Update of the European Strategy (ES) for Particle Physics

Brief recall of the procedure and bodies

Concentrate on the outcome of the closed ES drafting meeting which took place at the Ettore Majorana Foundation and Centre for Scientific Culture (EMFCSC) in Erice from 21 to 25 January 2013

Note that the statements of the 'Proposed Update of the European Strategy for Particle Physics' are at this stage a DRAFT to Council only (and in principle could be changed by Council in its March meeting)

I will highlight a very selective set of topics only, the full set of draft statements is available at

Erice (Sicily), 750 m

https://indico.cern.ch/getFile.py/access?resId=0&materialId=0&confId=217656

The time line

Autumn 2011	**CERN Council initiated an update exercise to the European Strategy for Particle Physics which was approved by a special Council Session held in Lisbon on 14th July 2006**
	This included appointing formally a European Strategy Group (ESG) as well as a European Strategy Preparatory Group (ESPG)
February 2012	**ESPG started collecting written input from community**
July 31st 2012	**Closing date for input to Open Symposium in Krakow**
10-12 Sep 2012	**Open Symposium in Krakow with more than 500 participants** http://espp2012.ifj.edu.pl/
October 15th 2012	**Closing date for community input to the Briefing Book**
21-25 Jan 2013	**2013 European Strategy Meeting in Erice to produce a draft proposal to Council**
March 2013	**Council finalizes the strategy document**
May 29th 2013	**Final approval by Council in a special meeting in Brussels**

European Strategy Group (ESG)

Members

Member States Representatives

Austria	Prof. A. H. Hogang
Belgium	Prof. W. Van Doninck
Bulgaria	Prof. L. Litov
Czech Republic	Prof. J. Chyla
Denmark	Prof. J.J. Gaardhoje
Finland	Prof. P. Eerola
France	Prof. J. Martino
Germany	Prof. S. Bethke
Greece	Dr P. Rapidis
Hungary	Prof. P. Levai
Italy	Prof. F. Ferroni
Netherlands	Prof. S. De Jong
Norway	Prof. A. Read
Poland	Prof. J. Krolikowski
Portugal	Prof. G. Barreira
Slovakia	Dr L. Sandor
Spain	Prof. F. del Aguila
Sweden	Prof. B. Asman
Switzerland	Prof. K. Kirch
United-Kingdom	Prof. J. Butterworth

CERN - Director-General	Prof. R. Heuer

Major European National Labs

CIEMAT	Dr C. Lopez
DESY	Prof. J. Mnich
IRFU	Dr Ph.Chomaz
LAL	Dr A. Stocchi
NIKHEF	Prof. F. Linde
LNF	Dr U. Dosselli
LNGS	Prof. S. Ragazzi
PSI	Dr L. Rivkin
STFC-RAL	Dr J. Womersley

Strategy Secretariat Members

Prof. T. Nakada	Scientific Secretary (Chair)
Prof. F. Zwirner	SPC Chair
Dr M. Krammer	ECFA Chair
Dr Ph. Chomaz	Repres. EU Lab. Directors
Prof. E. Tsesmelis	Scientific Assistant

Invited - President of Council	Prof. A. Zalewska

Invitees

Candidate for Accession and Associate Member States

Israel	Prof. E. Rabinovici
Romania	Dr S. Dita
Serbia	H. E. Amb. U. Zvekic

Observer States

India	Prof. T. Aziz
Japan	Prof. Sh. Asai
Russian Federation	Prof. A. Bondar
Turkey	Prof. Dr M. Zeyrek
United-States	Prof. M. Shochet

EU	Dr R. Lecbychova
ApPEC	Dr S. Katsanevas
Chairman FALC	Prof. Y. Okaka
Chairman ESFRI	Dr B. Vierkorn-Rudolph
Chairman NuPECC	Prof. A. Bracco
JINR, Dubna	Prof. V. Matveev

Former President of Council Prof. M. Spiro

Erice, ESG, January 2013

The European Strategy Preparatory Group (ESPG) Members

Strategy Secretariat Members

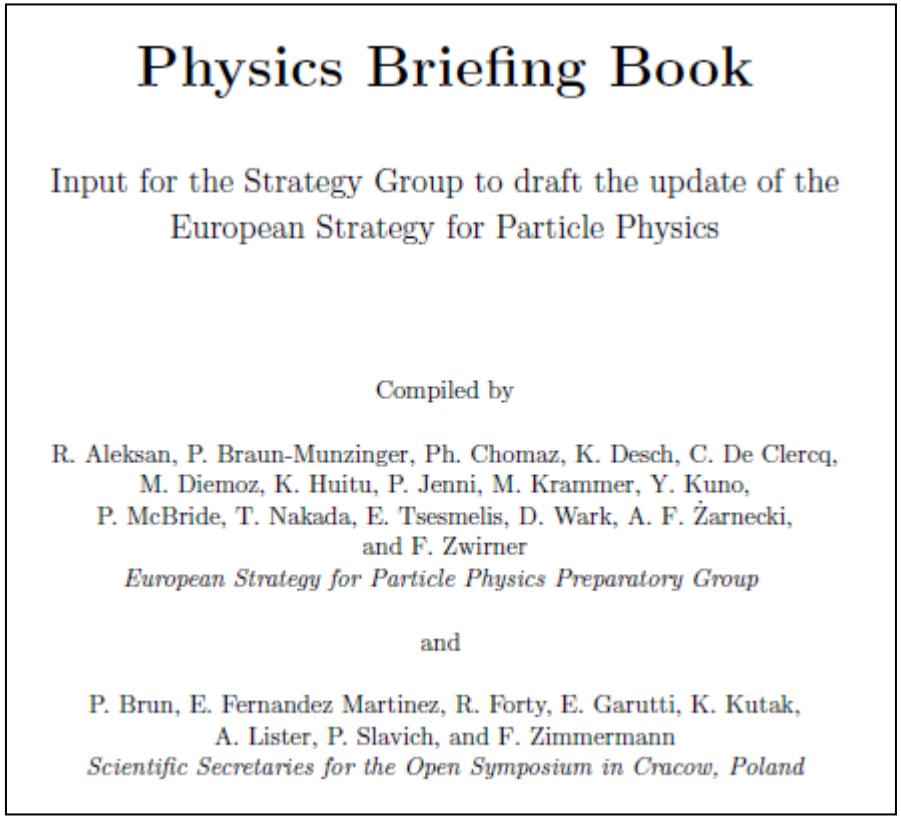
Prof. T. Nakada	Scientific Secretary (Chair)
Prof. F. Zwirner	SPC Chair
Dr M. Krammer	ECFA Chair
Dr Ph. Chomaz	Repres. EU Lab. Directors
Prof. E. Tsesmelis	Scientific Assistant

SPC
Prof. R. Aleksan (FR)
Prof. P. Braun-Munzinger (DE)
Prof. M. Diemoz (IT)
Prof. D. Wark (UK)

ECFA
Prof. K. Desch (DE)
Prof. K. Huitu (FI)
Prof. A. P. Zarnecki (PL)
Prof. C. De Clercq (BE)

CERN
Dr P. Jenni

ASIA/AMERICAS
Prof. Y. Kuno (Asia)
Prof. P. McBride (Americas)



Physics Briefing Book

Input for the Strategy Group to draft the update of the European Strategy for Particle Physics

Compiled by

R. Aleksan, P. Braun-Munzinger, Ph. Chomaz, K. Desch, C. De Clercq, M. Diemoz, K. Huitu, P. Jenni, M. Krammer, Y. Kuno, P. McBride, T. Nakada, E. Tsesmelis, D. Wark, A. F. Żarnecki, and F. Zwirner
European Strategy for Particle Physics Preparatory Group

and

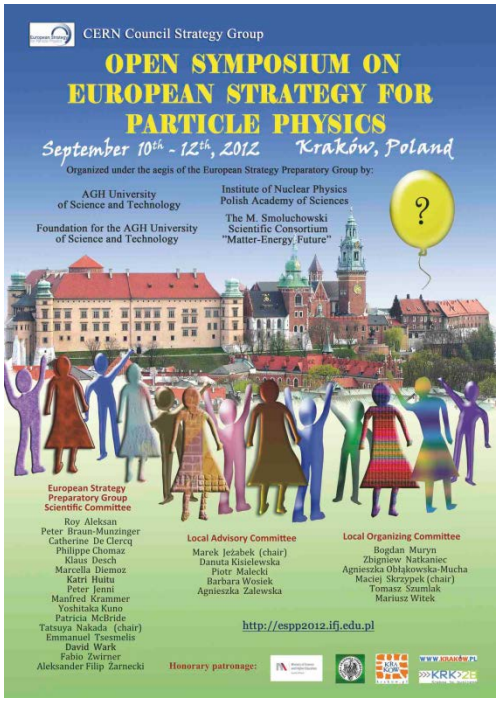
P. Brun, E. Fernandez Martinez, R. Forty, E. Garutti, K. Kutak, A. Lister, P. Slavich, and F. Zimmermann
Scientific Secretaries for the Open Symposium in Cracow, Poland

Briefing Book

The Briefing Book contains in 220 pages a 'digested summary' of the scientific and technical input to the European Strategy update (from 177 contributions and the Krakow Open Symposium)

