

# ECFA

European Committee for Future Accelerators



Alba, Barcelona, July 2018

Bengt Lund-Jensen, Roman Pasechnik, David Milstead

# ECFA

- Plenary ECFA (P-ECFA), Restricted ECFA (R-ECFA)
- European Committee for Future Accelerators
- Primary aim is the long-range planning of high-energy facilities, which include accelerators, large-scale facilities and equipment adequate for the conduct of a valid high-energy research programme by the community of physicists in the participating countries.
- To achieve these aims ECFA can engage in
  - among others - the following activities: - regular meetings;
  - ad hoc symposia and conferences sponsored or organized by ECFA;
  - study groups, set up by ECFA, or jointly with other organizations, for special problems
  - demographic studies of the high-energy physics community and resources in the ECFA countries, repeated at regular intervals; - monitoring of the ongoing implementation of the European Strategy for Particle Physics in the CERN Member States, and presentation of corresponding status reports to the European Strategy Session of Council.

# RECFA country visits 2018 & 2019

- The following visits and meetings are foreseen in 2018
  - *Romania (Bucharest), March 23-24, 2018*
  - *Austria (Vienna), April 6-7, 2018*
  - *Slovakia (Bratislava), May 18-19, 2018*
  - **ALBA (Barcelona), July 19-20, 2018 (including PECFA and RECFA meetings)**
  - The Netherlands (Amsterdam), October 19-20, 2018
  - CERN, November 15-16, 2018 (including PECFA and RECFA meetings)
- The following country visits in 2019 (too early to settle on the dates):
  - Spring RECFA visits: Spain-Slovenia-Poland
  - Summer RECFA and PECFA: at the EPS-HEPP meeting in Ghent, Belgium
  - Fall RECFA visit: Cyprus
  - Fall RECFA and PECFA: CERN

## ***Working group on Software Skills***

*( Kati Lassila-Perini, Alex Read, Eilam Gross, Tadeusz Lesiak  
+ ECFA Chairperson and the current and incoming Secretary )*

## ***Working group on Recognition of individual achievements***

*( Stan Bentvelsen, Roger Forty, David Milstedt, Peter Schleper, Antonio Zoccoli,  
+ ECFA Chairperson and the current and incoming Secretary )*

## ***Relations between ECFA and NuPECC***

## ***ApPEC-ECFA-NuPECC – Diversity Charter***

## ***ApPEC-ECFA Working Group on Detector R&D***

# Recognition of individuals

- Panel discussion
- Pierluigi Campana (LHCB), Max Klein (ATLAS), Jo van den Brand (LIGO), Francesco Forti (SuperB), Enrique Kajamovitz. - Moderator: Manfred Krammer
- Ways to recognise individuals
  - authorship ordering, opting in/out of signing papers, conference talks, awards ..
- Preceded by contact with collaborations and talk by J. D'Hondt.

## [ECFA Survey on Recognition of Individual Achievements in Large Collaborations](https://www.surveio.com/survey/d/C6P2Y7A9E5F9F2Y0U)

<https://www.surveio.com/survey/d/C6P2Y7A9E5F9F2Y0U>

ECFA created a working group to examine the recognition of individual achievements in large scientific collaborations. Based on feedback from an initial survey of the leaders of 29 CERN-based or CERN-recognised experiments in particle, nuclear, astroparticle and astrophysics, ECFA found that the community is ready to engage in dialogue on this topic and receptive to potential recommendations. In response, ECFA has launched a community-wide survey to verify how individual researchers perceive the systems put in place to recognise their achievements. The deadline for responses is 26 October 2018.

# Future colliders and the Update to the European Strategy for Particle Physics

CERN activates clause in its constitution allowing it to coordinate European Particle Physics Activities

2006

First strategy

[http://council.web.cern.ch/sites/council.web.cern.ch/files/European\\_Strategy/ESStatement.pdf](http://council.web.cern.ch/sites/council.web.cern.ch/files/European_Strategy/ESStatement.pdf)

