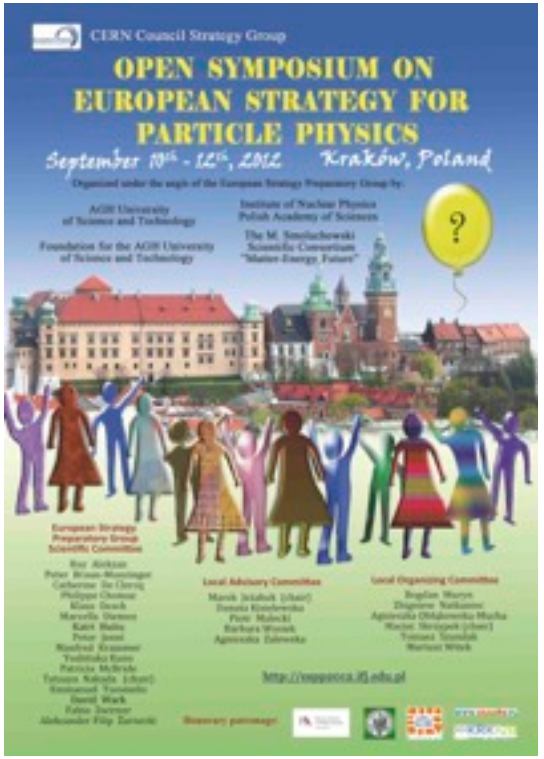
European Strategy for Particle Physics and Ongoing Update

https://europeanstrategygroup.web.cern.ch/EuropeanStrategyGroup/

for the European Strategy Preparatory Group

(slides courtesy of T. Nakada)



Update of the European Strategy for Particle Physics

http://europeanstrategygroup.web.cern.ch/EuropeanStrategyGroup/

- Mandate for the European Strategy Group (ESG):
  - Establish a Proposal for an update of the medium and long-term European Strategy for Particle Physics, for approval by the Council. 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.

Current Strategy

- Current strategy was adapted by the Council in July 2006
- It consists of 17 strategy statements:
  - two General issues; necessity of strategy
  - eight on Scientific activities (LHC, Accelerator R&D, ILC, Neutrino, Astroparticle, Flavour, Nuclear physics, Theory)
  - four Organizational issues
    - CERN Council's role in coordinating European particle physics
    - Globalization
    - Non-member state relation
    - Relation with EU
  - three Complementary issues
    - Outreach
    - Technology Transfer Network
    - Relation with industry

Framework of the Update

- Strategy Group and Preparatory Group set-up by the CERN Council
  - Preparatory Group
    - Producing scientific summary in a form of Briefing Book based on the community, funding agencies and policy makers inputs given at Open Symposium and written contributions
  - Strategy Group
    - Draft the updated strategy based on the scientific input from the Preparatory Group and non scientific input from its own working groups.
    - Producing deliberation document providing scientific rational for the strategy statements and discussion on possible governance and organization for strategy implementation
    - Producing glossy brochure for public, funding agencies and politicians

Composition of the Groups

- Preparatory Group
  - Nominated from SPC, ECFA, CERN, Americas and Asia
  - members of the Scientific Secretariat for the Council
- Strategy Group
  - Members
    - Delegates from the Member States, representing the member state government
  - Observers
    - Delegates from Associate and Observer States
    - Representatives from ApPEC, NuPEC, ESFRI, EU, FALC,
    - Director of Large National Laboratories and CERN DG
    - Members of the Scientific Secretariat for the Council
  - Preparatory Group members are also invited

Cracow Open Symposium for the European Strategy Updates

Overview

- The Open session was held from 10 -12 September, 2012
- Nearly 500 participants
- Format: Plenary speakers summarizing the current status and future options, with long discussion sessions, for
  - High energy frontier
  - Flavor and symmetries
  - Strong interactions
  - Astroparticle physics

  } directly relevant for the scientific strategy

  - Neutrino
  - Theoretical physics
  - Accelerator science
  - Instrumentation, computing, and infrastructure

  } relevant for auxiliary issues of the strategy

- Excellent local organization!!

Cracow Open Symposium

- No conclusions yet
- What follows is a short summary of the discussions and issues raised at the symposium.

Summary of discussions (I)

- Direct-search of new particles at the High Energy Frontier
  and
  Indirect-search for new physics, i.e. precision measurements at any energy machines to study rare processes looking for a deviation from the Standard Model calculations, are providing fruitful complementary results. But no compelling sign of New Physics so far.
  →Continue pushing on two fronts is essential.