Chapter headings

1- Introduction
2- Energy Frontier
3- Physics of Flavour and Symmetries
4- Neutrino Physics
5- Strong Interaction Physics
6- Astroparticle and Non-accelerator Physics
7- Particle Physics Theory
8- Accelerator Science and Technology
9- Instrumentation, Computing and Infrastructure



The present (public) version of the Briefing Book is available at
http://indico.cern.ch/materialDisplay.py?materialId=0&confId=222548

A final version will be published in a few weeks

ES Working Groups on organizational and other matters

Working Group 1	**Mandate and organisational structure for the Council for the European Strategy and its implementation**
Working Group 2	**Organisational structure for European participation in global projects, including the role and definition of the National Laboratories and the CERN Laboratory in the European Strategy**
Working Group 3	**Relations with external bodies, in particular EU-related issues**
Working Group 4	**Knowledge and technology transfer, relations with industry**
Working Group 5	**Outreach, communication and education**

The membership of these WGs were members from the ESG plus some external experts

Erice ES meeting procedure

The content and the scientific arguments of all the 8 chapters of the Briefing Book were presented and discussed in detail on the first two days of the meeting

The third day was devoted to the presentation and discussion of the organizational and other matters covered by WG1 to WG5

The proposed strategy update was then elaborated during the last two days in an iterative process (*), arriving at a consensus as presented now to Council for approval

It would be impossible to show highlights from all these presentations

Just as (rather biased and limited) examples a few pages, mainly from the 'High Energy Frontier' presentation … which in terms of very large facilities for the European Strategy dominated the discussion

_____

(*) The excellent steering and preparatory work of the Strategy Secretariat led by T Nakada with the SPC Chair F Zwirner, the ECFA Chair M Krammer and the representative of EU Lab Directors Ph. Chomaz deserves special mentioning

Accelerators for the TeV scale

Table 2.1: Overview of proton-proton colliders.

Facility	Years	E_{cm} [TeV]	Luminosity $[10^{34}cm^{-2}s^{-1}]$	Int. luminosity $[fb^{-1}]$	Comments
Design LHC	2014–21	14	1–2	300	
HL-LHC	2024–30	14	5	3000	luminosity levelling
HE-LHC	>2035	26–33	2	100–300/yr	dipole fields 16–20 T
VHE-LHC	>2035	42–100			new 80 km tunnel

pp colliders

e+e- colliders

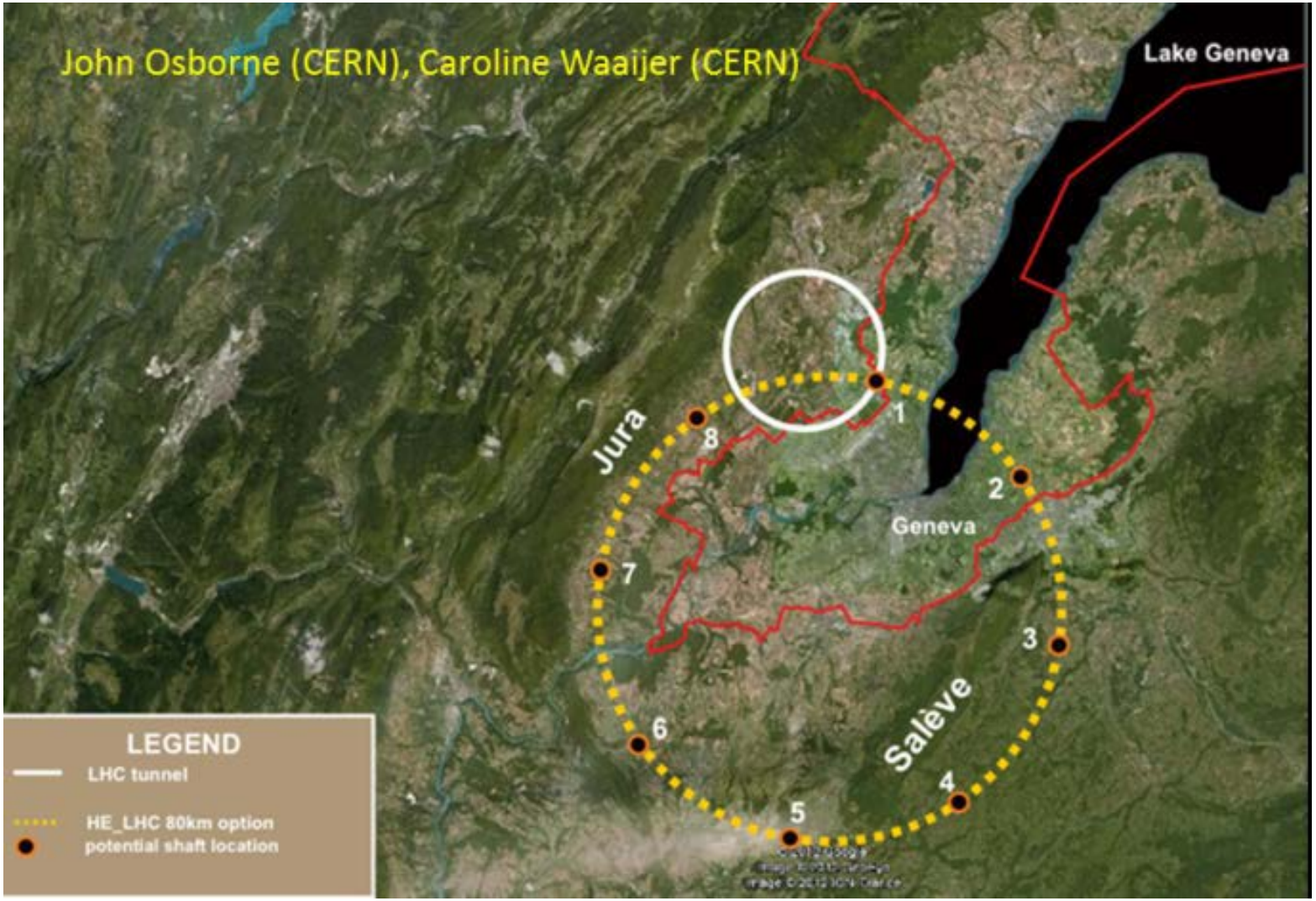
- Technical aspects in chapter 8
- eh colliders in chapter 5
- $\mu^+\mu^-$ and $\gamma\gamma$ colliders similar physics program as e^+e^- colliders

Table 2.2: Overview of electron-positron colliders (*different scenarios)

Facility	Year	E_{cm} [GeV]	Luminosity $[10^{34}cm^{-2}s^{-1}]$	Tunnel length [km]
ILC 250	<2030	250	0.75	
ILC 500		500	1.8	~ 30
ILC 1000		1000		~ 50
CLIC 500	>2030	500	2.3 (1.3)*	~ 13
CLIC 1400		1400 (1500)*	3.2 (3.7)*	~ 27
CLIC 3000		3000	5.9	~ 48
LEP3	>2024	240	1	LEP/LHC
TLEP	>2030	240	5	80 (ring)
TLEP		350	0.65	80 (ring)

From 'High Energy Frontier' presented by Marcella Diemoz

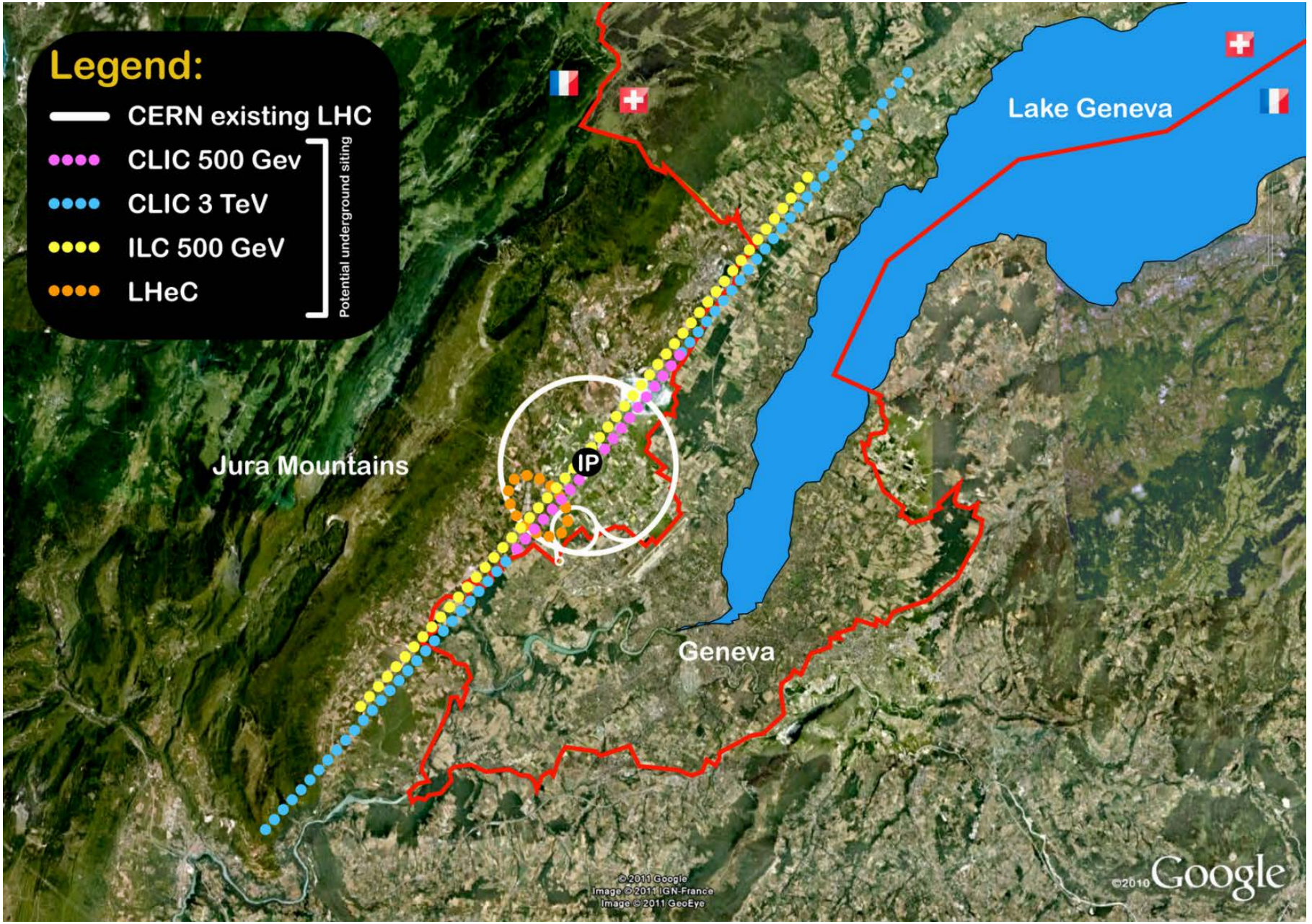
Pre-Feasibility Assessment for an 80 km Tunnel Project at CERN (CERN-ATS-2012-237, Briefing Book ID 165)



