everyone is welcome to bring their own contributions
  –> leads to a rich field of inputs
  – relevant WG conveners are glad to be contacted

  –> Started to lay out preliminary draft report structure, based on ongoing WG activity
  Overall editorial team: AR + conveners of WG1, WG2, WG3.

  –> Three main 'chapters', on WG1, WG2, WG3

- ***In addition***, the ECFA study is proposing a limited set of 'high-priority' topics as presented by Jenny on Wednesday morning
  – motivation is to lower threshold for participation, focus limited effort, and promote cross-group activity

  –> planned to lead to dedicated feature sections of report

mostly set by (seb-set of) WG conveners
IAC not involved

News du ECFA workshop

ECFA Report

High-priority topics

- Proposed 'high-priority topics' are not intended to map the physics programme comprehensively. Instead, should serve to:
  - complete the current overall picture where it's (most) necessary
  - offer guidance for contributing to the ECFA study
  - highlight processes particularly suitable for studying the ***interplay of the three WGs***

Higgs

1. $e^+e^- \to Zh$ at $\sqrt{s}$ = 240..250 GeV and 350 GeV:
- comparisons of theory calculations and MC generators for $e^+e^- \to f\bar{f}h$
- reconstruction of production (all channels)
- and decay angles ($h \to ZZ^*/WW^*/Z\gamma$) incl CP angles
- dependence on detector performance and reconstruction capabilities:
  - Higgs restframe reconstruction, also for $Z \to qq$ / $\tau^+\tau^-$
  - q vs qbar separation, ...
- SMEFT interpretation

Most studies of Higgs couplings and SMEFT interpretation so far assume CP conservation – add CP studies

2. $e^+e^- \to Zh$ with $h \to ss$ ($Z \to$ anything) at $\sqrt{s}$ = 240..250 GeV:
- branching fraction precision / discovery reach
- dependence on detector performance and reconstruction capabilities: e.g. $K^\pm$ ID, $K^0_S \to \pi^+\pi^-$, JER, ...
- SMEFT & BSM interpretation

H->ss addressed only recently – reconstruction and PID challenges, and interpretation

High-priority topics

W/Z

3. W Couplings in $e^+e^- \to W W$ and e**ν**W at $\sqrt{s}$ = 240..250 GeV and ~350 GeV including e.g.:
- comparision of theory predictions and MC generators
- detector-level studies including full differential angular information, reconstruction of CP angles, optimal observables / interface to global interpretations
- CP violating operators and other effects beyond "standard" TGCs

add full detector-level studies at 240GeV; include CPV operators

4. W mass from $e^+e^- \to W W$ and e**ν**W at threshold and continuum
- theory predictions and MC generators
- detector-level studies including mass reconstruction techniques
- systematic limitations and calibration strategies

M_W ultimate precision? assessment/development of analysis and calibration methods to highlight aspects of detector performance requirements

5. $e^+e^- \to$ bb, cc, ss, $\tau^+\tau^-$ at $\sqrt{s} = M_Z$ and above including e.g.
- comparision of theory predictions and MC generators
- detector-level studies of differential cross-section / asymmetry measurements
- interface to global interpretations
- for $\tau^+\tau^-$: τ polarisation and A_e extraction

2-fermion production hardly studied at Z. Focus on channels with detector/reco challenges; include τ polarisation

WE HAVE TO GIVE OPINION AND TO PROVIDE INPUTS

WE HAVE TO BE ACTIVE

News du ECFA workshop

High-priority topics

◆ Top

6. e+e− → tt at a typical threshold-scan energy, $\sqrt{s}$ = ~350 GeV
- detector-level studies of total & differential cross-section, asymmetries, CP observables
- detector requirements and reconstruction/analysis methods
- interface to global interpretations

full analysis at threshold (threshold calculations not all reflected in MC generators, polarisation & beam spectrum etc)

7. threshold scan optimisation, including
- theory predictions and MC generators
- backgrounds, polarisation, energy-step optimisation
- interpretation incl. "classic" threshold scan parameters as well as electroweak coupling parameter extraction, also CPV

◆ Direct discovery potential

LLPs with exotic signatures

8. e^+e^- → (very) weakly coupled / light / long-lived particles
- detector-level studies of "exotic" signatures: "kinks", "prongs", "V0", ...
- detector requirements, pattern recognition, reconstruction algorithms
- interface to BSM interpretations: plethora of models!

