

ECFA and perspectives of the particle physics in the world

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Outlook:

- mission of the Committee and its recent activities
- ECFA's role in connection with the European Strategy for Particle Physics
- summary of the conclusions and recommendations of the strategy update
- perspectives of the particle physics in the world
- summary and conclusions

- The European Committee for Future Accelerators (ECFA) was founded in 1963
- ECFA is advisory to CERN Management, CERN Council and its Committees, and to other organizations, national or international
- One of its main activities being to monitor and support the development of particle physics in the CERN member countries through regular visits
- ECFA consists of Plenary ECFA, Restricted ECFA, Chairman and Secretary and permanent or ad hoc working groups

- Plenary ECFA:
 - decides on all ECFA activities
 - appoints members after nomination by their country
 - normally holds two meetings per year, meetings are public unless otherwise decided

- Restricted ECFA:
 - composed of one member per country, the Director General and the Research Director of CERN, the Scientific Secretary of the Strategy Session of the CERN Council, the DESY Director in charge of high--energy physics and astroparticle physics, and the Director of the INFN Frascati Laboratory

- Aims of ECFA:
 - Long-range planning of European high-energy facilities
 - Equilibrium between the roles of international and national laboratories and university institutes
 - Adequate conditions for research and a just and equitable sharing of facilities between physicists, irrespective of nationality and origin

- ECFA activities:
 - Regular meetings of Restricted and Plenary ECFA (**Romania 2011**)
 - Sponsor or organize ad hoc symposia and conferences
 - Set up study groups and review groups
 - Visits to CERN members states and review organization and resources, repeated at regular intervals
 - Monitoring of the ongoing implementation of the European Strategy for Particle Physics in the CERN Member States, presentation of corresponding status reports to the European Strategy Session of Council
 - Represents European PP community in other organizations

- ECFA sponsored Workshops in 2013:
 - European Linear Collider Workshop ECFA LC2013 27--31 May 2013, DESY, Hamburg
<http://lc2013.desy.de>
 - ECFA High Luminosity LHC Experiments Workshop:
Physics and technology challenges 1--3 October 2013 Aix--les--Bains, France
Preparation work in several working groups ongoing.
<https://indico.cern.ch/conferenceDisplay.py?confId=252045>



- ECFAs role in connection with the European Strategy :
 - Monitoring of the ongoing implementation of the European Strategy for Particle Physics
 - Monitoring through country visits
 - Discuss and overlook R&D for possible future large scale facilities
 - Follow up of the recent strategy update: assess status of R&D for a future post--LHC accelerator project at CERN, i.e. CLIC, HE--LHC, VHE--LHC (TLEP)
 - Propose/support/oversee studies to be completed in time for the next strategy update
 - Sponsor Workshops
 - Review Proposals

- Update of the European Strategy for Particle Physics - brief history:
 - The first European Strategy for Particle Physics adopted by the CERN Council in June 2006 in Lisbon
 - The first update has officially started in September 2011 by the Council establishing the Preparatory Group (science input) and Strategy Group (strategy drafting)
 - Open Symposium organised by the Preparatory Group in September 2012 in Krakow
 - The draft proposal by the European Strategy Group as out come of the meeting in January 2013 in Erice
 - First Council discussion in March 2013, finalising the agreed draft for the formal approval later
 - Formal adoption by the CERN Council in its special Strategy Session in Brussels in May 2013

Candidate for Accession: Romania, Dr. Sanda Dita



CERN Council

Update of the European Strategy for Particle Physics

<http://europeanstrategygroup.web.cern.ch/EuropeanStrategyGroup/welcome.htm>

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Timeline

European Strategy Group

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Composition

Meetings (Indico)

Minutes of past meetings

Call for submissions

Other

European Strategy for
Particle Physics

Related links

The European Strategy for Particle Physics

Open Symposium - Krakow, 10-12 September 2012

- [Book](#) of Abstracts submitted to the Open Symposium

- Physics Briefing [Book](#) to the European Strategy Group (compiled by the Preparatory Group) **(220 pages)**

Strategy Group Meeting to draft Update of Strategy - Erice, 21-26 January 2013

At appropriate intervals, at most every 5 years, the European Strategy Session of Council will re-enact the process aimed at updating the medium and long-term European Strategy for Particle Physics, by setting up a Working Group, the [European Strategy Group](#) (ESG), similar to the Strategy Group in 2005/2006. The ESG will be a Working Group of Council which will cease to exist each time Council has adopted the new medium and long-term Strategy. The remit of the ESG will be to establish a proposal for the European Strategy Session of Council to update the medium and long-term European Strategy for Particle Physics.

Council, September 2007

For the purposes of the Strategy Update, the ESG will be assisted by an ad hoc [Preparatory Group](#).