Could house an e^+e^- collider TLEP up to 350 GeV or a Very High Energy Hadron Collider ranging from 42 TeV (8.3T LHC magnets) to 100 TeV (20T very high field magnets with HTS)

Indicating the Scale for Liner Colliders

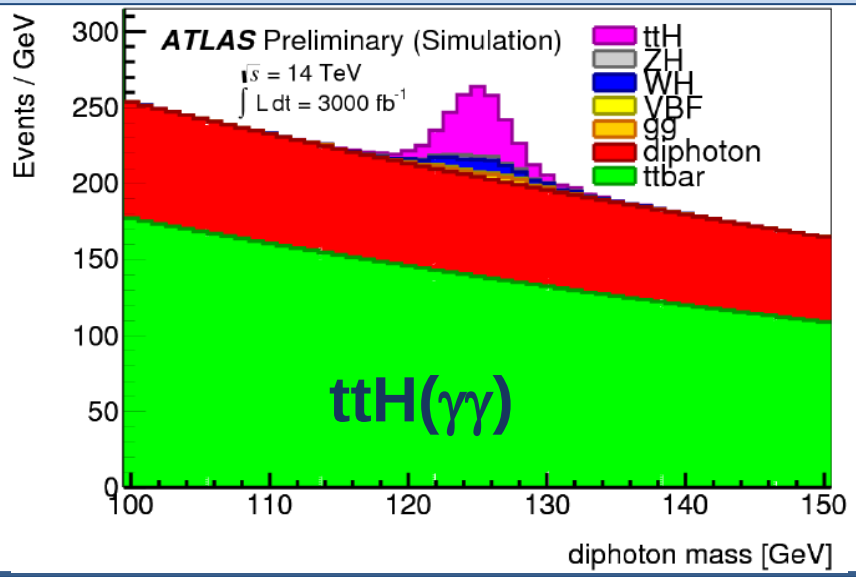
(Taken from C. Biscari, 'High Energy Accelerators', Krakow ES Symposium)

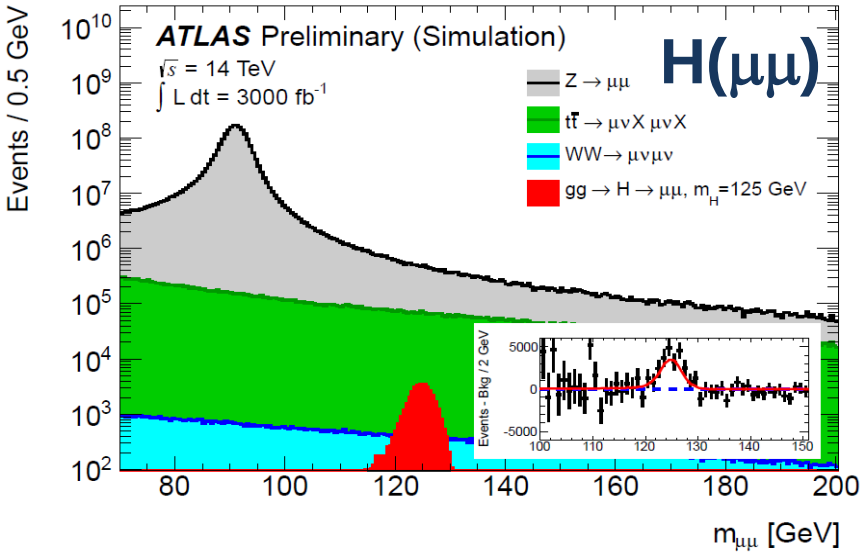


Physics @ LHC: high luminosity

From 'High Energy Frontier' presented by Marcella Diemoz

HL-LHC: $\sqrt{s}$ ~14 TeV, L=5x10^{34} cm^{-2}s^{-1} and 3000 fb^{-1} ~ 2030





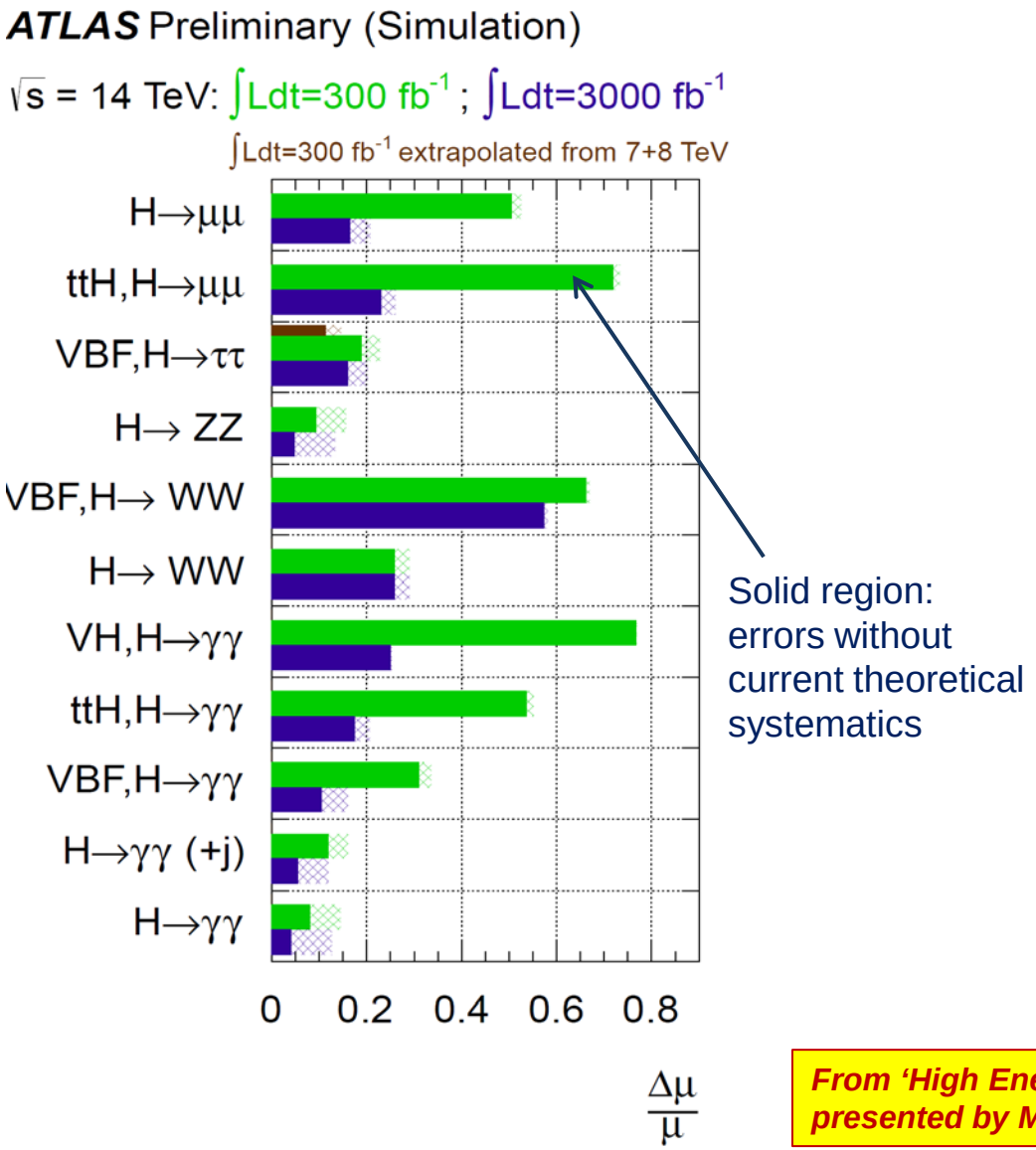
CMS ESTIMATE

Coupling	300 fb^{-1} syst. (%)		3000 fb^{-1} syst. (%)	
	actual	scaled	actual	scaled
κ_γ	6.5	5.1	5.4	1.5
κ_V	5.7	2.7	4.5	1.0
κ_g	11	5.7	7.5	2.7
κ_b	15	6.9	11	2.7
κ_t	14	8.7	8.0	3.9
κ_τ	8.5	5.1	5.4	2.0