=> can one develop a "matrix"/"database" to map experimental performance given eg in terms of boost, lifetime, decay mode onto model parameter space of BSM models predicting LLPs ?

High-priority topics

◆ Flavour

9. $B_s \to D_s K$ at $\sqrt{s} = M_Z$
- detector-level study with all backgrounds
- dependency on vertexing, Kaon-ID, ...
- global interpretations...

B mesons that are too heavy to be produced at Belle-II; final states that are difficult at LHCb, e.g. τ

10. $B_s \to K^{0*}\tau^+\tau^-$:
- detector-level study with all backgrounds
- topological reconstruction,
- dependency on τ and K* reconstruction, vertexing...
- global interpretations

High-priority topics

◆ Systematics

11. Luminosity measurement from low-angle Bhabha scattering
- theory and MC generators: comparison of state-of-the-art and ultimate requirements
- detector-level simulations at all √s, including backgrounds etc
- measurement strategies
- requirements on LumiCal: resolutions, alignment

Understand how to control with unprecedented precision

12. Measurement of b- and c-fragmentation functions / hadronisation
- detector-level study with all backgrounds
- new ideas how to model them theoretically => new measurement strategies?

Understand how well these can be constrained, as input to precision Higgs and EWK measurements

13. Measurement of gluon splitting to bb / cc
& interplay with separating h → gluons from h →bb/cc

News du ECFA workshop

Comments from Christophe G.

- Things have started, but not as much as we could have hoped for and not necessarily in the right direction

- WG1: I couldn't see a collective action/work yet: most of the talks were a report of individual works that could have been presented in any other conference -> not a workshop, no community building
- Situation in WG2 and WG3 seems better but we have to remain vigilant (ILCSoft, CALICE…)
- Cooperation with US/Snowmass is far from obvious
- WG conveners carry a lot of weight and, in WG1, biais towards ILC (
- Still too much focus on Higgs not enough discussion on Z, W, top…

News du FCCIS workshop

FCCIS Week 2022

5-9 December 2022 (confirmed by majority vote of FCC pillar coordinators and FCCIS WP leaders)

+ First FCC Scientific Advisory Committee (SAC) executive session

Frank Zimmermann, CGM #125m 22 September 2022

	Monday	Tuesday	Wednesday	Thursday	Friday
8h45-09h30	SAC welcome and Executive Session, chaired by **Andy Parker**	WP2-5 parallel sessions			
9h30 –10h00	FCC Study Status and Goals, FCCIS and SAC charge, **Michael Benedikt**				WP2 summary
10h00-10h15	questions and discussion				WP3 summary
10h15-10h45	coffee break				
10h45 – 11h30	FCC Physics & Detectors, **Patrick Janot**	WP2-5 parallel sessions			WP4 summary
11h30 – 12h15	FCC Accelerator status and R&D beyond FCCIS**, Tor Raubenheimer**				WP5 summary
12h15-13h30	lunch break				
13h30-14h00	Technical Infrastructure status, **Klaus Hanke**				
14h00-14h30	Civil Engineering status, **Tim Watson**				
14h30-15h00	FCCIS WP2 overview, **Ilya Agapov**				
15h00 – 15h30	FCCIS WP3 overview, **Johannes Gutleber**	WP2-5 parallel & joint sessions			
15h30 – 16h00	coffee break				
16h00 - 16h30	FCCIS WP4 overview, **Emanuela Sirtori**				
16h30 - 17h00	FCCIS WP5 overview, **Marcin Chrzaszcz**				
18h00	Welcome drink?				
19h30	SAC dinner		Workshop dinner?		

