

# The European Strategy for Particle Physics

# Initiative from the CERN Council

**An ad hoc scientific advisory group to prepare a Strategy**

- **CERN Council decisions 16<sup>th</sup> of June 2005**
  - **The principal decisions**
- **CERN Council decisions 15<sup>th</sup> of September 2005**
  - **Remit and plan of execution**

# The Strategy Group

## Co-chairpersons

- T. Åkesson ECFA
- K. Peach SPC

## Preparatory group

- R. Aleksan ECFA
- S. Bertolucci ECFA
- A. Blondel SPC
- M. Cavalli-Sforza SPC
- R. Heuer SPC
- F. Linde ECFA
- E. Rondio ECFA
- B. Webber SPC

## Directors

- R. Aymar CERN
- M. Calvetti LNF
- E. Coccia LNGS
- J. Engelen CERN
- R. Eichler PSI
- A. Wagner DESY
- J. Womersley RAL
- G. Wormser LAL
- J. Zinn-Justin Dapnia

## Scientific secretary

- M. Mangano CERN

## Members from delegations

- W. Majerotto AUSTRIA
- R. Gastmans BELGIUM
- J. Chyla CZECH REPUBLIC
- H. Boggild DENMARK
- J. Tuominiemi FINLAND
- J. Feltesse FRANCE
- G. Herten GERMANY
- D. Nanopoulos GREECE
- G. Vesztergombi HUNGARY
- L. Cifarelli ITALY
- S. de Jong NETHERLANDS
- S. Stapnes NORWAY
- J. Nassalski POLAND
- G. Barreira PORTUGAL
- M. Aguilar SPAIN
- B. Åsman SWEDEN
- A. Rubbia SWITZERLAND
- J. Thomas UK

## Observers

- R. Staffin USA
- E. Rabinovici ISRAEL
- D. Demir TURKEY
- M. Nozaki JAPAN
- M. Danilov RUSSIA
- R. Wade ApPEC
- T. Bressani NuPECC
- R. Petronzio FALC

# Major Milestones

- **1. Publication of the web-page**
  - 19<sup>th</sup> of September
  - Interface to the community
  - Call for input from the community
  
- **2. Open Symposium in Orsay**
  - 30<sup>th</sup> of January to 1<sup>st</sup> of February 2006
  - Collect the views of the community
  
- **3. Workshop in Zeuthen/Berlin**
  - 2-6<sup>th</sup> of May
  - Draft Strategy Document
  
- **4. Council meeting in Lisbon**
  - 14<sup>th</sup> of July 2006
  - Aim: Unanimous approval of the Draft Strategy Document

# Web-page

<http://cern.ch/council-strategygroup>

(18,000 hits so far, received 71 written contributions)

The screenshot shows a Microsoft Internet Explorer browser window displaying the CERN Council Strategy Group home page. The browser's address bar shows the URL <http://council-strategygroup.web.cern.ch/council-strategygroup/>. The page content includes a navigation menu on the left, a main heading "Welcome to the CERN Council Strategy Group home page!", and several sections: "Our charge", "Previous work", and "Why this Strategy Group?". A red circle highlights the link "Convention The European strategy for particle physics" in the navigation menu.

**CERN Council Strategy Group**

**NEWS**  
(New posting July 14: **strategy process completed**)

**CERN Council**  
[Convention The European strategy for particle physics](#)  
[Strategy Group](#)  
[Mandate](#)  
[Members](#)

**Preparatory Group**  
[Members](#)  
[Action Plan](#)  
[Meetings](#)

**Open Symposium**  
[Web page](#)  
[Final Agenda](#)  
[Recorded webcast](#)

**Briefing Book**  
[Volume 1](#)  
[Volume 2](#)  
[Volume 3](#)

## Welcome to the CERN Council Strategy Group home page!

### Our charge

The [Strategy Group](#) was set up on the initiative of the CERN Council to prepare a Draft Strategy Document aiming for unanimous approval by the CERN Council. This strategy should address the main lines of Particle Physics in Europe, accelerator-based and non-accelerator based, including R&D for novel accelerator and detector technologies.

The strategy should also address the visibility of the field, the collaboration between the European laboratories, the coordinated European participation in world projects and knowledge transfer beyond our field. The complete mandate is available [here](#).

### Previous work

The Work of the Strategy Group was preceded by two reports. The European Committee on Future Accelerators ([ECFA](#)) approved in 2001 a document for accelerator-based research, and the Consultative Group on High Energy Physics reported to the OECD Global Science Forum in 2002. Both these reports are accessible [from this page](#), as is the OECD Science Ministers 2004-communicue on these matters (see paragraph 21).