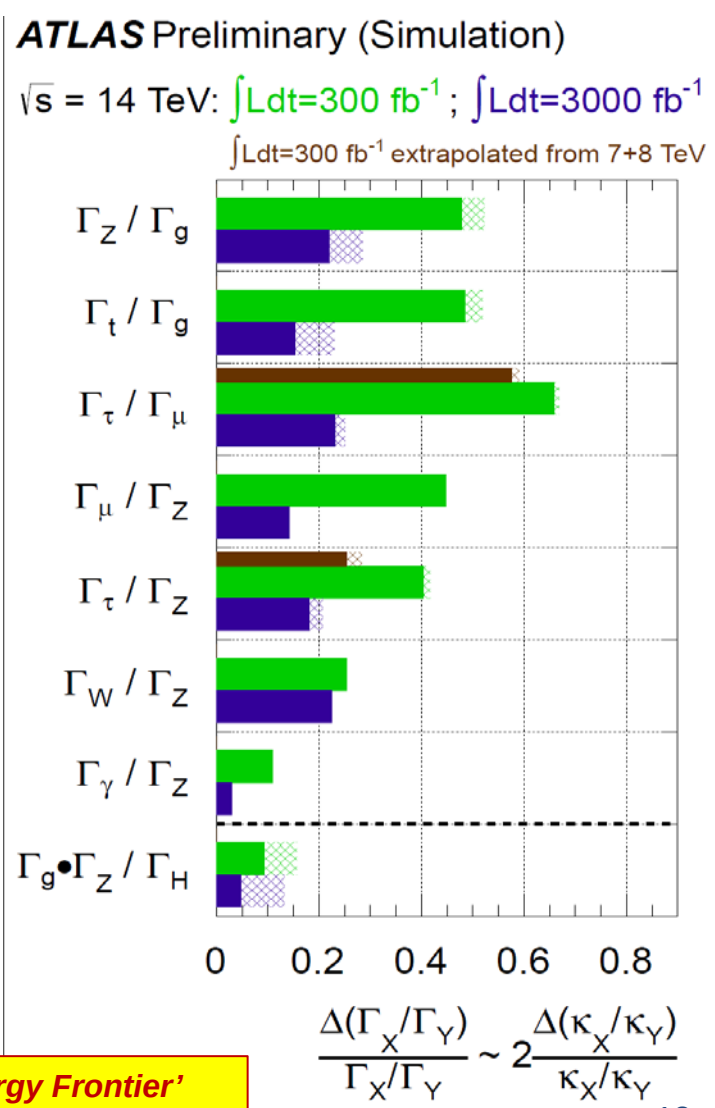
Profit from statistics:

- **rare H production channels**
- **rare H decay channels**
- **H couplings**
- **Higgs self coupling (HH detection)**
- **VBS: dynamics of EWSB (is it SM?)**
- **New physics with suppressed couplings**

High Lumi: precision



Solid region: errors without current theoretical systematics

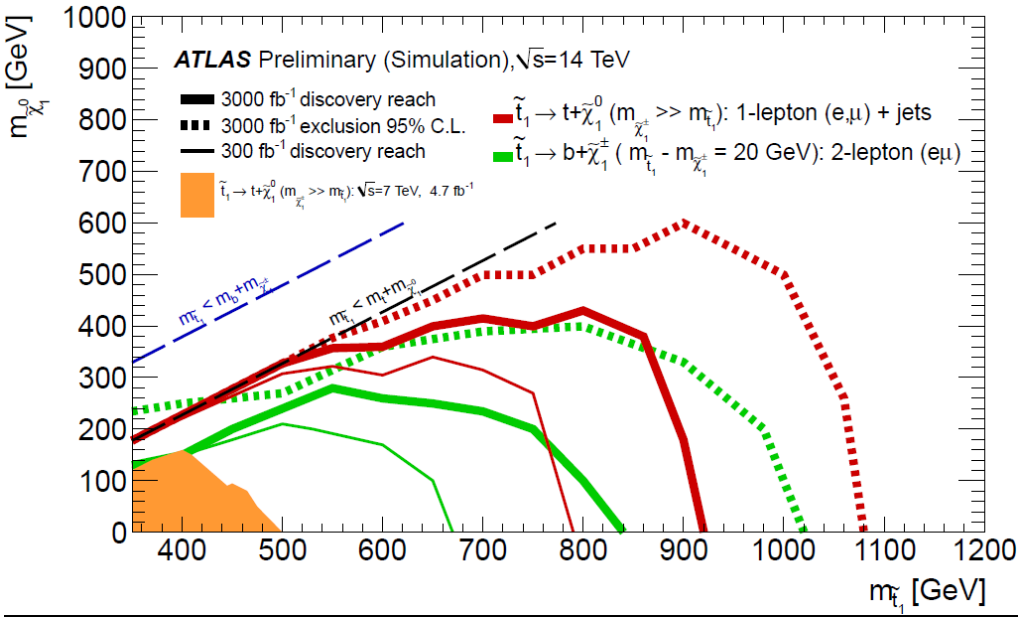


From 'High Energy Frontier' presented by Marcella Diemoz

BSM

A factor 10 in luminosity gives further room for discoveries:

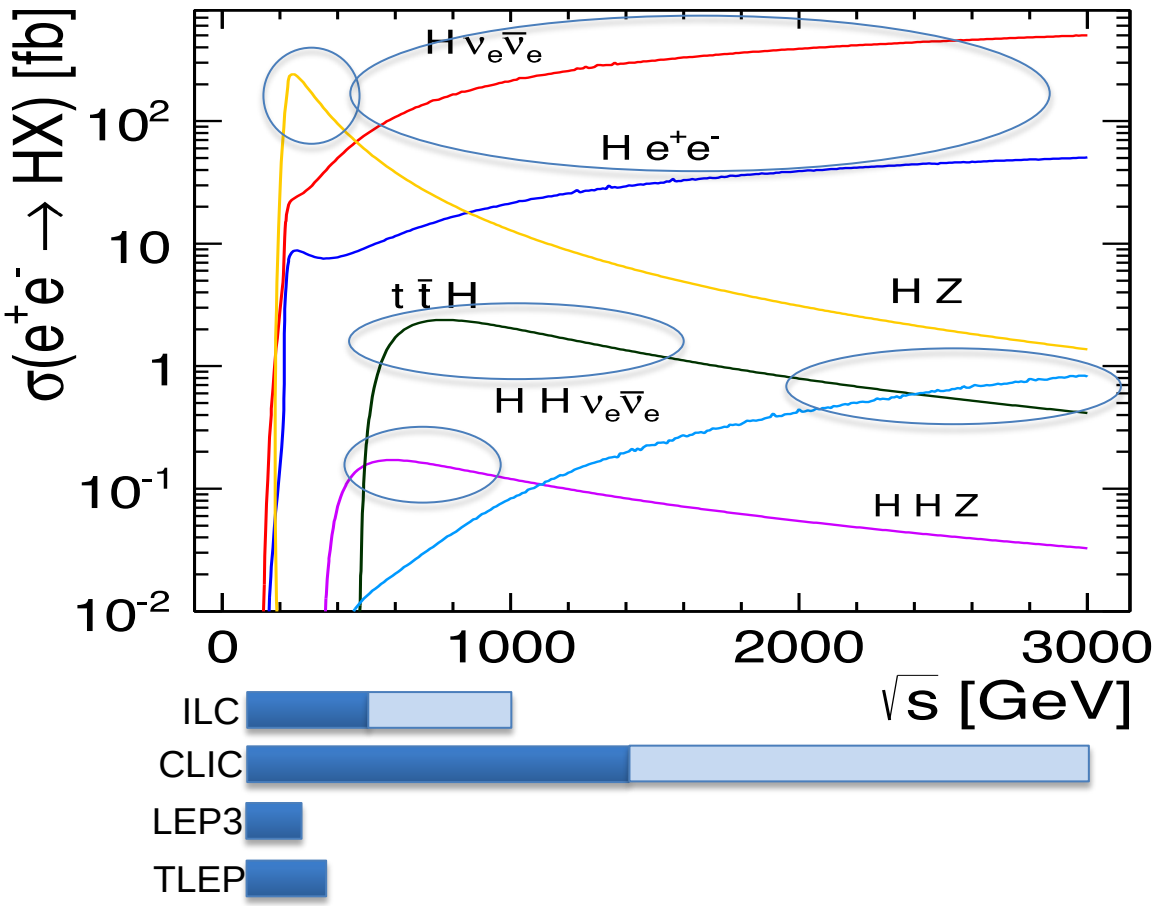
- **Moderate gain in the searches of strongly coupled heavy objects. Typical improvement of about 20% in the mass reach.**
- **Substantial improvement in probing new states with smaller couplings than those assumed by sequential SM.**
- **Substantial improvement in probing new states beyond the kinematical reach of 14 TeV through precise measurement of the Higgs properties.**

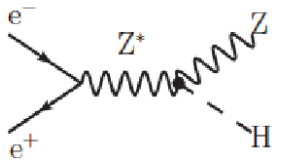


3° generation squark have low x-sect: with 3000 fb-1 exclude the parameter space for a light stop (below 1 TeV) no matter the value of the LSP mass... A definitive challenge to SUSY & naturalness). And in case of discovery enough statistics for further studies.