The European Strategy for Particle Physics - Update 2013:

CERN-Council-S/106, 7 May 2013

<http://council.web.cern.ch/council/en/EuropeanStrategy/esc-e-106.pdf>

- Preamble
- General Issues (a, b)
- High-priority large-scale scientific activities (c, d, e, f)
- Other scientific activities essential to the particle physics programme (g, h, i, j, k)
- Organisational issues (l, m)
- Wider impact of particle physics (n, o, p)
- Concluding recommendations (q)

Preamble

- Since the adoption of the European Strategy for Particle Physics in 2006, the field has made impressive progress in the pursuit of its core mission, elucidating the laws of nature at the most fundamental level.
- A giant leap, **the discovery of the Higgs boson**, has been accompanied by many experimental results confirming the Standard Model beyond the previously explored energy scales. **These results raise further questions on the origin of elementary particle masses and on the role of the Higgs boson in the more fundamental theory underlying the Standard Model, which may involve additional particles to be discovered around the TeV scale.**
- Significant progress is being made towards solving long-standing puzzles such as the matter-antimatter asymmetry of the Universe and the nature of the mysterious dark matter.
- **The observation of a new type of neutrino oscillation** has opened the way for future investigations of matter-antimatter asymmetry in the neutrino sector.
- Intriguing prospects are emerging for experiments at the overlap with astroparticle physics and cosmology.
- Against the backdrop of dramatic developments in our understanding of the science landscape, Europe is updating its Strategy for Particle Physics in order to define the community's direction for the coming years and to prepare for the long-term future of the field.

General Issues

- 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.*
- 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.*

High-priority large-scale scientific activities

The strategy update must strike a balance between maintaining the diversity of the scientific program and setting priorities since the available resources are limited.

- Only large scale projects/facilities of global and supra-regional dimension are prioritized
- Competitive small and medium size projects (national, regional) are important to keep the diversity of our field, since a breakthrough often emerges in unexpected areas

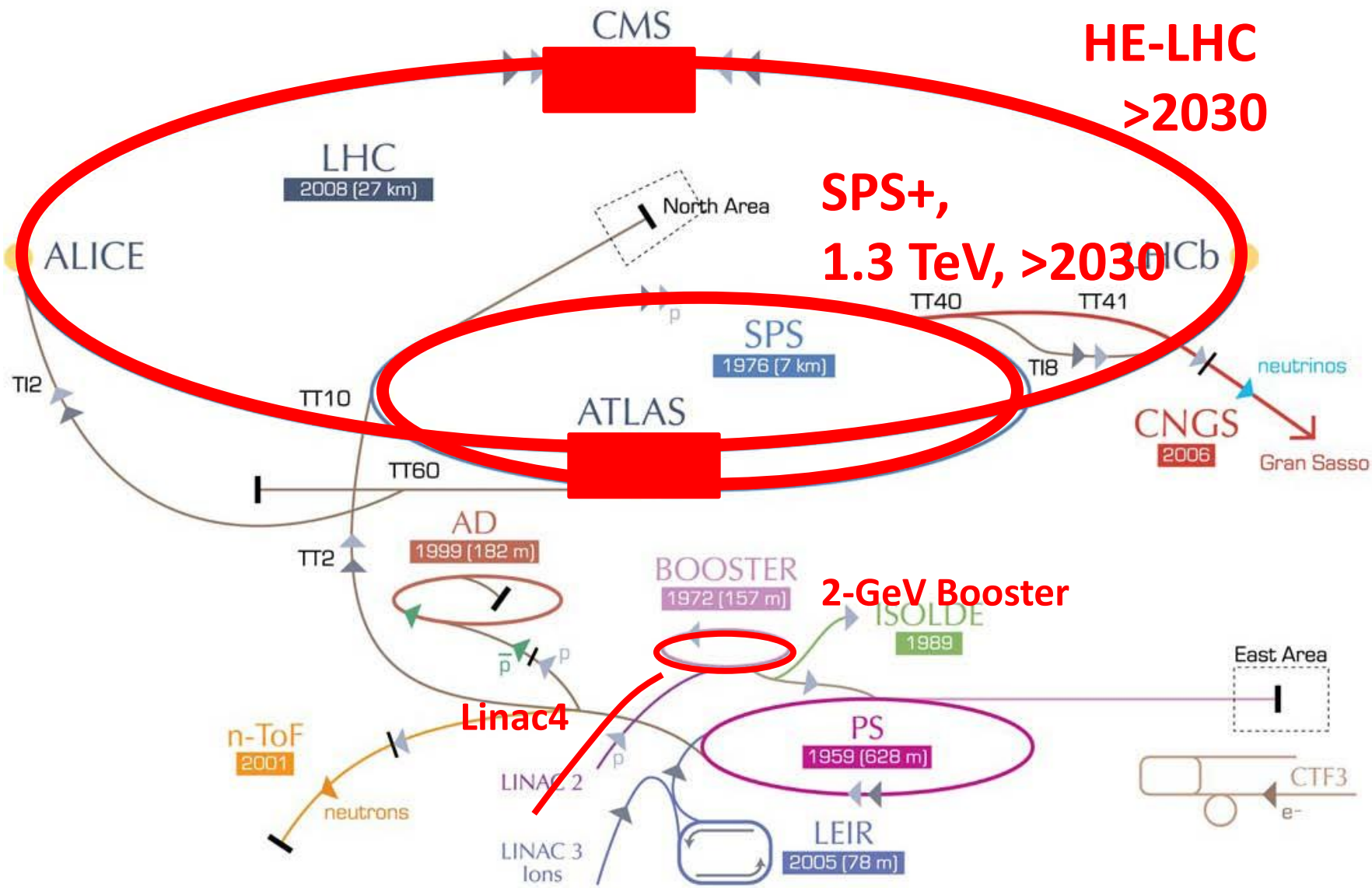
After careful analysis of many possible large-scale scientific activities requiring significant resources, sizeable collaborations and sustained commitment, the following four activities have been identified as carrying the highest priority.