News du FCCIS workshop

From Panos:

- Apart from the plenary presentation on Monday, no specific PED contribution is needed during the workshop

- It will be useful to understand how PED activities can be reported in the framework of the FCCIS project
  - Work out a plan to meet the WP5 deliverables presented by Marcin two meetings ago
  - See slides attached again to the agenda
  - Meeting scheduled with Christian Caron to understand our “publication plan” (?)

From Michael B.:

- Request to extend the FCC-IS end date unlikely to be accepted

- As of today, we are expected to deliver a scientific, book-style document that describes the experimental physics research programme based on theoretical physics motivations and the response to those scientific drivers
  Deadline: 01/06/2024 (i.e., exactly in between the intermediate FS report, and the final FS report)

6th FCC Physics Workshop

- **Krakow, Jan. 23-27, 2023:** https://indico.cern.ch/event/1176398/
- Jagiellonian University, 5 mn walk from the city centre, 10 mn walk from Wawel Castle
- 20-30 mn to airport by taxi, 45 mn to airport by public transport
- Registration fees: ~ 200 EUR, incl.: day-long coffee breaks, lunches, conf. dinner
- Expected # participants: 150-200 (Liverpool had 642 registrants - remote)
- All coordinators and physics group conveners are supposed to go. And that they should invite as many people as possible! We'll make sure that everyone who is interested could give a talk.

— Main Goals —

- prepare Mid-Term Report and Full Feasibility Study Report
- monitor progress
- strengthen the FCC PED community
- strengthen FCC physics case

Program outline

- In-person meeting
- Plenary only (possibility of one day of parallel sessions will be discussed in the SPC)
- Monday morning to Friday afternoon
- Two evening sessions (8pm-10pm)
- Excursion and dinner: Thursday afternoon/evening:

  3pm-4pm buses departs
  4pm-7pm excursion
  7-10pm dinner
  10pm-11pm bus back

- Sessions (FCC-ee & FCC-hh)
  - Precision incl. EW, Higgs, QCD, Flavour
  - BSM
  - Detectors
  - EPOL
  - MDI
  - Software
  - Complementarity studies

FCC-Lyon

Status,
Cf agenda

https://indico.in2p3.fr/event/27968/

FCC France workshop en 2023 ?

- 2 options principales:

a) Refaire France-Italie en 2023 (et donc plutôt en Italie cette fois-ci)

b) Alterner une année France-Italie, une année France toute seule, et donc France (seule) en 2023 et Italie en 2024 en format France-Italie

En 2023 à l'automne il y aura la mid-term review donc l'option b) pourrait se retrouver favorisée, d'autant qu'en 2025 on serait alors de nouveau "France seule", et ceci marcherait bien car il y aura aussi la final review du FCC FS à la fin 2025.

Demandes ressources financières

COUT VOYAGE	CRACOVIE Phys wkshop 1500	LONDRES FCC-week 1800	FCC-France 300	FCC-meet CERN 500	ECFA FC wkshop 1000	stages & FCC-FR & info.	TOTAL (kE) TOT	(kE) TOT-stages	rounded (kE) TOT-stages
APC+FCC-FR	3000	3600	1200	3000	2000	6000	18,8	18,8	19
CPPM	1500		600	500	1000		3,6	3,6	4
IJC Lab	1500	3600	900	1000	1000		8	8	8
IPHC	1500	1800	900	3000	1000	2000	10,2	10,2	10
IP2I	3000	5400	1500	1000	2000	4800	17,7	12,9	13
LAPP	1500	1800	600		1000		4,9	4,9	5
LLR	1500	3600	1200		1000	1800	9,1	7,3	7
LPC	1500	1800	900	1000	2000		7,2	7,2	7
LPNHE	1500	1800	300	1000	1000		5,6	5,6	6
LPSC	1500	0	600	500	1000	1800	5,4	3,6	4
L2IT							0	0	0
TOTAL-2023							90,5	82,1	83