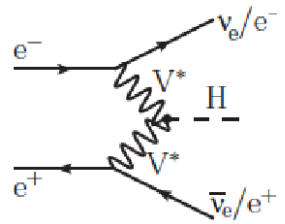
From 'High Energy Frontier' presented by Marcella Diemoz

Precision Higgs Studies

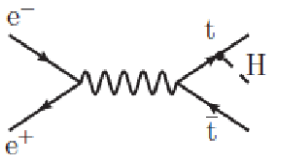




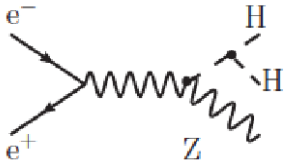
Mass
g_Z (m.i.)
BR´s
(LHC)-invisible



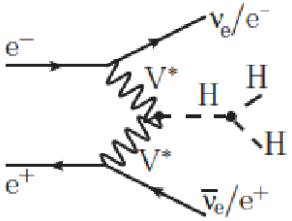
Γ_{tot}



g_t (ILC,CLIC)



g_{HHH} (ILC500)



g_{HHH} (ILC1000, CLIC)

- Many processes at different √s needed & accessible
- HZ (at 250-350 GeV): recoil mass as anchor for model-independence

From 'High Energy Frontier' presented by Marcella Diemoz

Precision Higgs Studies

ILC/CLIC	250/350 GeV	500 GeV	3 TeV
g_{Hbb}	1.6/1.4%		2%
g_{Hcc}	4/3%	2%	2%
$g_{H\tau\tau}$	3/3%	2.5%	
g_{HWW}	4/3%	1.4%	<2%
$g_{H\mu\mu}$	–	–	7.5%
g_{HZZ}	1.5–2%		
g_{HWW}/g_{HZZ}			<1%
g_{ttH}	–	15%	
g_{HHH}	–	30–40%	20%
Γ_H	11/7%	5%	

250/350 fb^{-1} 500 fb^{-1} 1000 fb^{-1}

Note: ILC250 Lumi not (yet) optimized

invisible decays to < few%

- model-independent
- statistics-limited (down to ~1%)
- scaling law:

$$\Delta g / g \sim 1/\sqrt{\int Ldt \times n_{experiments}}$$

Coupling	LEP3	TLEP
g_{HZZ}	1.3%	0.4%
g_{Hbb}	1.4%	0.6%
$g_{H\tau\tau}$	2.8%	0.8%
g_{Hcc}		1.3%
g_{HWW}	3.1%	1.3%
$g_{H\gamma\gamma}$	6.9%	3.1%
$g_{H\mu\mu}$	–	13%
g_{Htt}	–	–
m_H (MeV)	52	15

500 fb^{-1} 2500 fb^{-1} (?)

scaled to 1 experiment

From 'High Energy Frontier' presented by Marcella Diemoz

Directly from the submissions from LEP3 and TLEP proponents

(Briefing Book ID 171 and 173)

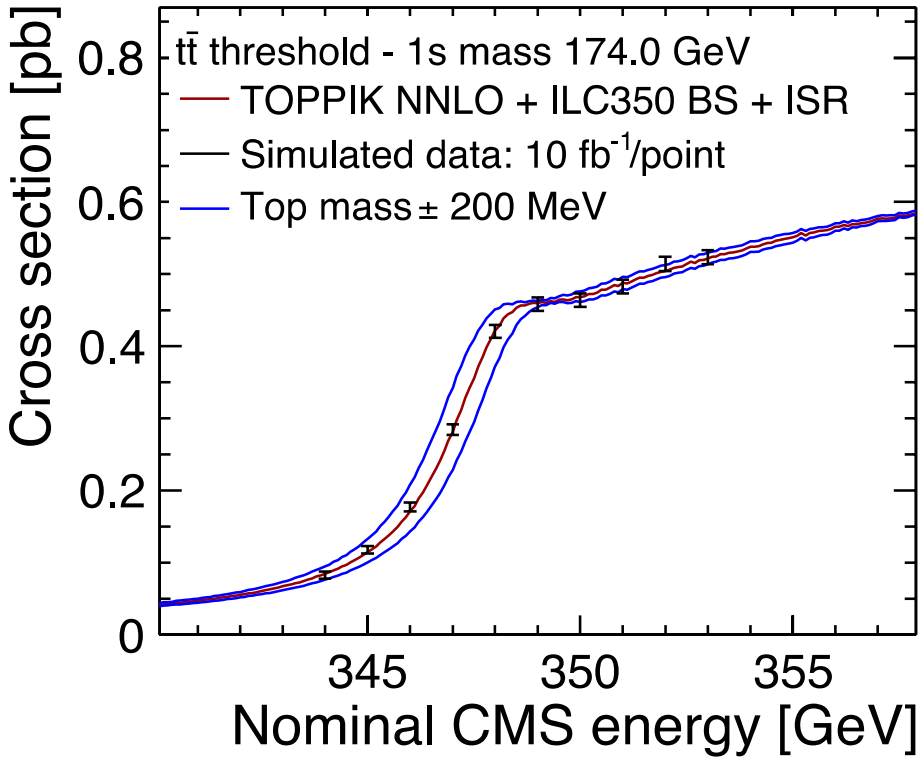
Table 2: Summary of possible Higgs measurements with LEP3 and TLEP compared with the LHC and the ILC operating at 250 GeV.

	ILC	LEP3 (2)	LEP3 (4)	TLEP (2)	LHC (300)	HL-LHC
σ_{HZ}	3%	1.9%	1.3%	0.7%	–	–
$\sigma_{HZ} \times BR(H \to b\bar{b})$	1%	0.8%	0.5%	0.2%	–	–
$\sigma_{HZ} \times BR(H \to \tau^+\tau^-)$	6%	3.0%	2.2%	1.3%	–	–
$\sigma_{HZ} \times BR(H \to W^+W^-)$	8%	3.6%	2.5%	1.6%	–	–
$\sigma_{HZ} \times BR(H \to \gamma\gamma)$	?	9.5%	6.6%	4.2%	–	–
$\sigma_{HZ} \times BR(H \to \mu^+\mu^-)$	–	–	28%	17%	–	–
$\sigma_{HZ} \times BR(H \to \text{invisible})$	?	1%	0.7%	0.4%	–	–
g_{HZZ}	1.5%	0.9%	0.6%	0.3%	13%/5.7%	4.5%
g_{Hbb}	1.6%	1.0%	0.7%	0.4%	21%/14.5%	11%
$g_{H\tau\tau}$	3%	2.0%	1.5%	0.6%	13%/8.5%	5.4%
g_{Hcc}	4%	?	?	0.9%	?/?	?
g_{HWW}	4%	2.2%	1.5%	0.9%	11%/5.7%	4.5%
$g_{H\gamma\gamma}$	?	4.9%	3.4%	2.2%	?/6.5%	5.4%
$g_{H\mu\mu}$	–	–	14%	9%	?	?
g_{Htt}	–	–	–	–	14%	8%
m_H (MeV/c^2)	50	37	26	11	100	100

Notes

- **LHC and e^+e^- measurements are not directly comparable**
- **(2) and (4) for LEP3 and TLEP mean 2 or 4 experiments combined, assuming CMS performance enhanced with upgraded b and c tagging**
- **Current knowledge of theory systematics below 1% have been questioned**

Top (√s ≥ 350 GeV) + TGC/QGC (500/1000+ GeV)



- Δm_{top} = 20 MeV (stat.)
  100 MeV (theo.)
- $\Delta \Gamma_{top}$ = 30 MeV

Top mass crucial parameter
in SM and many BSM extensions

Further examples:
At √s = 500 GeV + polarisation:
ΔA_{LR} = 5% → sensitivity to e.g.
10-20 TeV KK-states

ttγ, ttZ < 1%

Study EWSB through:
Triple Gauge Couplings (500+): sensitivity up to 10 x LHC (depending on coupl.)
Quartic Gauge Couplings: (1000+): WW→WW