A priori these 4 activities are not prioritized, it is meant that all 4 should be pursued - a challenge the CERN mid (and long) term plan has to address!

- Highest Priority:
Full exploitation of LHC physics potential (c)
- High Priority items:
 - design studies and R&D at energy frontier (d)
 - possible participation in the ILC Project (e)
 - development of neutrino programme (f)

There is a program at the energy frontier with the LHC for at least 20 years !

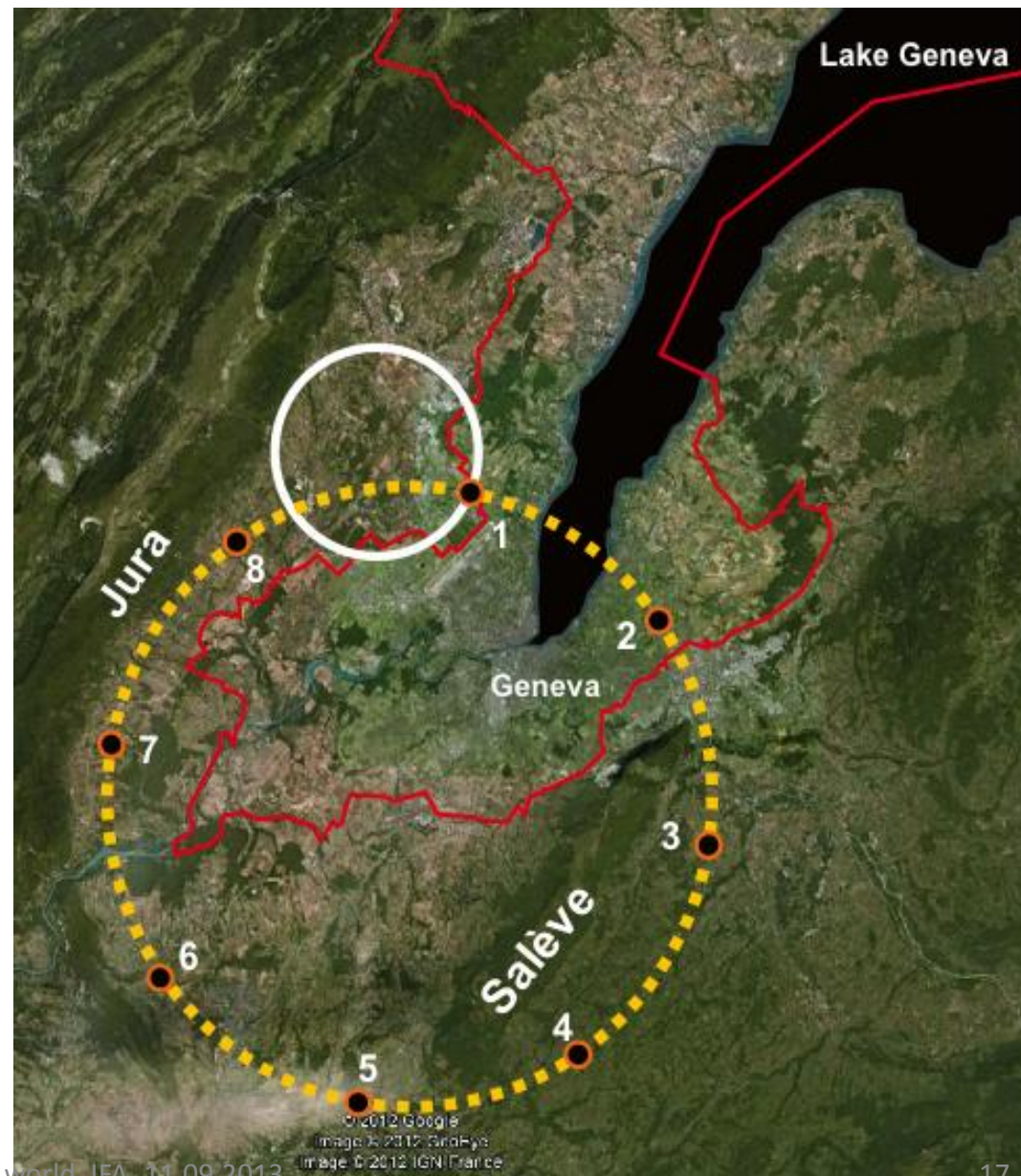
High Energy - LHC (HE-LHC) : 2-2.5 x 14 TeV - LHC modifications



