



European Strategy for Particle Physics Update Process Status

<https://europeanstrategygroup.web.cern.ch/EuropeanStrategyGroup/>
Council Open Session

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T. Nakada

EPFL-LPHE

Lausanne, Switzerland

Scientific Secretary for Strategy Session of CERN Council
Chair of Strategy Group and Preparatory Group



Strategy Update where are we?

- Physics Briefing Book, a draft very close to the final version submitted to the ESG and SPC (also accessible by the public,
<https://indico.cern.ch/materialDisplay.py?contribId=2&materialId=1&confId=217861>
- Polished and updated version for printing will be released before the Erice meeting in January 2013
- Strategy drafting week by the Strategy Group
21-25 January 2013
- March Council week (18-22 March 2013) for discussion on the draft
- Special session of Council for adoption on *23 May 2013*
(the current date is uncertain at the moment, + 1 week?)

Examples from Briefing Book

- Environment for the update
 - Major scientific changes since 2006
 - Experience in LHC operation, both by the machine and experiments in p-p, Pb-Pb, p-Pb collisions
 - Discovery of Higgs like particle
 - Compelling sign of physics beyond the Standard Model neither from the direct search at high energy nor precision experiments so far
 - Third angle, θ_{13} , in the neutrino mixing found to be $\neq 0$
 - Major items where decisions are required (in random order)
 - LHC upgrade for $0.3 \rightarrow 1$ or 3 ab^{-1}
 - Short and long baseline neutrino facilities and experiments
 - Toward ILC under discussion in Japan
 - Needs for preparing for the decision process of the next large machine in Europe

Examples from Briefing Book

- Physics at High Energy (I)
 - ATLAS and CMS achievement
 - Standard Model Physics: QCD, top, W, and Z
 - Higgs studies: production and decays
 - Search for particles beyond the Standard Model
 - ATLAS and CMS prospects for short ($\int \mathcal{L} dt = 0.3 \text{ ab}^{-1}$) and longer term (1 to 3 ab^{-1} , HL-LHC)
 - Higgs studies and New Physics search
 - Proton-proton for higher energies with 16 to 20 T dipoles?
 - With the LHC tunnel: 26 to 33 TeV (HE-LHC)?
 - New 80 Km circumference tunnel: 42 to 100 TeV (VHELHC)?
 - What will 2015-1017 data @13 TeV will say?

Examples from Briefing Book

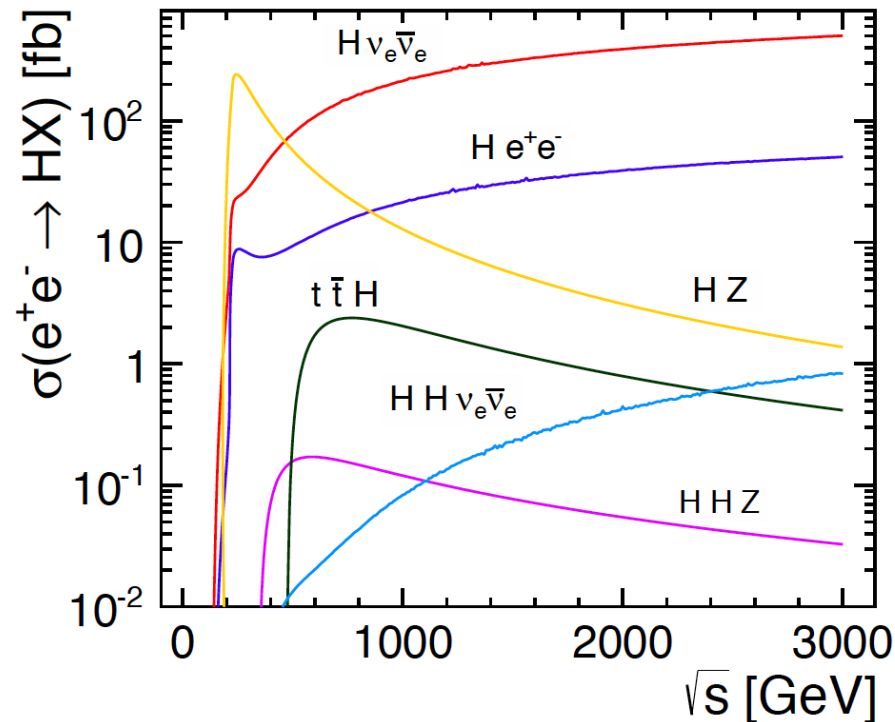
- Physics at High Energy (II)

- e^+e^- colliders

- Higgs studies at $\sqrt{s} \approx 250$ GeV ($e^+e^- \rightarrow HZ$)
 - Higgs studies at much higher energies ($e^+e^- \rightarrow Ht\bar{t}$, HHZ , $HH\nu\bar{\nu}$, ...)
 - Trilinear and quartic gauge coupling
 - Top physics (mass in particular)
 - Search for weakly coupling SUSY particles
 - Linear colliders versus circular colliders
 - at lower energies, $L_{\text{circular}} > L_{\text{linear}}$
 - $\sqrt{s}$: circular limited to ~ 350 GeV, linear > 1 TeV (ILC $\rightarrow$ CLIC)
 - many machines built for circular, only one for linear
 - paper/software studies for circular, TDR/CDR stages for linear
 - expandability: circular TLEP $\rightarrow$ VHELHC, linear 250 $\rightarrow$ 500 $\rightarrow$?
 - $\gamma\gamma$ collider: 2×125 GeV e^- + laser, limited to $\gamma\gamma \rightarrow H$

Examples from Briefing Book

- Physics at High Energy (III)
 - Accessibility on Higgs physics by the e^+e^- machines depends on the energy



- At LHC, all the processes are in principle accessible but some are limited by the statistics and background; e.g. coupling to c or H .