LABO	tot FTE	FTE	Status	Lab	initials	Name	Field / study
APC	2,5	0,5	PHD	APC	AL	Li Ang (phd3)	ZH: mass/x-section
		0,8	*	APC/IN2	GB	***Bernardi Gregorio***	ZH: mass/x-section
		0,4	*	APC	GM	**Marchiori Giovanni**	ZH: couplings
		0,3	M2	APC	m2-APC		ZH: mass/x-section
		0,5	PD	APC	TL	Li Tong (pd)	LAr calo detailed simulation
CPPM	0,5	0,35	*	CPP	FD	**Djama Farès**	Physics studies
		0,1		CPP	MB	Barbero Marlon	Vertex detector
		0,05		CPP	EM	Monnier Emmanuel	Lar Calo
IJCLab	1,1	0,4	*	IJC	NM	**Morange Nicolas**	Lar Calo
		0,35	*	IJC	JL	Lefrançois Jacques	Grainita
		0,05		IJC	DF	Fournier Daniel	Lar Calo
		0,1		IJC	LS	Serin Laurent	Lar Calo
		0,1		IJC	RC	Chiche Ronic (IR)	Lar Calo
		0,1		IJC	YA	Amhis Yasmine	b-->sll
IP2I	2,1	0,25	TH	IP2	AD	Deandra Aldo	Signatures BSM,modèles composites,physique électrofaible de précision
		0,2		IP2	DC	Contardo Didier	65nm MAPS
		0,15		IP2	GB	Boudoul Gaelle	65nm MAPS, performances reconstruction traces
		0,25	TH	IP2	GC	Cacciapaglia Giacomo	Signatures BSM,modèles composites,physique électrofaible de précision
		0,05		IP2	GG	Grenier Gerald	SDHCAL/RPC + transfert au circulaire
		0,1		IP2	IL	Laktineh Imad	SDHCAL/RPC + transfert au circulaire
		0,1		IP2	LM	Mirabito Laurent	SDHCAL/RPC + transfert au circulaire
		0,15	TH	IP2	NM	Mahmoudi Nazila	Contraintes des mesures de couplages Higgs sur modeles de NP, distincti
		0,1	IR	IP2	RB	Barbie Remi (IR)	65nm MAPS
		0,15		IP2	SG	**Gascon Suzanne**	Calorimetrie homogene haute res (xtaux, fibres cristallines, Grainita)
		0,3	M2	IP2	m2-IP2		Signatures BSM,modèles composites,physique électrofaible de précision
		0,3	M2	IP2	m2-IP2		Performances reconstruction traces

IPHC	**2,7**	0,1		**IPH**	AB		Besson Auguste	Vertex Detector Optimization with CMOS sensors
		0,5	IR	**IPH**	EM		Emmanuel Medernach (IR)	Contribution to FCC Software R&D
		0,9	PHD	**IPH**	GD		Gaëlle Sadowski (phd1)	Vertex Detector Optimization with CMOS sensors
		0,1		**IPH**	JA		Andrea Jeremy	Long Lived Particles study in FCC
		0,6		**IPH**	ZE		**El Bitar Ziad**	Contrbution to all FCC activities at IPHC
		0,5	PD	**IPH**	pd-IPH			Vertex Detector Optimization
LAPP	**0,8**	0,1	M2	**LAP**	CB		Claire Bourdarios	communication
		0,1	*	**LAP**	LDC		Lucia Di Ciaccio	electroweak
		0,3	*	**LAP**	MD		**Delmastro Marco**	Higgs
		0,3	M2	**LAP**	m2-LAP			Higgs
LLR	**1,3**	0,3	PD	**LLR**	pd-LLR			Higgs self-coupling
		0,35	*	**LLR**	RS		**Salerno Roberto**	Higgs self-coupling
		0,35	*	**LLR**	VB		Boudry Vincent	calice pour FCC
		0,3		**LLR**	m2-LLR			calice pour FCC
LPC	**1,6**	0,1		**LPC**	HC		Chanal Hervé (IR)	GRAiNITA
		0,9	PHD	**LPC**	LR		Lars Roerig (phd1)	top,Flavours, SMEFT
		0,2		**LPC**	PG		Gay Pascal	Higgs couplings
		0,2		**LPC**	RM		Madar Romain	top,Flavours, SMEFT
		0,15		**LPC**	SM		**Monteil Stéphane**	GRAiNITA, Flavour studies
		0,05		**LPC**	TM		Miralles Tristan	Flavour studies
LPNHE	**2,3**	0,8		**LPN**	AB		Blondel Alain	EW physics, EPOL
		0,3	*	**LPN**	BM		Malaescu Bogdan	QCD, alpha_s extraction
		0,15	PHD	**LPN**	LD		Delagrange Line (phd1)	QCD, Xsections measurements
		0,8		**LPN**	LP		**Poggioli Luc**	QCD studies, R&D calorimetry
		0,15	PHD	**LPN**	LP		Pawar Lata (pd)	QCD, jet substructure
		0,1	IR	**LPN**	ir		IR	Under discussion for calo. R&D
LPSC	**0,4**	0,1		**LPS**	FM		**Malek Fairouz**	Z-- b bar, mesure de A(F,b)
		0,3	M2	**LPS**	m2-LPS			Z-- b bar, mesure de A(F,b) a
L2IT	**0,05**	0,05		**L2IT**	JS		**Stark Jan**	fcc-hh
TOTAL	**15,35**	**15,35**						