From 'High Energy Frontier' presented by Marcella Diemoz

Flavour and Symmetry

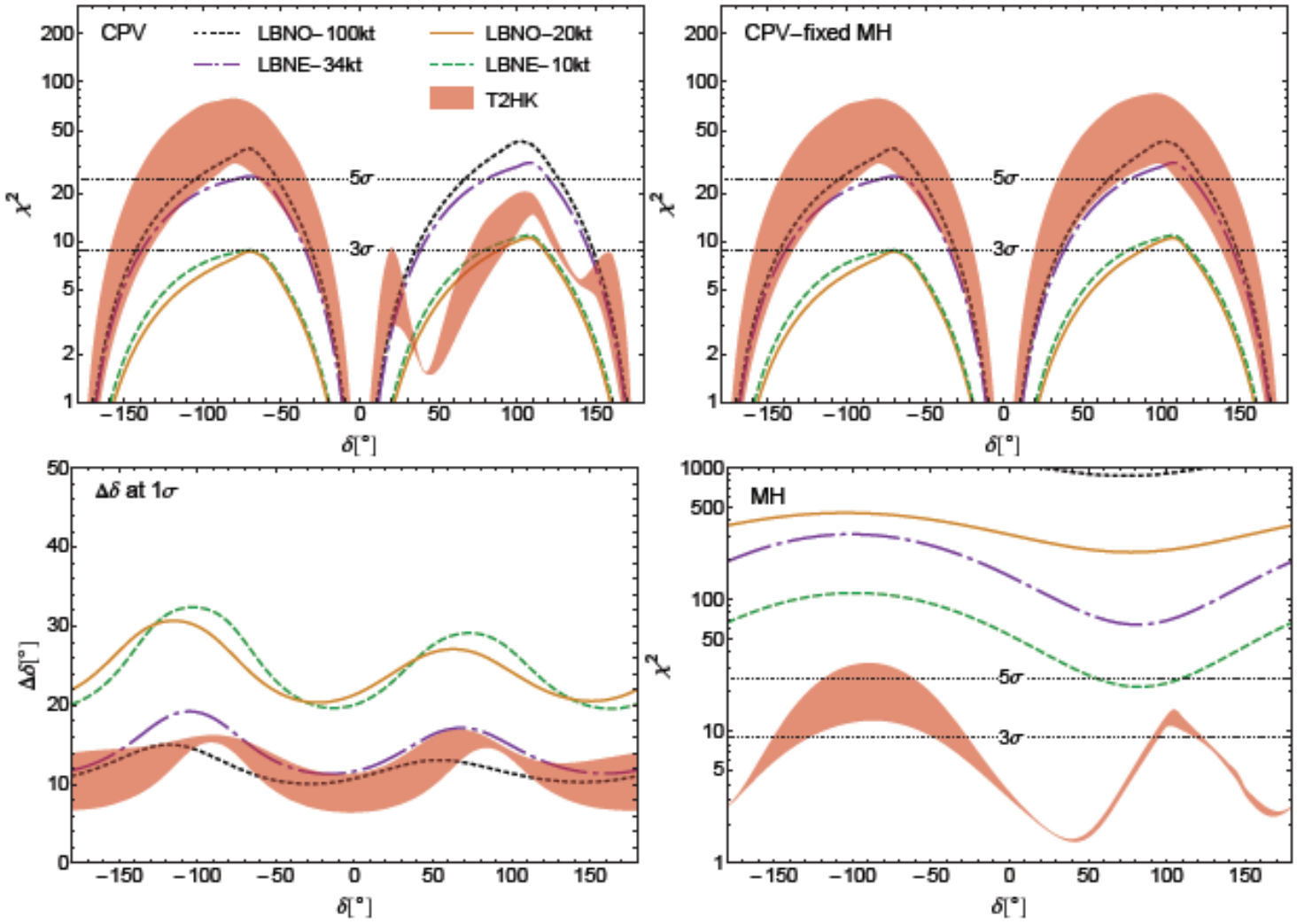
(Paintings of Kabuki actors)

Summary

- There has been substantial recent progress in flavour physics since 2006.
  - B factories (both Belle and BaBar), high PT physics (CDF, D0, ATLAS and CMS) and LHCb
  - NA62 for kaons, and MEG for muon CLFV.
- The success of the SM in flavour physics excludes new physics sources in ther flavour breaking sector at the TeV energy scale.
- With high intensity/luminosity facilities, future experiments would find deviations from the SM, and hints for new physics.
  - The key approach is to push forward the precision in the cleanest observables.
- Flavour physics is complementary to high-energy/high-PT physics, and also complementary amongst themselves.
- Flavour physics is required to understand new physics beyond the SM.

From 'Physics of Flavour and Symmetry' presented by Yoshitaka Kuno

Long baseline neutrino experiments



CP violating phase δ
Mass Hierarchy (sign of Δm^2_{31})

(LBNO, LBNE for 10y, T2HK for 5y)

See Briefing Book for references

Proposed Update of the European Strategy for Particle Physics

(Erice, 25 January 2013)

The full text of the tree-page document, which is a DRAFT to Council, is available at

https://indico.cern.ch/getFile.py/access?resId=0&materialId=0&confId=217656

The format of the document is such that the statements for each point are given in normal text, and then *the recommended actions in italics*

The points are labled from a) …. to …. q) such that they can be referred to easily; it is NOT to be taken as an overall priority ordering

In what follows, only parts are reproduced, and highlights in bold/colour are my own!

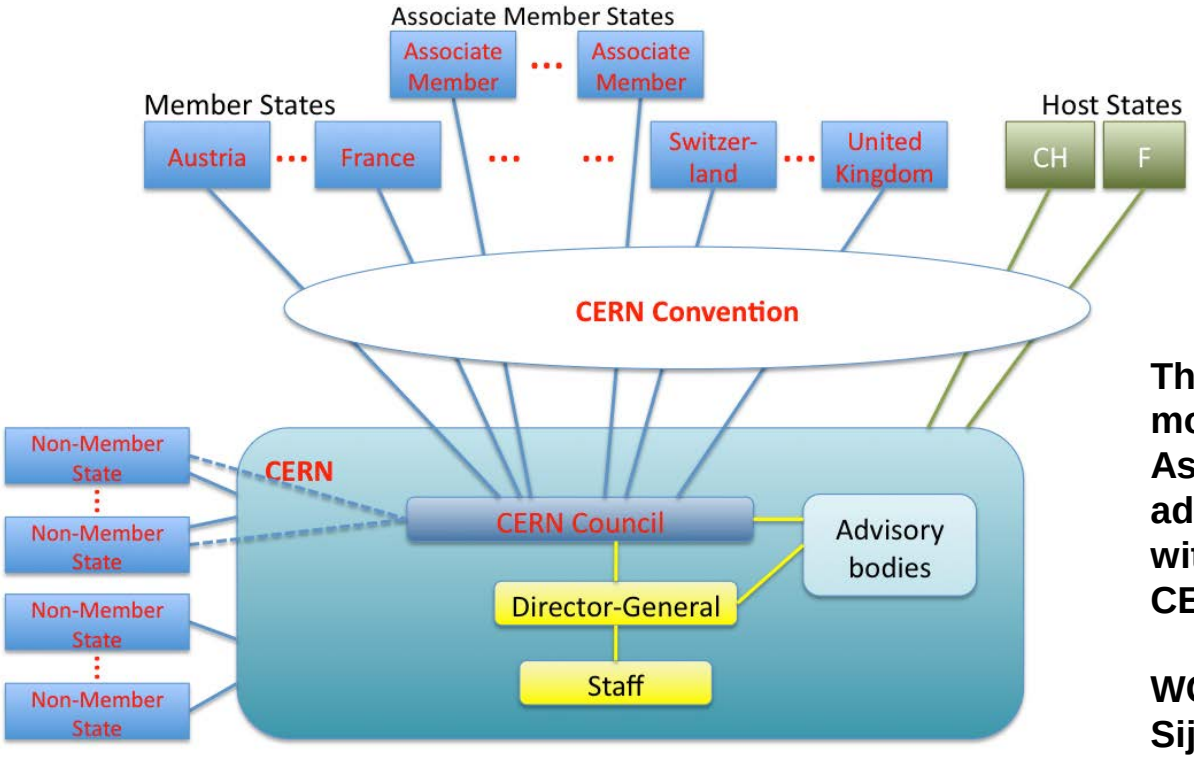
Entrance to the former San Domenico monastery with the Paul Dirac Lecture Hall where the ES meeting took place

General issues

ESPP DRAFT Statement for Council approval

a) The success of the LHC is proof of the effectiveness of the European organisational model for particle physics, founded on the sustained long-term commitment of the CERN Member States and of the national institutes, laboratories and universities closely collaborating with CERN.

Europe should preserve this model in order to keep its leading role, sustaining the success of particle physics and the benefits it brings to the wider society.



The current CERN governance model, including Member States, Associate Member States and ad-hoc partners with and without observer status in CERN Council

WG2 presentation by its convener Sijbrand de Jong

ESPP DRAFT Statement for Council approval

b) The scale of the facilities required by particle physics is resulting in the globalisation of the field.

The European Strategy takes into account the worldwide particle physics landscape and developments in related fields and should continue to do so.

My personal comments

This a very important statement for our field, and when it comes to concrete considerations it is by far not obvious how to implement in the best interest for the whole community

Europe can only act as a useful strong partner in a global context when it maintains CERN as focal point for its HEP community

High-priority large-scale scientific activities

After careful analysis of many possible large-scale scientific activities requiring significant resources, sizeable collaborations and sustained commitment, the following four activities have been identified as carrying the highest priority.

ESPP DRAFT Statement for Council approval

c) 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**. The LHC is in a unique position to pursue this programme.

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.

My personal comments

It could not be more explicit!
This 'result' was not given in advance, and the ATLAS and CMS inputs, as well as the ones from LHCb and ALICE, were very important for that
(now 'we LHC people' have to deliver… !)

ESPP DRAFT Statement for Council approval

d) **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.***

My personal comments

This is to be understood as going clearly beyond 'only' technology R&D studies, by including all aspects of a future high energy frontier facility road map, and by keeping well in mind the 'global context'

ESPP DRAFT Statement for Council approval

e) **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.

My personal comments

Council can only discuss the needed resources and implications of a participation in a global ILC project in Japan when an official proposal is on the table, but there is no doubt that there is considerable interest for it in the European community

However, the future of CERN must remain secured, as said before, while contributing to healthy physics activities in other regions

Via San Francesco, the only long straight street in Erice

ESPP DRAFT Statement for Council approval

f) Rapid progress in neutrino oscillation physics, with significant European involvement, has established a **strong scientific case for a long-baseline neutrino programme exploring CP violation and the mass hierarchy** in the neutrino sector.