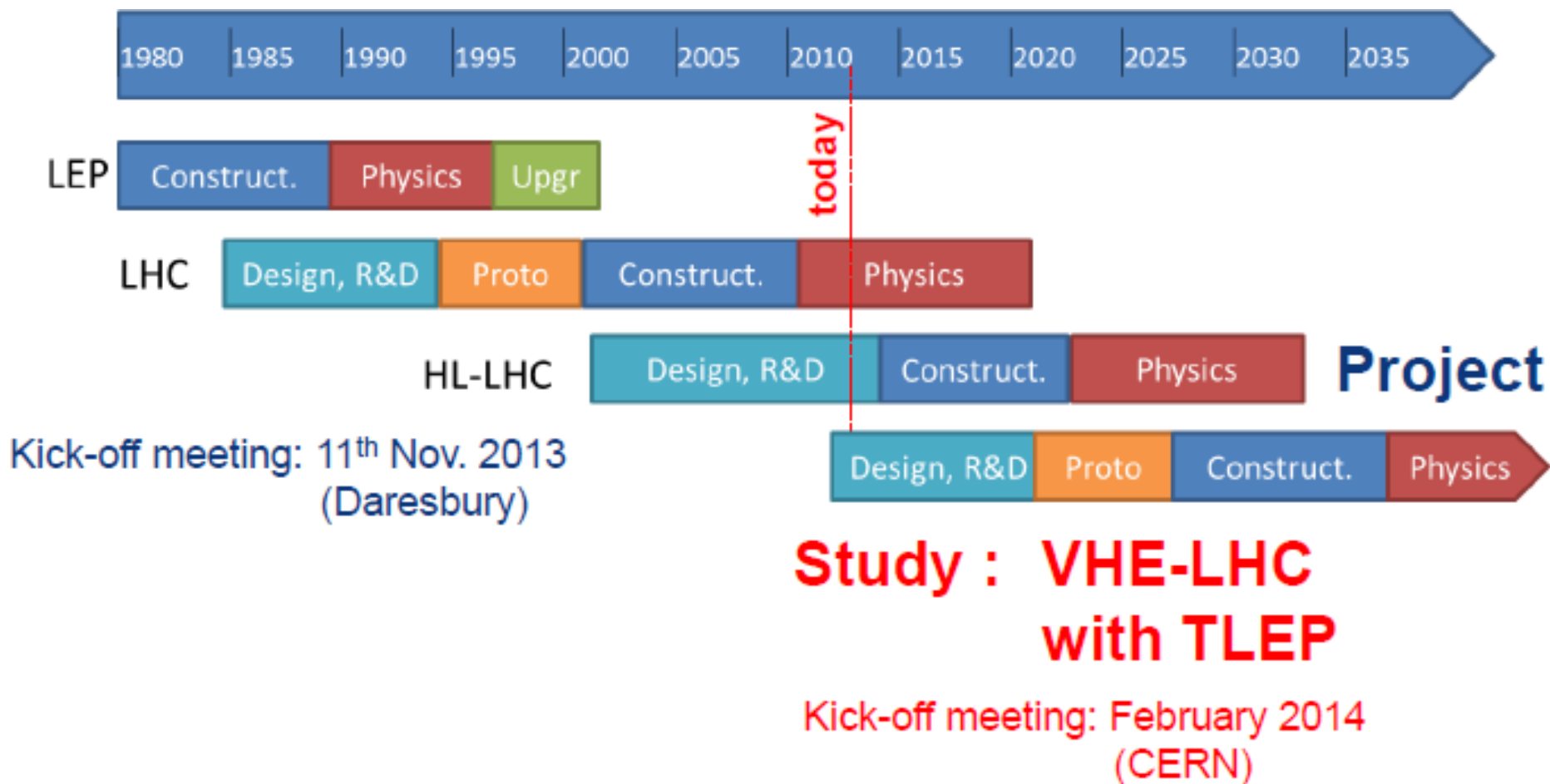
Beyond the HE-LHC - Very High Energy LHC

(VHE-LHC):

- studies on a new "80-100" km tunnel in the Geneva area: ~ 100 TeV
- the tunnel would also allow $e+e-$ (TLEP) and $e-p$ (VHE-LHeC) collisions in addition to $p-p$ collisions