Demandes ressources humaines

En 2022: 3 Postdocs LHC-FCC attribués:

IPHC : CMS / FCC (tracking for FCC) ➔

LLR : CMS / FCC (Calice for FCC) ➔ Luis Porteles started 1/11/2022

APC : ATLAS / FCC (L.Argon simulation for FCC) ➔ Tong LI started 15/9/2022

Demandes 2023

IP2I : PostDoc CMS / FCC

LPC : Postdoc LHCb / FCC

LPSC : PostDoc/Etudiant ATLAS / FCC

APC : Etudiant ATLAS / FCC

Proposition d'organisation pour la mid-term review du FCC feasibility study

Deliverables for the mid-term review

- A mid-term report is expected by fall 2023, with three deliverables of our choice
  - Section 1: Physics case
    - Documentation of the specificities and complementarity of the FCC-ee and FCC-hh physics cases, in particular for the Standard Model Higgs boson characterization.
      - Should include the FCC-ee standalone physics case (Council specific request)
      - Should include specificities and complementarity with other colliders (our suggestion)

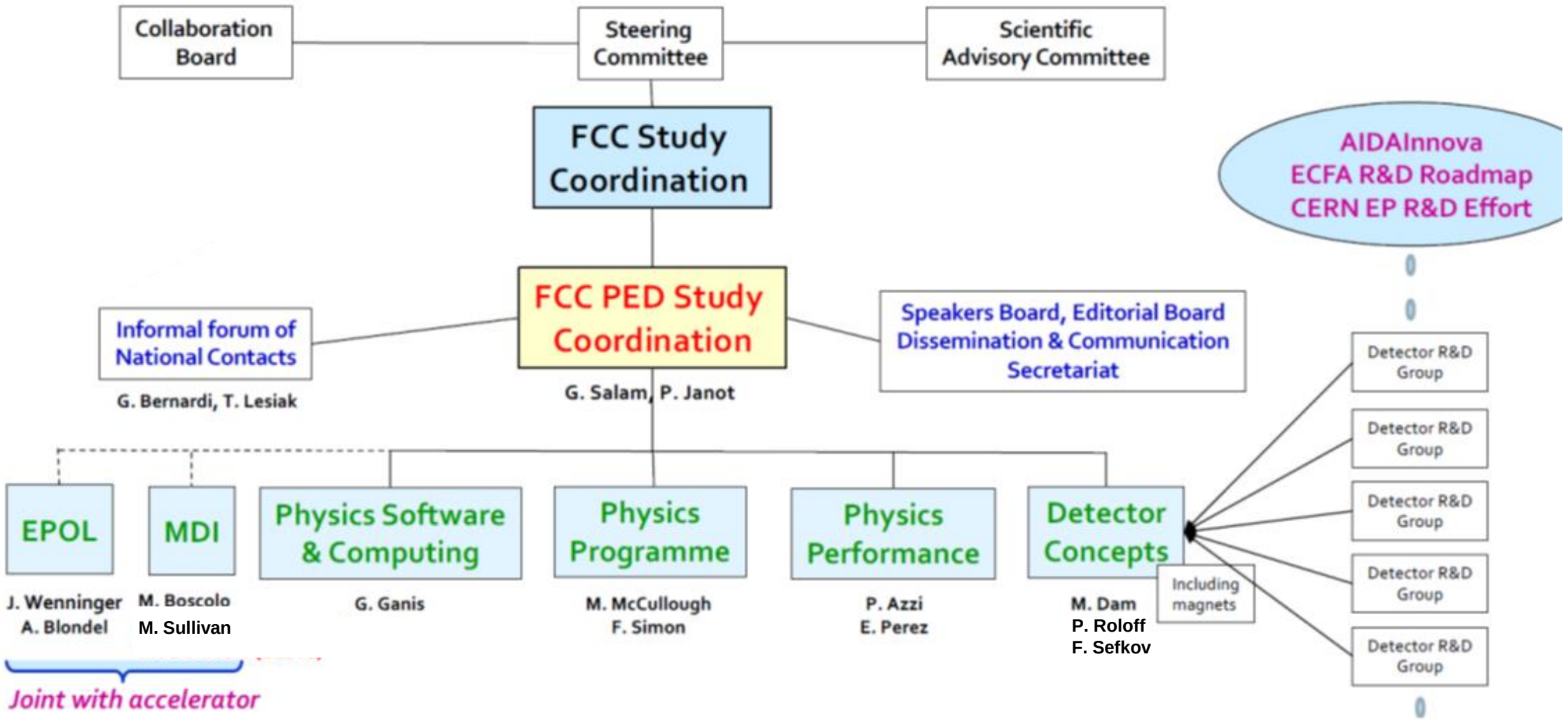
        Other e+e- Higgs factories

        Multi-TeV muon collider
      - Should extend to topics beyond the SM Higgs boson characterization

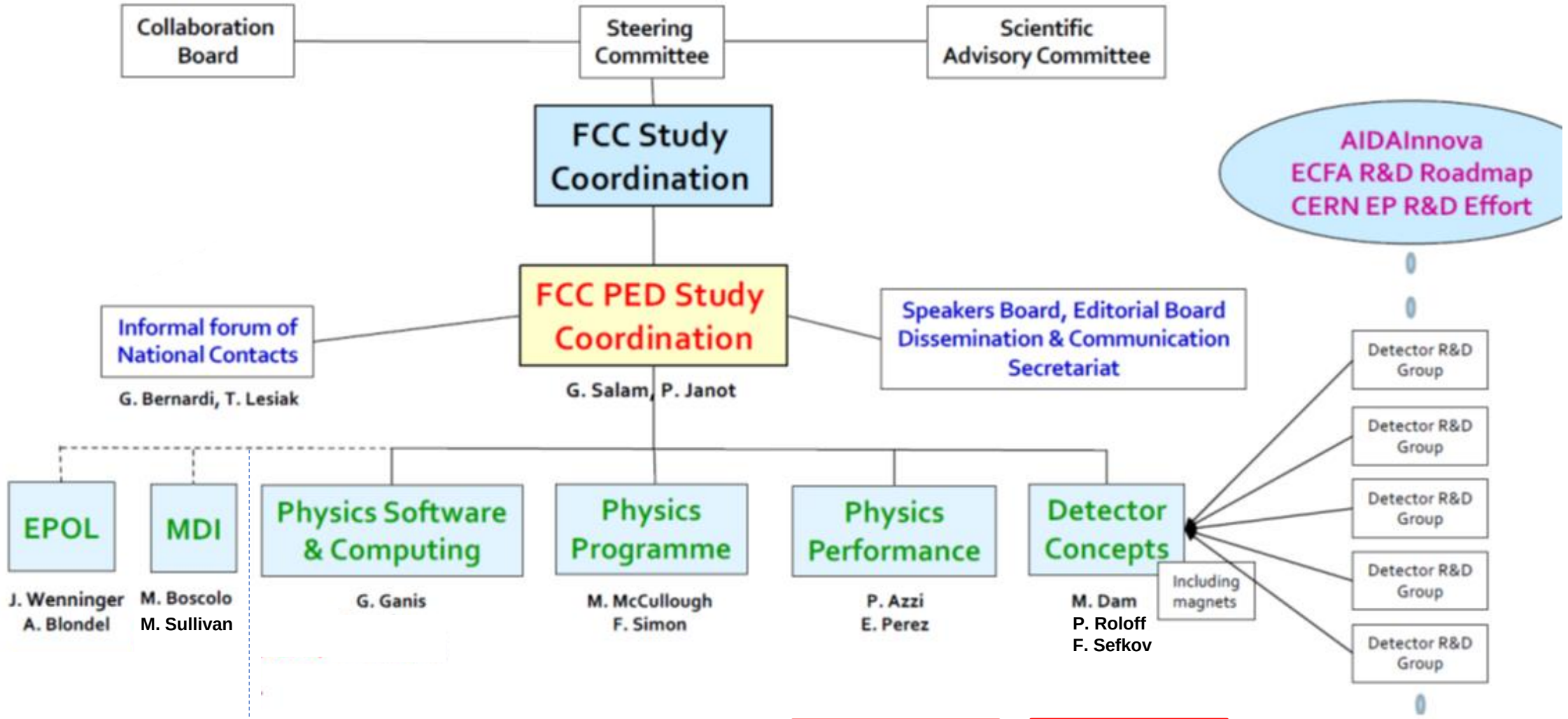
        See a first list in Christophe's presentation in PED coordination meeting (30 June)
      - Carbon footprint during operation (and installation) is explicitly requested