*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**.*

My personal comments

I think the message is clear, I have no further comment…

The Norman Castle and the Castello Pepoli Erice

All the next sections are very important as well, but regrettably there is no time to report in full on them here (only the headings, and some selected parts are shown, please read the full draft text!)

Other scientific activities essential to the particle physics programme

g) **Theory is a strong driver of particle physics ….**

h) Experiments studying quark flavour physics, investigating dipole moments, searching for charged lepton flavour violation and performing other precision measurements at lower energies ... **may give access to higher energy scales** … ***Experiments in Europe with unique reach … as well as participation in other regions …***

i) The success of particle physics experiments, such as those required for the high-luminosity LHC, relies on **innovative instrumentation, state-of-the-art infrastructures and large-scale data-intensive computing…**

j) A range of important non-accelerator experiments take place at **the overlap of particle and astroparticle physics**… (close collaboration with ApPEC)

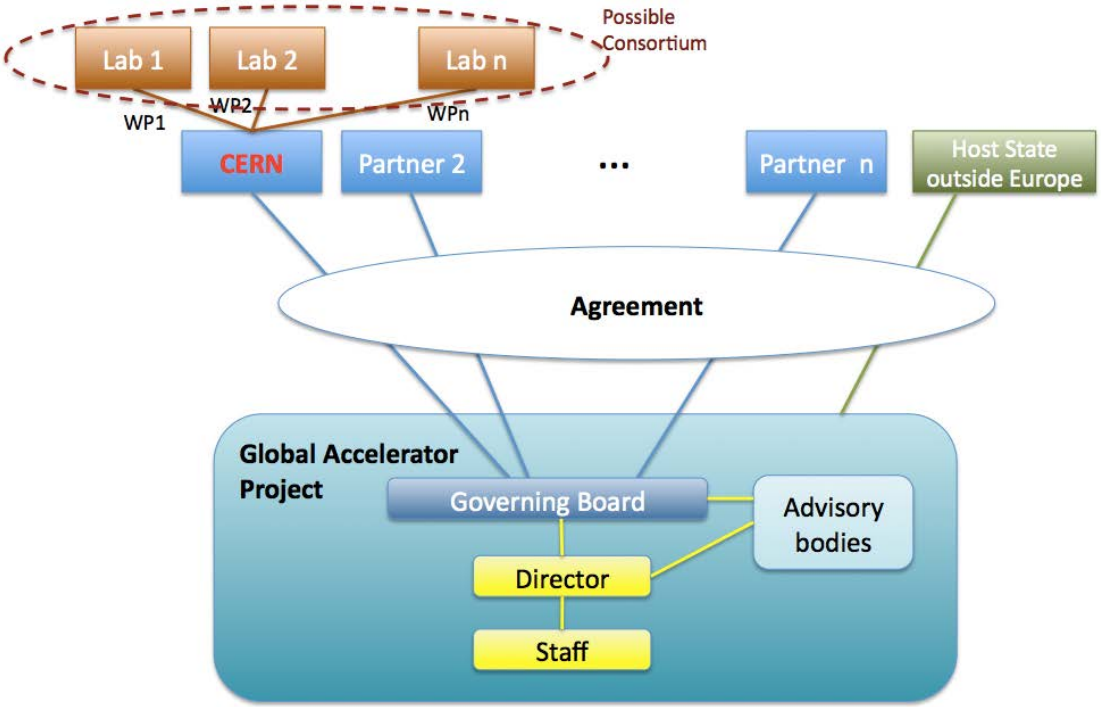
k) A variety of **research lines at the boundary between particle and nuclear physics** require dedicated experiments. … *CERN should continue to work with NuPECC on topics of mutual interest.*

ESPP DRAFT Statement for Council approval

Organisational issues

l) **Future major facilities in Europe and elsewhere require collaboration on a global scale**.

CERN should be the framework within which to organise a global particle physics accelerator project in Europe, and should also be the leading European partner in global particle physics accelerator projects elsewhere. Possible additional contributions to such projects from CERN's Member and Associate Member States in Europe should be coordinated with CERN.



Example of possible participation of European national laboratories through CERN in global projects outside Europe

WG2 presentation by its convener Sijbrand de Jong

m) **A Memorandum of Understanding has been signed by CERN and the European Commission, and various cooperative activities are under way…**

… *CERN and the particle physics community should strengthen their relations with the European Commission …*

Wider impact of particle physics

n) **Sharing the excitement of scientific discoveries with the public …**
is part of our duty as researchers….

o) **Knowledge and technology developed for particle physics research…**

p) **Particle physics research requires a wide range of skills and knowledge…**

Concluding recommendations

ESPP DRAFT Statement for Council approval

q) **This is the first update of the European Strategy for Particle Physics**. It was prepared by the European Strategy Group based on the scientific input from the Preparatory Group with the participation of representatives of the Candidate for Accession to Membership, the Associate Member States, the Observer States and of other organisations. **Such periodic updates at intervals of about five years are essential.**

Updates should continue to be undertaken according to the principles applied on the present occasion. The organisational framework for the Council Sessions dealing with European Strategy matters and the mechanism for implementation and follow-up of the Strategy should be revisited in the light of the experience gained since 2006.

My personal comments

We arrived at point q), that's it… thanks already for your attention!

… But there is one more comment

One of the many nice restaurants and bars in Erice, but closed in January…

Some history: 26 years ago …
La Thuile 7 – 13 January 1987
(Carlo Rubbia's Long Range Planning Committee)

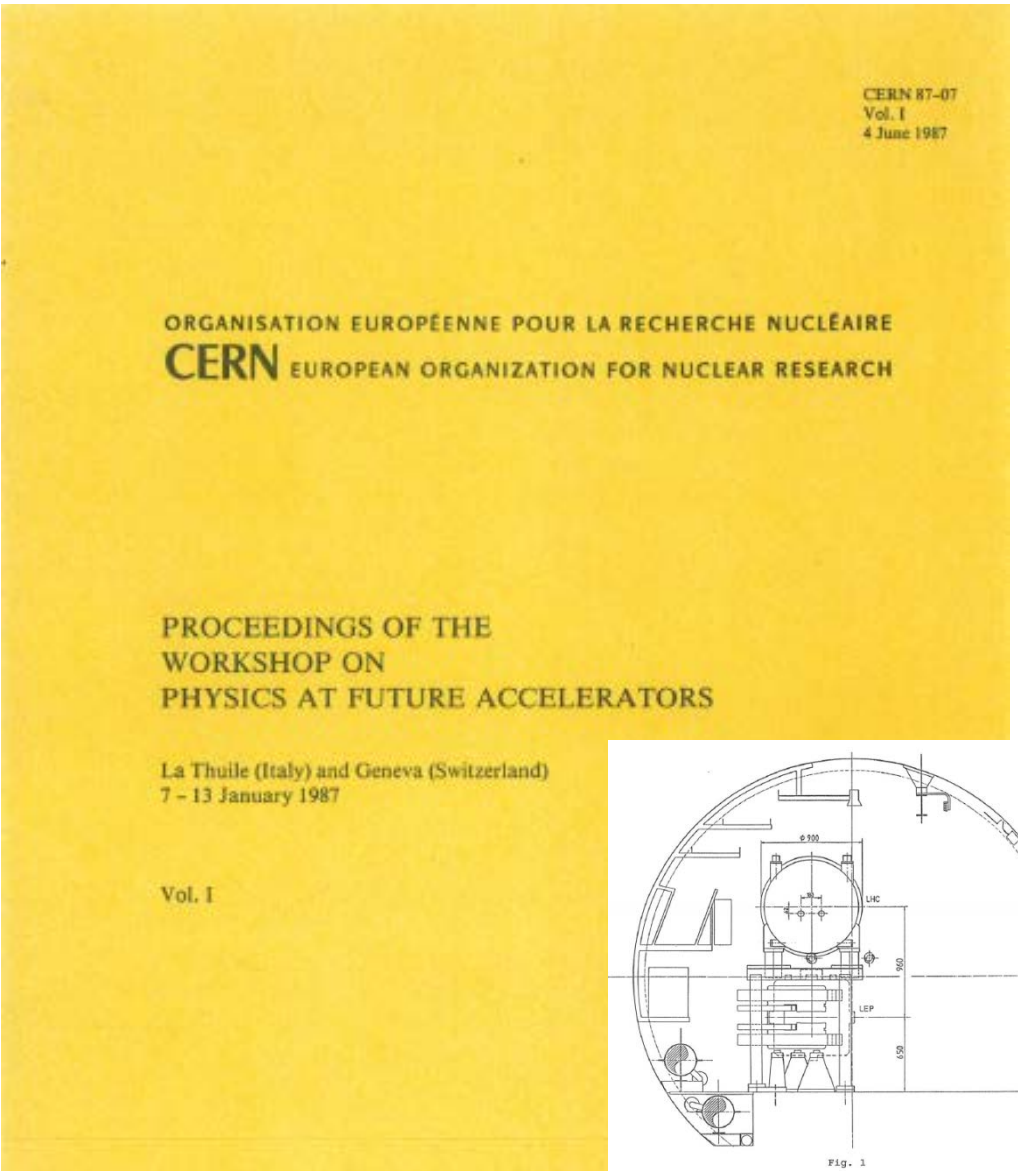
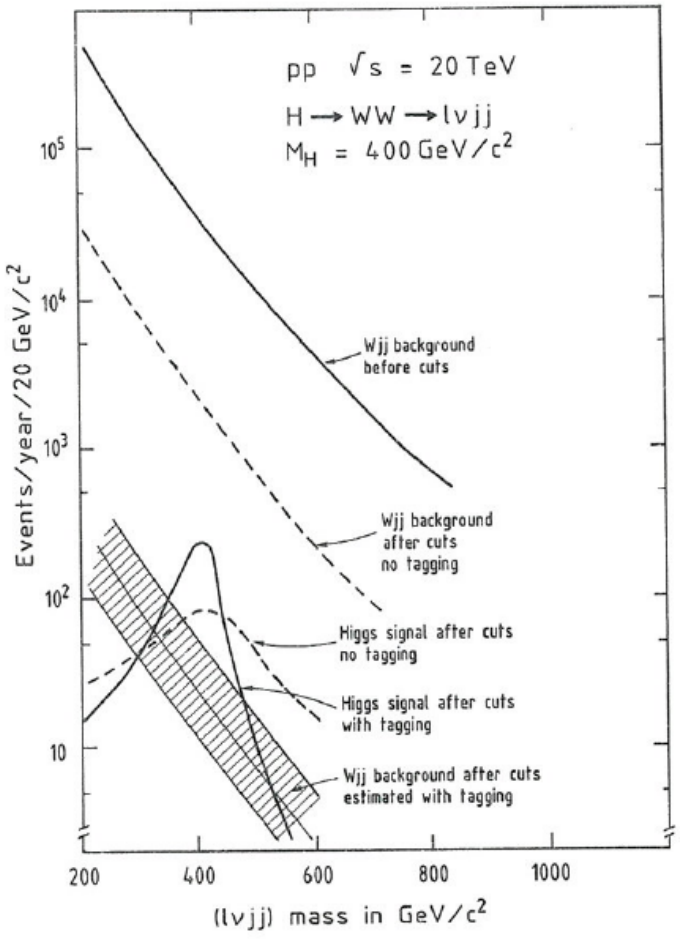