Roadmap : exploit synergy effects between HL-LHC, HE-LHC, VHE-LHC



ILC - International Linear Collider (500 GeV) <http://www.linearcollider.org>



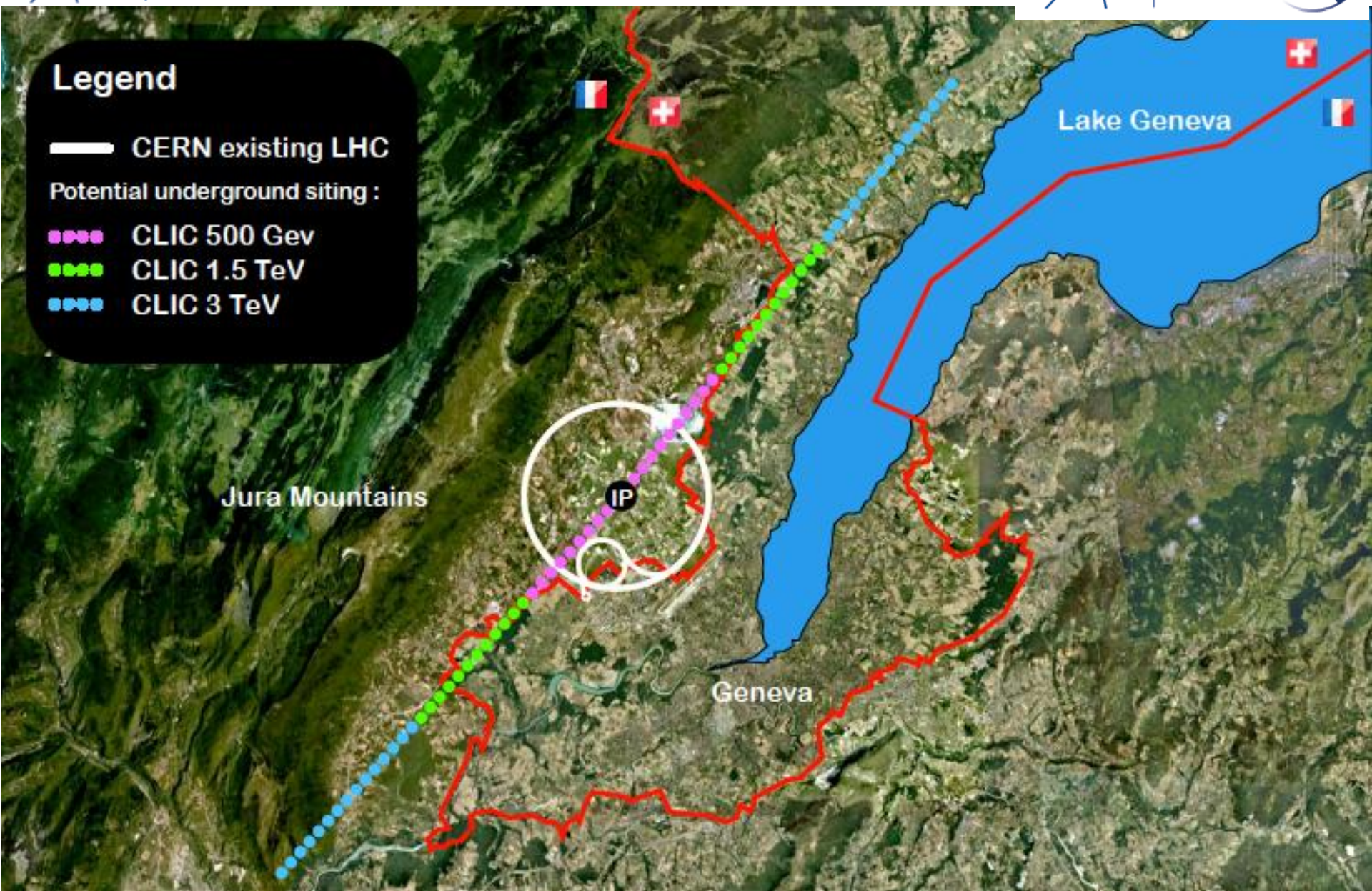
e+ bunch
compressor

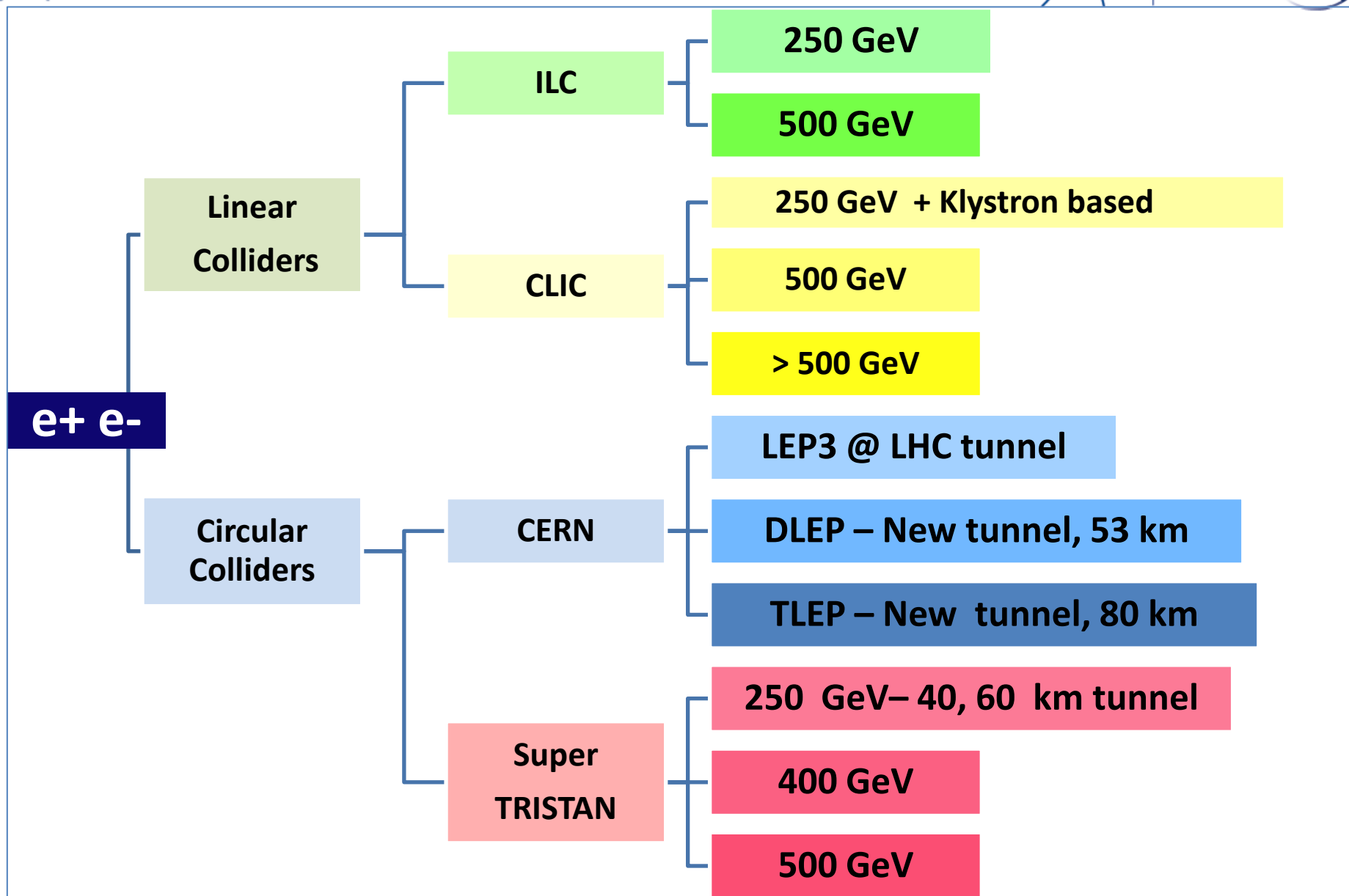
- Stage 1: $\sim 350\text{-}375$ GeV \Rightarrow Higgs and top physics
- Stage 2: ~ 1.5 TeV \Rightarrow ttH, $\nu\nu$ HH + New Physics (lower mass scale)
- Stage 3: ~ 3 TeV \Rightarrow New Physics (higher mass scale)