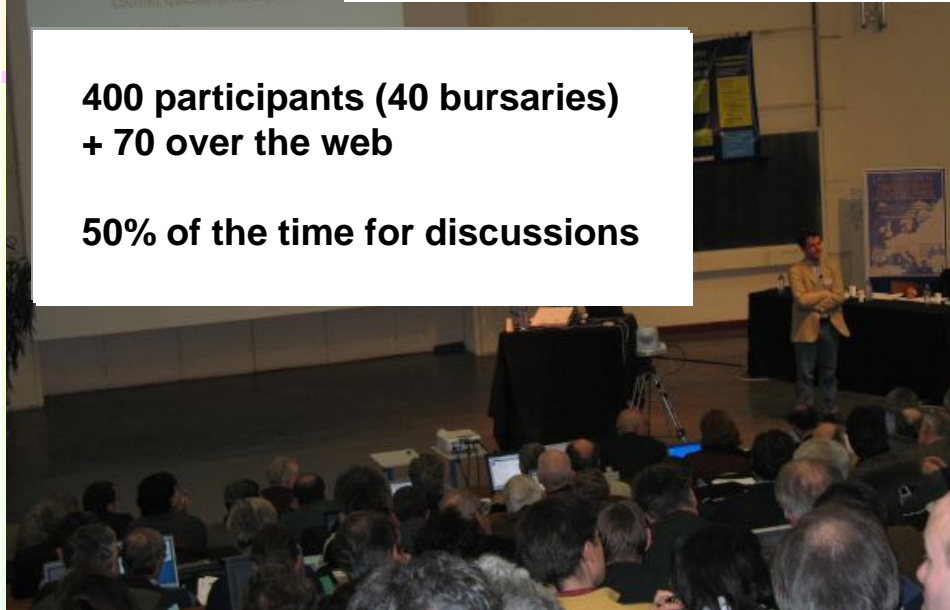
### Why this Strategy Group?

This group had the direct aim to propose a Strategy for approval by the CERN Council as an intergovernmental body. Since CERN is an international organization, its Council is composed of government representatives, so an approval in the CERN Council implies an agreement between governments. To use the CERN Council as an intergovernmental forum to agree on a Strategy for the European Research Area has indeed support in the [CERN Convention](#), but this is the first time that it is

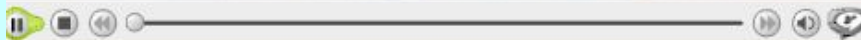
# Open Symposium January 30<sup>th</sup> to February 1<sup>st</sup>

400 participants (40 bursaries)  
+ 70 over the web

50% of the time for discussions

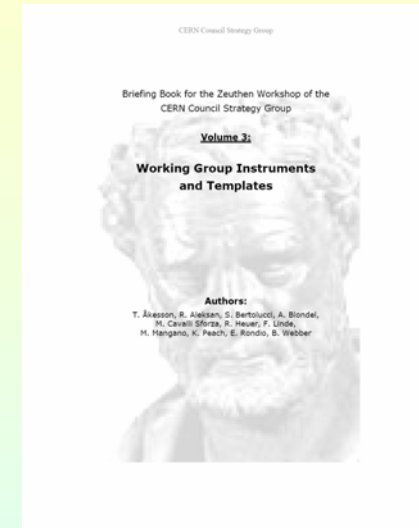
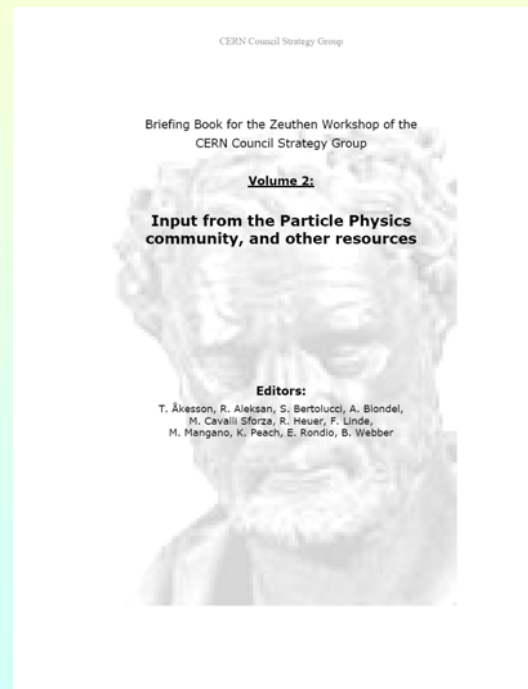