Examples from Briefing Book

- Neutrino Physics (I)
 - Different neutrino sources have been used and contributed to the current results
 - cosmic (solar and atmospheric)
 - reactor
 - accelerator
 - radioactive sources
 - Recent highlight
 - $\theta_{13} \neq 0$ and appear to be the larger side, ≈ 0.1 , major contribution by the reactor experiments
- allows a better definition for the next step

Examples from Briefing Book

- Neutrino Physics (II)
 - Major remaining questions
 - mass hierarchy
 - CP violation in the neutrino oscillation
 - number of ν families 3?
 - m_ν Dirac or Majorana?
 - absolute mass scale of ν
 - and others...
 - New accelerator based facilities proposed in Europe to address the first three questions:
 - SBL and ICARUS+NESSIE at CERN
 - LBL at CERN and LAGUNA in Finish mine (if available)
Other LBL ideas: source at ESS or IHEP (Protovino)

Examples from Briefing Book

- Neutrino Physics (III)
 - Points important for strategy are:
 - Competitions with ν 's from cosmic, reactor and radioactive source
 - Competitions and collaborations with the Japan and US projects
 - Japan: Hyper K and JPARC upgrade
 - US: LBNE for long baseline
Short base line programme
 ν STORM
 - HyperK the best CP, LBNO best mass hierarchy, LBNE needs to go underground and to build near detector then becomes competitive with LBNO.
 - Neutrino factory needed for systematic precision measurements of the mixing parameters (not just a qualitative discovery)

Examples from Briefing Book

- Other topics covered are,
 - Flavour and Precision Physics in indirect ways to search for New Physics
 - Strong Interaction Physics, for QCD studies at soft, hard and ultra dense environments
 - Astroparticle Physics relevant for particle physics,
 - Theoretical Physics in more organizational issues,
 - Accelerator Science identifying the challenges for the future machines and indicating needs of coordinated effort and networking on R&D
 - Instrumentation, computing and infrastructure addressing the future needs.

Four first Current Strategy Statements

- The LHC will be the energy frontier machine for the foreseeable future, maintaining European leadership in the field; *the highest priority is to fully exploit the physics potential of the LHC, resources for completion of the initial programme have to be secured such that machine and experiments can operate optimally at their design performance. A subsequent major luminosity upgrade (SLHC), motivated by physics results and operation experience, will be enabled by focused R&D; to this end, R&D for machine and detectors has to be vigorously pursued now and centrally organized towards a luminosity upgrade by around 2015.*
 - LHC is running now and the base programme is up to $\sim 300 \text{ fb}^{-1}$. Do we have scientific justification already now to upgrade machine and experiments for 1 to 3 ab^{-1} ?

Four first Current Strategy Statements

- In order to be in the position to push the energy and luminosity frontier even further it is vital to strengthen the advanced accelerator R&D programme; *a coordinated programme should be intensified, to develop the CLIC technology and high performance magnets for future accelerators, and to play a significant role in the study and development of a high-intensity neutrino facility.*

→LHC results at ~13 TeV needed for the decision on the next large accelerator in Europe. What are the necessary accelerator R&D's?

Four first Current Strategy Statements

- It is fundamental to complement the results of the LHC with measurements at a linear collider. In the energy range of 0.5 to 1 TeV, the ILC, based on superconducting technology, will provide a unique scientific opportunity at the precision frontier; *there should be a strong well-coordinated European activity, including CERN, through the Global Design Effort, for its design and technical preparation towards the construction decision, to be ready for a new assessment by Council around 2010.*
 - Japanese HEP community sees a window of opportunity for the next couple of years to host ILC. What is the European position toward this initiative? Is this an opportunity for a new worldwide facility, complementing a possible future machine at CERN without jeopardizing it?

Four first Current Strategy Statements

- Studies of the scientific case for future neutrino facilities and the R&D into associated technologies are required to be in a position to define the optimal neutrino programme based on the information available in around 2012; *Council will play an active role in promoting a coordinated European participation in a global neutrino programme*

→ Now θ_{13} is measured. The necessary short term neutrino facilities and experiments are well defined and proposed. Should Europe build its own facilities (they are in principle within the European scope), or participate in those in other regions, i.e. in Japan (HyperK), and in US (LBNE and Short Baseline beams) to make them better?

Outline of Erice agenda

- 21-22 January
 - Discussion on the scientific issues
- 23 January
 - organization, governance, external relation, knowledge transfer, communication and outreach matters
- 24-25 January
 - Discussion and drafting the Strategy Statements

With an aim to leave Erice with the completed draft of Strategy Statements on 26th January
+ deliberation document will be submitted to the March Council for discussion.