    - Proposed editors:
      - Michelangelo Mangano, Christophe Grojean, Matthew McCullough, Frank Simon, (Alain Blondel), …
      - Other suggestions from the Physics Groups ?

- Section 2: Theoretical calculations
  - Strategic plan for improved calculations needed to reduce theoretical uncertainties towards matching the FCC-ee expected statistical precision on the most important measurements.
    - Should include a detailed plan for MC generators as well
  - Proposed editors
    - Ayres Freitas, Janusz Gluza (EW) , Staszek Jadach (QED), (Patrick Janot – experiment's side)
    - Requires also QCD and Flavour experts – suggestions ?
- Section 3: Detector requirements
  - First documentation of the main detector requirements to fully exploit the FCC-ee physics opportunities, in particular to reduce experimental uncertainties towards matching the expected statistical precision on the most important measurements.
    - Should include a complete list of requirements, also those for which we don't have a complete study yet
  - Proposed editors
    - Emmanuel Perez, Patrizia Azzi, Mogens Dam, other suggestions ?


Collaboration Board
Steering Committee
Scientific Advisory Committee
FCC Study Coordination
AIDAInnova
ECFA R&D Roadmap
CERN EP R&D Effort
FCC PED Study Coordination
Informal forum of National Contacts
G. Bernardi, T. Lesiak
G. Salam, P. Janot
Speakers Board, Editorial Board
Dissemination & Communication
Secretariat
Detector R&D Group
Detector R&D Group
Detector R&D Group
Detector R&D Group
Detector R&D Group
EPOL
MDI
Physics Software & Computing
Physics Programme
Physics Performance
Detector Concepts
Including magnets
J. Wenninger
A. Blondel
M. Boscolo
M. Sullivan
G. Ganis
M. McCullough
F. Simon
P. Azzi
E. Perez
M. Dam
P. Roloff
F. Sefkov
Joint with accelerator

Proposition d'organisation dans FCC France pour le mid-term feasibility study→ contacts thématiques



EPOL, MDI, Accelerators	Physics SW & Computing	Physics Theory	Physics Performance	Detector Concepts
A. Blondel A. Faus-Golfe	. .	G. Cacciapaglia B. Fuks	. .	. .

Contacts FCC-France