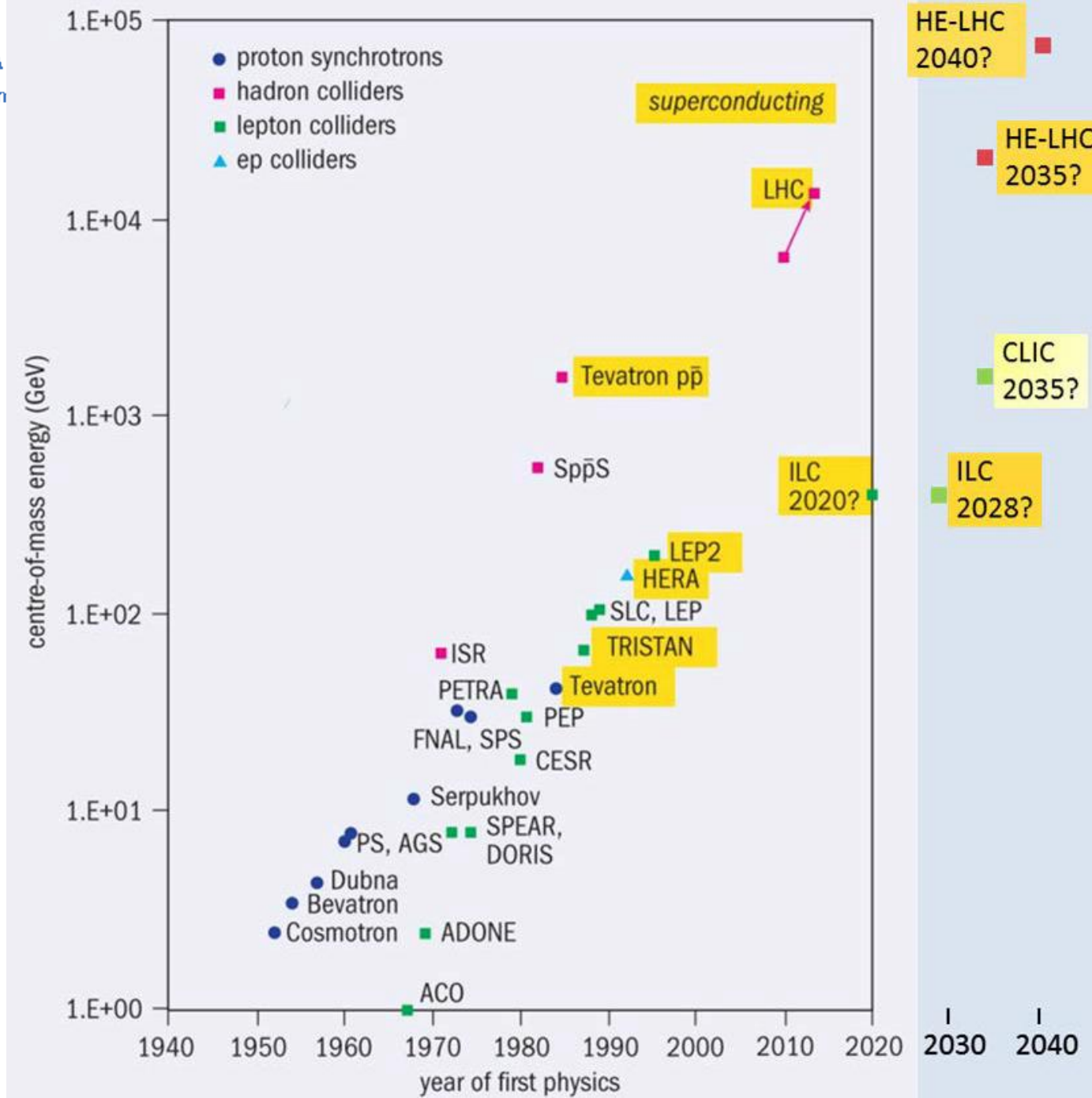


2 km

ILC Scheme | © www.form-one.de







Why

HL-LHC, HE-LHC, VHE-LHC, ILC, TLEP, ... ?





Fundamental interactions in nature	Gravity	Weak	Electromagnetic	Strong
		(Electroweak)		
	Carried By	Graviton (not yet observed)	$W^+ W^- Z^0$	Photon
Acts on	All	Quarks and Leptons	Quarks and Charged Leptons and $W^+ W^-$	Quarks and Gluons
Standard Model				

	<i>Strength</i>
<i>Strong</i>	$\alpha_s = \frac{g_s^2}{4\pi\hbar c} \sim 1^\dagger$
<i>Electromagnetic</i>	$\alpha_{em} = \frac{e^2}{4\pi\hbar c} \sim \frac{1}{137}$
<i>Weak</i>	$G_F m_p^2 \sim 10^{-5}^\dagger$
<i>Gravitational</i>	$G_N m_p^2 \sim 10^{-36}$

† *Short range*

Neutrino

- Neutrinos play a fundamental and special role in particle physics, astrophysics and cosmology
- Neutrino masses → presently the **ONLY** evidence of new physics beyond the Standard Model

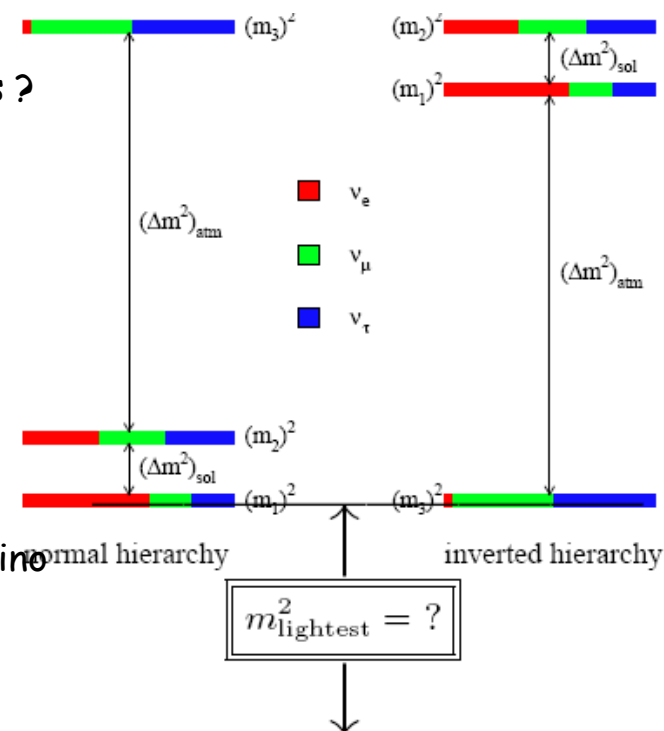
- A window to questions related to a deeper description of physics and to the evolution of the Universe

- why are neutrino masses so small ?
- why is the mixing matrix so different than one of the quarks ?
- how is the hierarchy of the ν mass eigenstates ?
- which is the absolute mass of the lightest state ?
- are neutrinos Majorana particles ?
- is CP violated by neutrinos ?
- are there sterile states and is there mixing ?

Strategy:

- enable large scale detector development and tests for neutrino detectors, e.g. LAGUNA, ICARUS-NESSIE
- launch study for a neutrino (test)beam in the North Area

$$V_{MNS} \sim \begin{pmatrix} 0.8 & 0.5 & 0.2 \\ 0.4 & 0.6 & 0.7 \\ 0.4 & 0.6 & 0.7 \end{pmatrix} \quad V_{CKM} \sim \begin{pmatrix} 1 & 0.2 & 0.001 \\ 0.2 & 1 & 0.01 \\ 0.001 & 0.01 & 1 \end{pmatrix}$$



Other scientific activities essential to the particle physics programme:

- theoretical physics in close collaboration with experiments and extending to neighbouring fields such as astroparticle physics and cosmology; high-performance computing and software development (g)
- moderate cost and smaller collaborations; participation in experiments in other regions of the world (h)
- infrastructure and engineering capabilities R&D programme and construction of large detectors; infrastructure for data analysis, data preservation and distributed data-intensive computing (i)
- collaboration with ApPEC on detector R&D (j)
- collaboration with NuPECC on topics of mutual interest (k)

CERN organise the participation in global projects independent of location

CERN involved in European Union framework programmes (European Strategy

Forum on Research Infrastructures - ESFRI)

Outreach and communication (adequate funding)

Knowledge and technology transfer (HEPTech)

Education and training

Membership for Non-European countries

New Associate Membership defined

Updates of the strategy should continue

Summary of the conclusions and recommendations of the strategy update:

- Moving into the next phase :
 - **Implementing** particle physics policy and programme inline with the Strategy by the member states and at CERN
 - **Promoting** coordination and collaboration with the relevant organisations and other regions as encouraged in the Strategy
 - **Enhancing** activities and networking in the social relevant issues as outlined in the Strategy
 - **Taking up** the proposed organisational adjustments for the Strategy matter by the ESG working groups
- Looking forward to the plan of the other regions, and stay tuned with development of the field

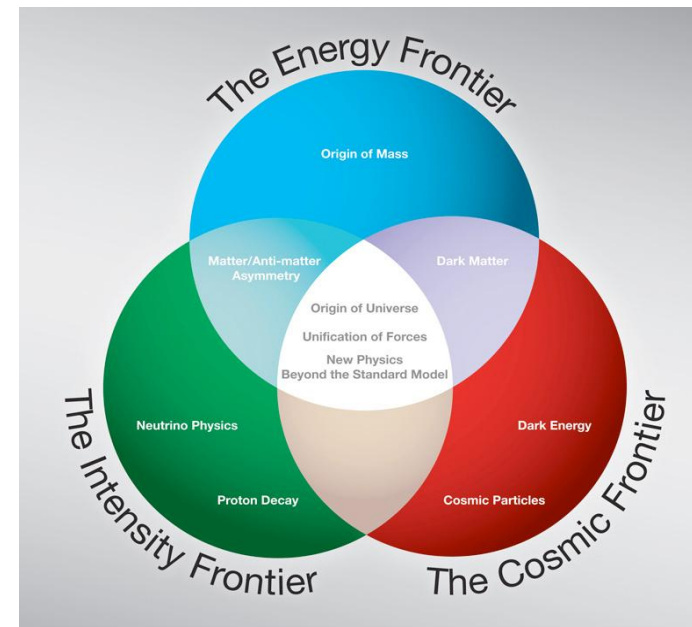
The Ongoing Strategy Discussion in the U.S.

(Strategic planning for U.S. HEP program is in progress)

- Energy Frontier (each: absolutely central)
 - HL-LHC - Accelerator and Detectors - ATLAS and CMS
 - ILC (hosted in Japan) Accelerator and Detectors

- Intensity Frontier (each: absolutely central)
 - Mu2e, LBNE, Project X - Accelerator and Detectors, nuSTORM (don't know enough yet)

- Cosmic Frontier (each: absolutely central)
 - LSST, G3 Dark Matter (DM-G3), Next Generation Dark Energy



SNOWMASS <http://www.snowmass2013.org>

Goal: Identify compelling HEP science opportunities over an approximately 20-yr time frame

A Proposal for a Phased Execution of the International Linear Collider Project

The Japan Association of High Energy Physicists (JAHEP) endorsed the document on 18 October 2012

ILC shall be constructed in Japan as a global project based on agreement and participation by the international community.

Physics : Precision study of "Higgs Boson" , top quark, "dark matter" particles, and Higgs self-couplings,

Scenario : Start with a Higgs Boson Factory ~ 250 GeV. Upgraded in stages up to a center-of-mass energy of ~ 500 GeV, which is the baseline energy of the overall project. Technical extendability to a 1 TeV region shall be secured.

Japan covers 50% of the expenses (construction) of the overall project of a 500 GeV machine. The actual contributions, however, should be left to negotiations among the governments.

The International Committee for Future Accelerators <http://www.fnal.gov/directorate/icfa/index.html>

- History
 - 1967 to 1976 East-West meetings on the future of particle physics
 - ICFA founded in 1976 by Commission 11 (Particles and Fields) of the International Union of Pure and Applied Physics (IUPAP)
 - Study the scientific, technical, organizational aspects of world-wide collaboration to construct a very large accelerator
- ICFA MEMBERSHIP (September 2013):
 - CERN Member States (3), USA (3), Japan (2), Russia (2), Canada (1), China (1), C11 (1), Other Countries (3)

Romania ?

- LHC - ATALS, ALICE and LHCb (c)
- LHeC - (d)
- ILC (e)
- Neutrino (f)
- Theory (g)
- ISOLDE, nTOF - fixed target programme (h)
- R&D - Detectors (i)
- outreach - IPPOG (n)
- HEPTech - (o)

Programme at the energy frontier with the LHC for at least 20 years

R&D, Studies for the next projects ongoing

Global collaboration vital

Thank You !