2013

Strategy update

<https://cds.cern.ch/record/1567258/files/esc-e-106.pdf>

2020

Strategy update

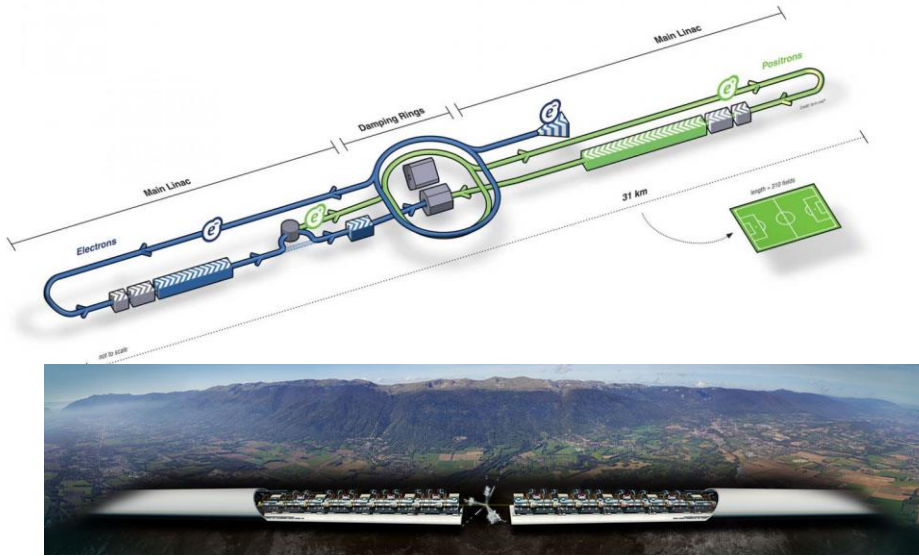
*Discussion on Swedish submission on Thursday:  
Protect and promote our current and planned program.  
Show our thinking on the strategy questions.*

# What will (almost certainly) happen ?

- The LHC will deliver  $3000\text{fb}^{-1}$  by 2035
  - Sensitivity up to  $\sim 3$  TeV in new physics
  - Greater precision on SM quantities
- New measurements of  $g-2$  muon
  - x 5 improvement in sensitivity
- New searches for electron, neutron EDMs + other non-collider experiments
  - $\sim$ order of magnitude improvement expected



# The strategic issues

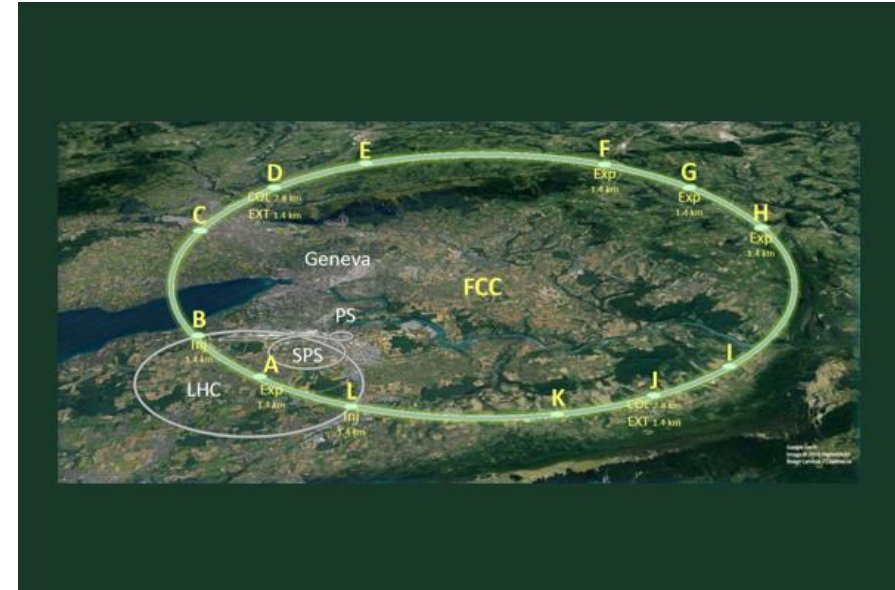


$e^+e^-$  collider at

$\sqrt{s} \square 200 - 3000 \text{ GeV}$

for precision Higgs/EWSB.

Precision frontier - new physics  
from deviations wrt SM.



hadron-hadron collider

at  $\sqrt{s} \sim 100 \text{ TeV}$

Precision Higgs/EWSB +  
new physics searches  
at energy frontier.