Fig. 1

Collider parameters

Machine		$\sqrt{s}$ (TeV)	L ($cm^{-2} s^{-1}$)
LHC	pp	16	$10^{33} \rightarrow 10^{34}$
	ep	1.3	10^{32}
		1.8	10^{31}
CLIC	e^+e^-	2	$10^{33} \rightarrow 10^{34}$



Backup

Charge to the ESG meeting (I), by its Chairperson Tatsuya Nakada

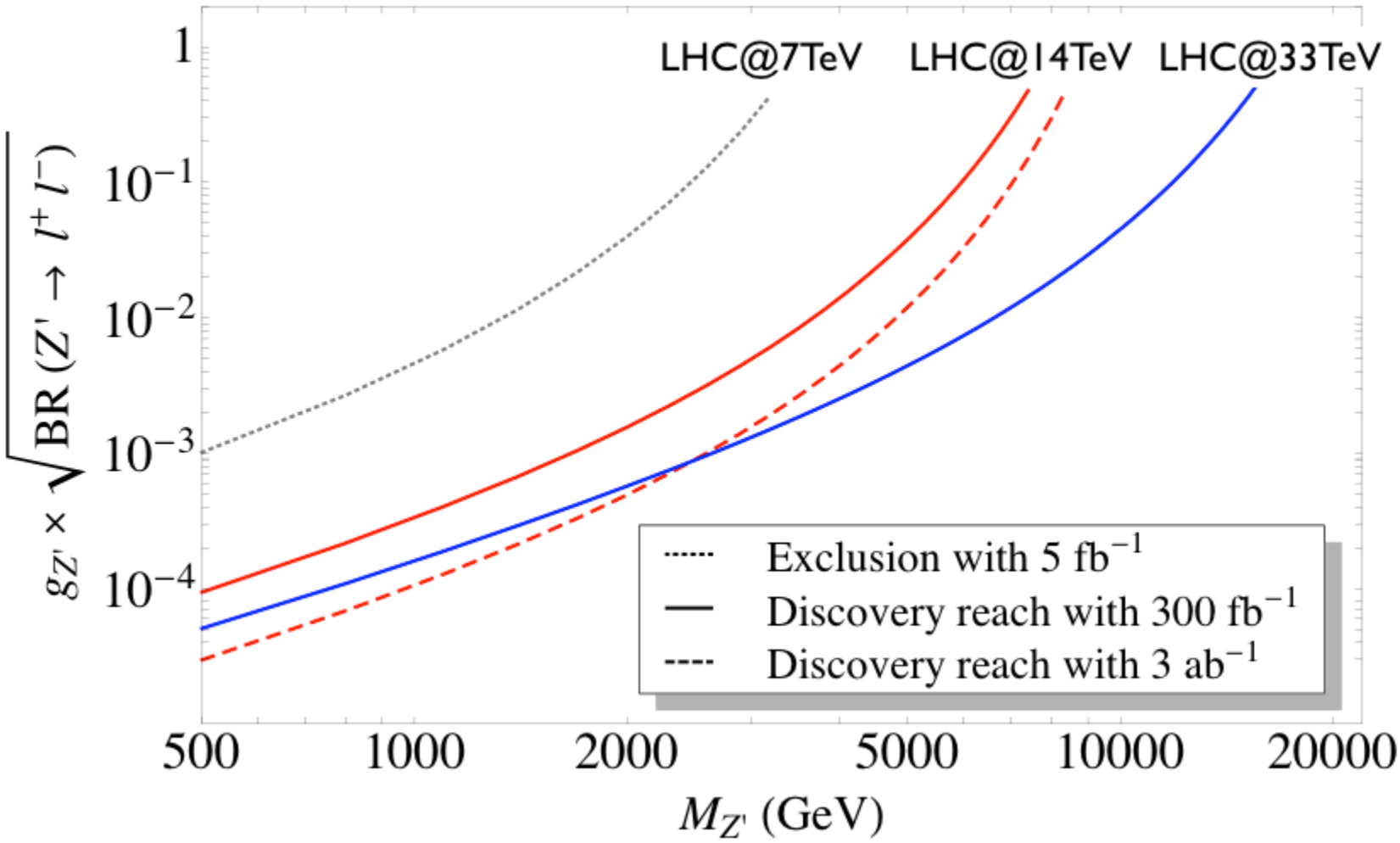
Recall the Council Document

- The Strategy Update shall in particular aim at:
  - enhancing the visibility of existing European particle physics programmes;
  - increasing collaboration among Europe's particle physics laboratories, institutes and universities;
  - promoting a coordinated European participation in global projects and in regional projects outside Europe;
  - encouraging knowledge transfer to other disciplines, industry, and society.
- The proposal shall include a review of the implementation of the 2006 Strategy, as well as of the structures and procedures currently in place with regard to the Strategy.

Charge to the ESG meeting (II), by its Chairperson Tatsuya Nakada

Recall the Council Document

- The proposal shall outline priorities following a thematic approach, with special emphasis on future large infrastructures/projects, including preparatory steps for a next project at CERN after LHC in a global context, and consider time scales and resources. It shall also consider possible future participation by CERN in experiments outside the Geneva Laboratory as part of the Strategy implementation.
- The proposal shall comprise a series of ordered and concise statements of 1-2 pages in total, followed by more detailed presentations that shall not exceed 25 pages.


LHC@7TeV
LHC@14TeV
LHC@33TeV
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
$g_{Z'} \times \sqrt{\mathrm{BR}\,(Z' \to l^+ l^-)}$
Exclusion with 5 fb^{-1}
Discovery reach with 300 fb^{-1}
Discovery reach with 3 ab^{-1}
500
1000
2000
5000
10000
20000
$M_{Z'}$ (GeV)

TLEP Ring e^+e^- collider: Primary Cost Driver

Tunnel: ~60% cost

Building on existing technologies and experience (LEP, KEKB, PEPII…)

Using SC cavities

Could cover a wide range of energy up to 350 Gev collision energy.

Energy CM (GeV)	90	240	350
Luminosity ($x10^{34}cm^{-2}s^{-1}$)	100	~5	~0.7
Cavity Gradient (MV/m)	20	20	20
#5-cell SC cavities	100	300	600
Beam lifetime (mn)	37	16	27
Total AC power (MW)	250	250	250

Most parameters have been achieved or are planned at SuperKEKB

From 'Accelerator Science and Technology' presented by Roy Aleksan

Summary

- Neutrino oscillations are the first confirmed BSM particle physics.
- $0\nu\beta\beta$ decay and absolute neutrino mass measurements are just as (or more) important and deserve strong support in the strategy.
- We still have a lot of work to do to completely characterize the MNSP matrix.
- The measurement of "large" θ_{13} has opened up a range of new experiments on a realizable scale.
- There is no other way to do this physics than build major projects to measure a few numbers – but we need those numbers.
- For real measurements (rather than just a discovery) of δ we need to move beyond conventional beams – further R&D for a Neutrino Factory is needed.
- The sterile neutrino question also needs an answer from a definitive experiment (or experiments) – ICARUS/NESSIE and νStorm are possibilities at CERN.
- The European neutrino physics community has worked hard to remain coherent during the LHC era, it would be a shame to lose it now.

Dave Wark
Imperial College/RAL

From 'Neutrino Physics' presented by Dave Wark