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- Discovery of "Higgs" like boson at LHC opens a new line of indirect-search: precision measurement of "Higgs" properties.
  →Is LHC alone enough or a *new facility also needed*?
  Linear or Circular e^+e^- colliders, Circular $\mu^+\mu^-$ collider
  γ-γ collider based on circular e^- storage rings
  →A new machine with only Higgs justifiable?

Summary of discussions (II)

- LHC serves as a wide platform with open questions:
  -Direct (ATLAS&CMS) and indirect (LHCb) New Physics search, perturbative and non-perturbative QCD (ALICE, ATLAS, CMS, LHCb, etc.). Further exploitation is possible by upgrading the machine luminosity and detectors.

  →What is the scientific scope for the LHC upgrade from 0.3 to 1~3 ab^{-1}? (W_L scattering, H self-coupling, ..)

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  →What is the scientific scope for the upgrade from 0.3 to 1~3 ab^{-1}? (W_L scattering, Trip.H. coupling, ..)
- The next large machine at CERN:
  →A machine running concurrently with LHC possible?
  e.g. LHeC (or possibly LEP3)
  Is PDF measurements by LHeC crucial for High-Lumi LHC?
  →For making a decision, input from the LHC run at 13~14 TeV is needed

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- A facility for a long baseline neutrino detector share common interests between astroparticle physics and particle physics (both accelerator and non-accelerator based)
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- Major challenges in neutrino physics: mass hierarchy, precision measurement of the mixing parameters (in particular the CP violation phase), sterile neutrinos.

Summary of discussions (IV)

- European neutrino community presented
  - CERN SPS long baseline neutrino beam to Finland with a massive liquid Ar detector for the mass hierarchy and mixing parameter measurements → ApPEC joint coordination?
  - CERN SPS short baseline neutrino beam for sterile neutrino search, with exiting detector moving from GSNL to CERN
  - Neutrino factory for ultimate precision measurements of the mixing parameters for a longer term future.

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- Interest generated by an idea of muon storage ring without pre-cooling. A clean low energy neutrino source for sterile neutrino search, with conventional technology(?)
- Possibilities of having long baseline wide band ν beam in Europe other places than CERN?

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- JP community pushes 250-500 GeV linear e^+e^- collider with a hope to start data taking before 2030, and Hyper Kamiokande water Cherenkov (or liquid-Ar in Okinoshima) detector for JPARC neutrino beam with a hope to start construction in ~2018, while SuperKEKB construction is in progress.

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- For high baryon density environment, SPS can provide interesting data, as well as RHIC, and new facilities, e.g. FAIR, NICA, …:

  →Do we need experiments at all the facilities?

Next Steps

- 21-26 January 2013, drafting session of the European Strategy Group in Erice.

Start with the Current Strategy

- 3. 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. May be more concrete statements for the upgrade needed.

Start with the Current Strategy

- 4. 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.*

→Accelerator R&D; should be focused on items mainly needed for possible future machines at CERN? Can we do all?

Start with the Current Strategy

- 5. 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? Should this be seen as an opportunity for a new worldwide facility, complementing a possible future machine at CERN without jeopardizing it?

Start from the Current Strategy,

- 6. 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 and the necessary short term neutrino facilities and experiments are well defined and proposed. Should Europe build its own facilities or participate in those in other regions?

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- Outreach event in May in Brussels, also targeting at the EU parliament members.

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- Brochure for funding agencies, politicians, and public
  by CERN communication group and Strategy Group

Backup

European Strategy for Particle Physics

CERN/2685

2006 Discussion Document contains more information

The European strategy for particle physics

Particle physics stands on the threshold of a new and exciting era of discovery. The next generation of experiments will explore new domains and probe the deep structure of space-time. They will measure the properties of the elementary constituents of matter and their interactions with unprecedented accuracy, and they will uncover new phenomena such as the Higgs boson or new forms of matter. Long-standing puzzles such as the origin of mass, the matter-antimatter asymmetry of the Universe and the mysterious dark matter and energy that permeate the cosmos will soon benefit from the insights that new measurements will bring. Together, the results will have a profound impact on the way we see our Universe; *European particle physics should thoroughly exploit its current exciting and diverse research programme. It should position itself to stand ready to address the challenges that will emerge from exploration of the new frontier, and it should participate fully in an increasingly global adventure.*

General issues

1. European particle physics is founded on strong national institutes, universities and laboratories and the CERN Organization; *Europe should maintain and strengthen its central position in particle physics.*

2. Increased globalization, concentration and scale of particle physics make a well coordinated strategy in Europe paramount; *this strategy will be defined and updated by CERN Council as outlined below.*