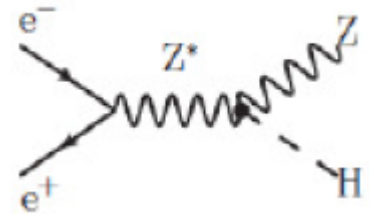
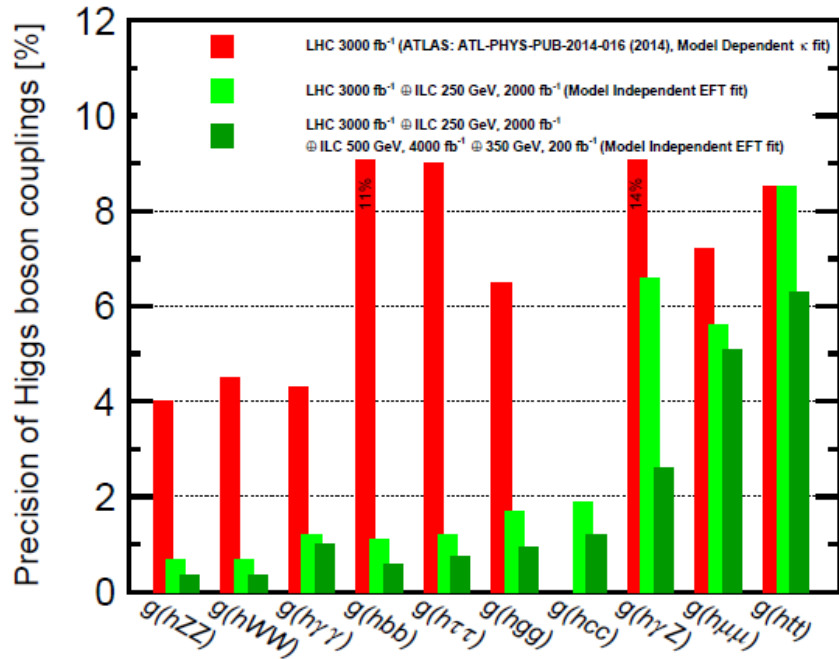


# The collider market place

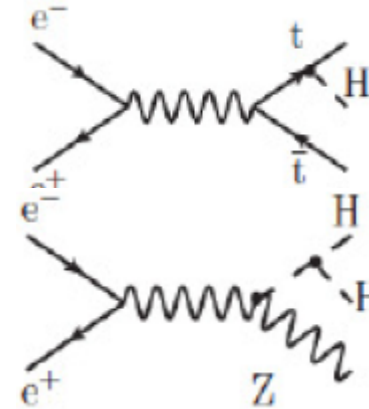
Collider	$\sqrt{s}$ (TeV)	$\int \mathcal{L}$ ( $\text{ab}^{-1}$ )	Location	Type	Date	Mature
ILC	0.25 0.5,1.0 ?	2	Japan	Linear e+e-	>2030	Shovel-ready TDR (2013)
CLIC	0.38 1.5,3	0.5 1.5,2	CERN	Linear e+e-	>2035	CDR (2012)
FCC-ee	0.25/0.36	10/2.6	CERN	Circular e+e-	>2035	No
LEP3	0.25	1	CERN	Circular e+e-	>2035	No
CEPC	0.25	5	China	Circular e+e-	>2035	CDR (2017)
HE-LHC	28	10	CERN	Circular hh	>2040	No
FCC-hh	100	10	CERN	Circular hh	>2045	No

# $e^+ + e^- \Leftrightarrow$ high precision Higgs factory

$$\frac{\sigma(pp \rightarrow H + X)}{\sigma(pp \rightarrow X)} \square 10^{-9} \quad \frac{\sigma(e^+e^- \rightarrow H + X)}{\sigma(e^+e^- \rightarrow X)} \square 0.01$$

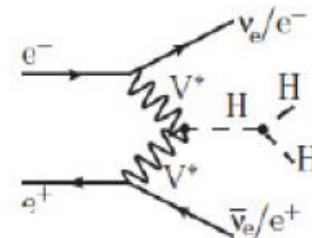


$\sqrt{s} = 250$  GeV  
 $g_Z$ , BR's,  
 (LHC)-invisible



+

$\sqrt{s} = 500$  GeV  
 $g_t, g_{HHH}$



+

$\sqrt{s} = 1000$  GeV  
 $g_{HHH}$

ILC~CLIC~LEP3 sensitivity, FCCee (x 2-5 better)

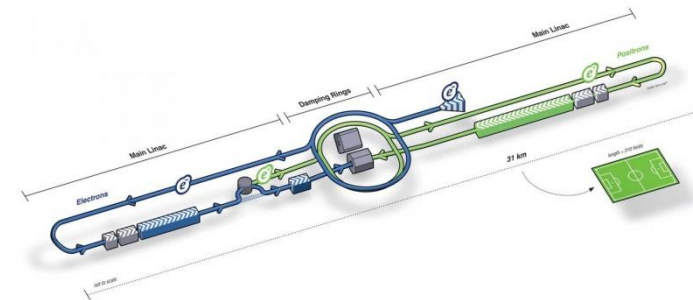
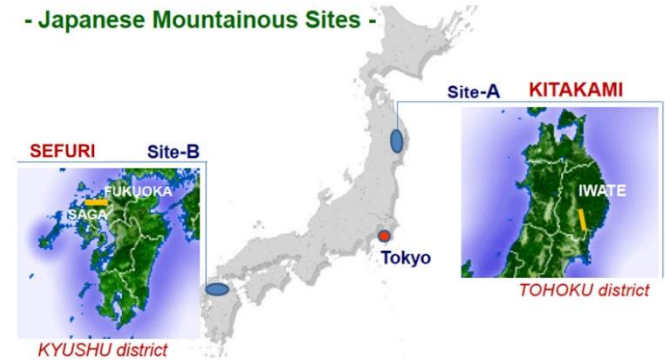
Tree-level sensitivity to new physics:

$\Delta g < 1\%$  for  $\Lambda > 1$  TeV

Sensitivity to new physics in loops

# International Linear collider

<i>ILC Physics Goals</i>	<i>500 GeV</i>	<i>350 GeV</i>	<i>250 GeV</i>
• precision Higgs couplings	✓	✓	✓
• g <sub>HWW</sub> and overall normalization of Higgs couplings	✓	✓	
• search for invisible and exotic Higgs decay modes	✓	✓	✓
• Higgs couplings to top	✓		
• Higgs self-coupling	✓		
• search for extended Higgs states	✓		
• precision electroweak couplings of the top quark	✓		
• precision <b>W</b> couplings	✓	✓	
• precision search for <b>Z'</b>	✓		
• search for supersymmetry	✓		
• search for Dark Matter	✓		
• top quark mass from threshold scan		✓	
• precision Higgs mass			✓



Original plan  $\sqrt{s}=500$  GeV  $\rightarrow$  1 TeV .

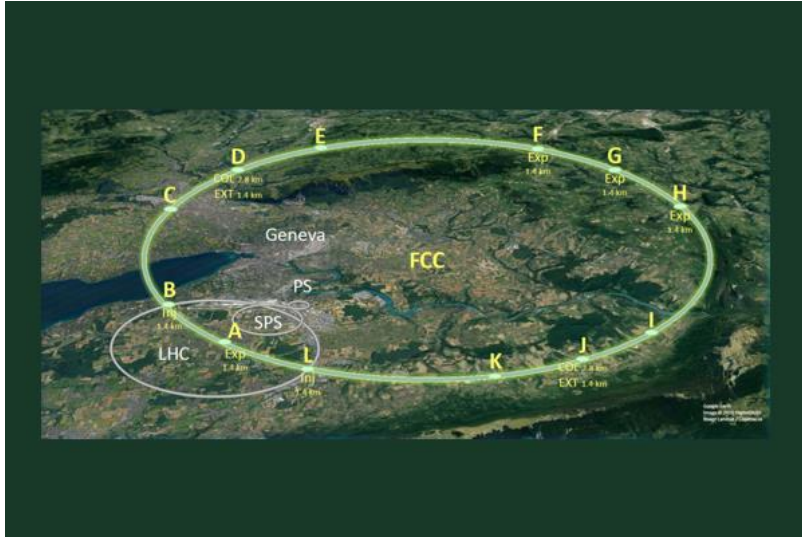
Now  $\sqrt{s}=250$  GeV , maybe 380 GeV, 500 GeV

Most (not all) core measurements are kept but a lot is lost.

Project started in the 1990's. Decision expected in 2018/2019

in time for the strategy update.

# Hadron-hadron colliders



Future circular collider

$pp$  collider at  $\sqrt{s} = 100$  TeV

New tunnel (80-100 km).

16 T magnets

FCC-ee first ( $\sqrt{s} = 380$  GeV) ?