Scientific activities

3. 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 focussed 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.*

4. 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.*

5. 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.*

6. 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.*

7. A range of very important non-accelerator experiments take place at the overlap between particle and astroparticle physics exploring otherwise inaccessible phenomena; *Council will seek to work with ApPEC to develop a coordinated strategy in these areas of mutual interest.*

8. Flavour physics and precision measurements at the high-luminosity frontier at lower energies complement our understanding of particle physics and allow for a more accurate interpretation of the results at the high-energy frontier; *these should be led by national or regional collaborations, and the participation of European laboratories and institutes should be promoted.*

9. A variety of important research lines are at the interface between particle and nuclear physics requiring dedicated experiments; *Council will seek to work with NuPECC in areas of mutual interest, and maintain the capability to perform fixed target experiments at CERN.*

10. European theoretical physics has played a crucial role in shaping and consolidating the Standard Model and in formulating possible scenarios for future discoveries. Strong theoretical research and close collaboration with experimentalists are essential to the advancement of particle physics and to take full advantage of experimental progress; *the forthcoming LHC results will open new opportunities for theoretical developments, and create new needs for theoretical calculations, which should be widely supported.*

Organizational issues

11. There is a fundamental need for an ongoing process to define and update the European strategy for particle physics; *Council, under Article II-2(b) of the CERN Convention, shall assume this responsibility, acting as a council for European particle physics, holding a special session at least once each year for this purpose. Council will define and update the strategy based on proposals and observations from a dedicated scientific body that it shall establish for this purpose.*

12. Future major facilities in Europe and elsewhere require collaborations on a global scale; *Council, drawing on the European experience in the successful construction and operation of large-scale facilities, will prepare a framework for Europe to engage with the other regions of the world with the goal of optimizing the particle physics output through the best shared use of resources while maintaining European capabilities.*

13. Through its programmes, the European Union establishes in a broad sense the European Research Area with European particle physics having its own established structures and organizations; *there is a need to strengthen this relationship for communicating issues related to the strategy.*

14. Particle physicists in the non-Member States benefit from, and add to, the research programme funded by the CERN Member States; *Council will establish how the non-Member States should be involved in defining the strategy.*

Complementary issues

15. Fundamental physics impacts both scientific and philosophical thinking, influencing the way we perceive the universe and our role in it. It is an integral part of particle physics research to share the wonders of our discoveries with the public and the youth in particular. Outreach should be implemented with adequate resources from the start of any major project; *Council will establish a network of closely cooperating professional communication officers from each Member state, which would incorporate existing activities, propose, implement and monitor a European particle physics communication and education strategy, and report on a regular basis to Council.*

16. Technology developed for nuclear and particle physics research has made and is making a lasting impact on society in areas such as material sciences and biology (e.g. synchrotron radiation facilities), communication and information technology (e.g. the web and grid computing), health (e.g. the PET scanner and hadron therapy facilities); *to further promote the impact of the spin-offs of particle physics research, the relevant technology transfer representatives at CERN and in Member states should create a technology transfer forum to analyse the keys to the success in technology transfer projects in general, make proposals for improving its effectiveness, promoting knowledge transfer through mobility of scientists and engineers between industry and research.*

17. The technical advances necessary for particle physics both benefit from, and stimulate, the technological competences available in European industry; *Council will consolidate and reinforce this connection, by ensuring that future engagement with industry takes account of current best practices, and continuously profits from the accumulated experience.*

Unanimously approved by the CERN Council at the special Session held in Lisbon on 14 July 2006

2006 European Strategy for Particle Physics

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Reference for Strategy Update: European Roadmap for Astroparticle Physics (2011)

http://www.aspera-eu.org/images/stories/roadmap/SAC-Roadmap-Nov-1-2011-final.pdf

2006 European Strategy for Particle Physics

8. Flavour physics and precision measurements at the high luminosity frontier at lower energies complement our understanding of particle physics and allow for a more accurate interpretation of the results at the high-energy frontier; *these should be led by national or regional collaborations, and the participation of European laboratories and institutes should be promoted.*

European Strategy Group Membership

Member States	
Austria	
Belgium	Prof. W. Van Doninck
Bulgaria	
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Denmark	Prof J.J Gaardhoje
Finland	Prof. P. Eerola
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Hungary	Prof. P. Levai
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Associate Member; pre-stage of Membership	
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Observer States	
India	Prof. T. Aziz
Japan	Prof. Sh. Asai
Russian Federation	Prof. A. Bondar
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United States	Prof. M. Shochet

- European Strategy Preparatory Group membership

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