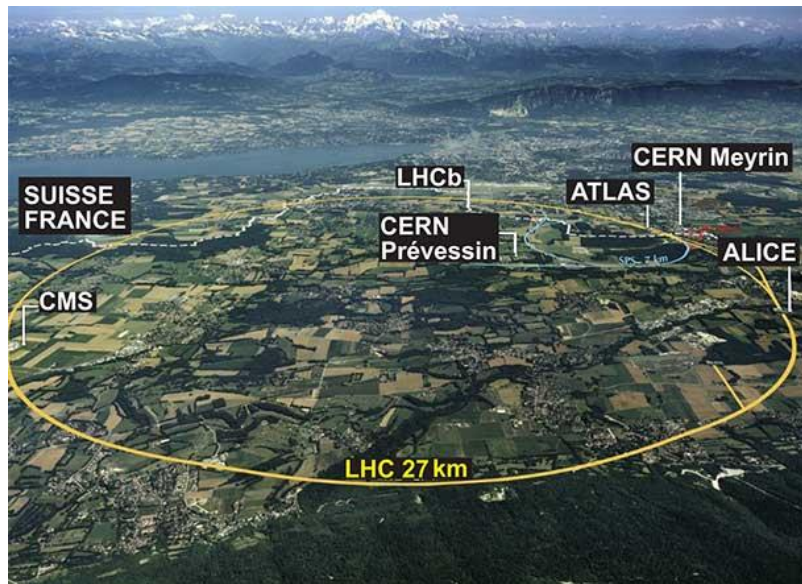
High Energy LHC

$pp$  collider at  $\sqrt{s} = 28 \square 14 \times \frac{16}{8}$  TeV

Existing tunnel

16 T magnets

LEP3 first ( $\sqrt{s} \square 240$  GeV) ?



# $hh$ physics at 100 TeV

- An order of magnitude lower in probed distance scale
- Factors  $\sim 5$ -10 in mass scale for new physics
- Complete exploration of the Higgs sector (quartic coupling)
  - Test electroweak baryogenesis
- High precision Higgs + SM measurements + DM searches



- No "no lose" theorem unlike Tevatron and LHC.
- No consensus (yet??) in community.
- For the first time in  $\sim 50$  years its not clear that a new insight will come from pushing the high energy frontier.



# The cards are on the table



How do we think they should be played over the medium and long term ?



# European PP strategy update discussion tomorrow

THURSDAY, 18 OCTOBER

09:30 → 13:00	Discussion session: Swedish input to the European Strategy of Particle Physics	12:30 → 13:30	Lunch
10:00	<b>Strategy overview</b> ⌚ 15m <b>Speakers:</b> David Anthony Milstead (Stockholm University (SE)), David Milstead	13:30 → 17:00	Discussion session: Swedish input to the European Strategy of Particle Physics
10:15	<b>BSM</b> ⌚ 20m <b>Speakers:</b> Caterina Doglioni (Lund University (SE)), Christian Ohm (KTH Royal Institute of Technology (SE)), Rikard Enberg (Uppsala University)	13:30	<b>Discussion of draft and key points</b> ⌚ 3h
10:35	<b>SM</b> ⌚ 20m <b>Speakers:</b> Leif Lönnblad (Lund University (SE)), Rebeca Gonzalez Suarez (Uppsala University (SE))		
10:55	<b>Heavy ions</b> ⌚ 20m <b>Speakers:</b> Leif Lönnblad (Lund University (SE)), Peter Christiansen (Lund University (SE))		
11:15	<b>Neutrinos</b> ⌚ 20m <b>Speakers:</b> Chad Finley, Roman Pasechnik		
11:35	<b>Break</b> ⌚ 15m		
11:50	<b>Detectors</b> ⌚ 20m <b>Speakers:</b> Bengt Lund-Jensen (KTH Royal Institute of Technology (SE)), Richard Brenner (Uppsala University (SE))		
12:10	<b>Accelerators</b> ⌚ 20m <b>Speaker:</b> Roger Ruber (Uppsala University (SE))		

Please attend and make your voice heard.

This is the first time in 50 years when it is not obvious where to go in the long term.

Long term planning begins now.

We will submit a contribution for the Swedish pp community.

More details from Kerstin on the strategy process.



# Summary

- ECFA focus on individual recognition
- Preparation for the European PP Strategy Update