From the webcast



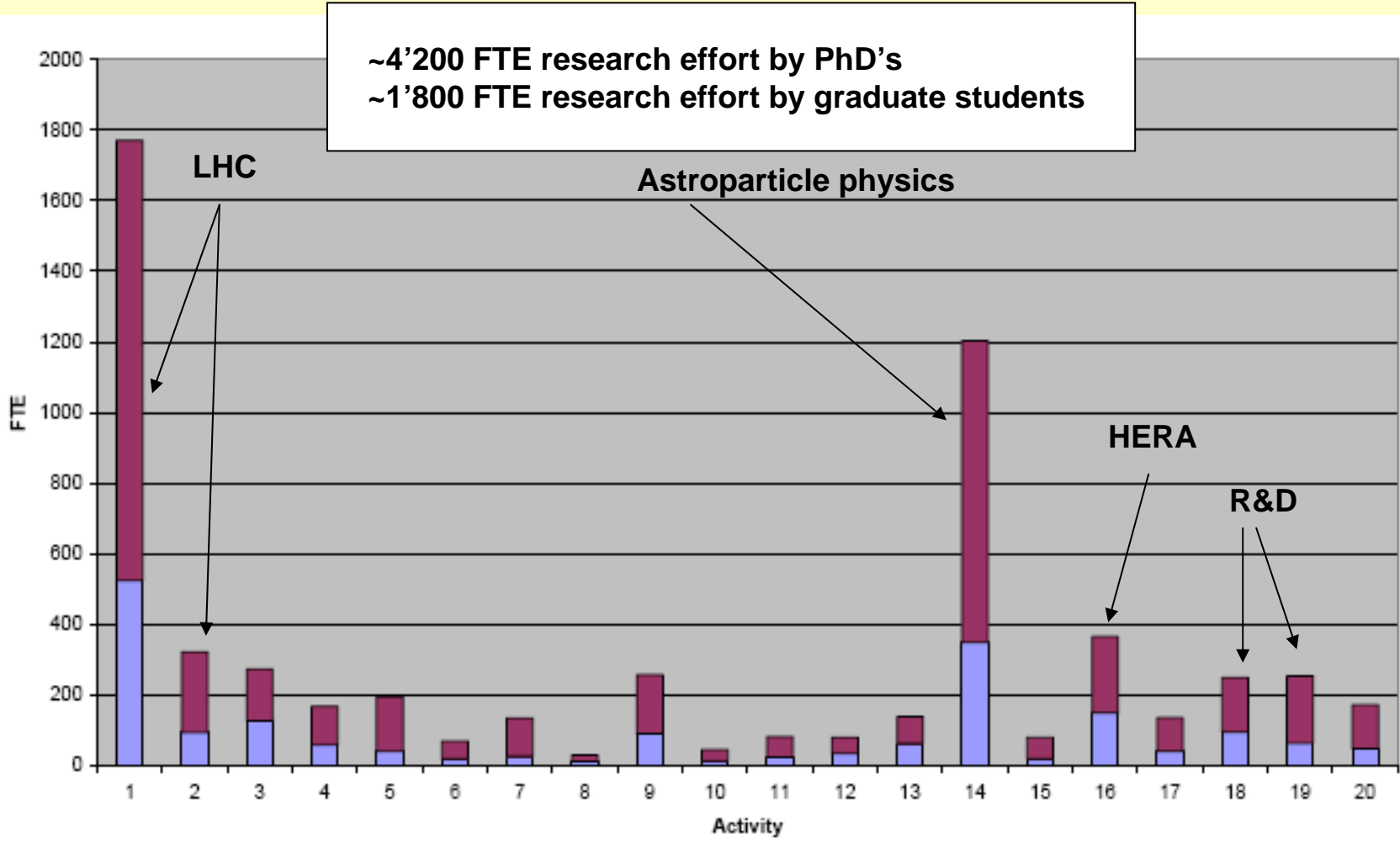
# BRIEFING BOOK

Outcome of the Orsay meeting, received written contributions, ...



AVAILABLE AT

<http://cern.ch/council-strategygroup>



Label	1	2	3	4	5	6	7	8	9	10
Area	LHC: ATLAS, CMS and LHCb	LHC: ALICE	Ongoing Tevatron experiments	Preparations for a linear collider	Ongoing accelerator neutrino programmes	Preparing for future accelerator neutrino programmes	Ongoing non-accelerator based neutrino programmes	Preparing for future non-accelerator based neutrino programmes	Ongoing b-, quarkonium-factories	Next generation b-, quarkonium-factories
Label	11	12	13	14	15	16	17	18	19	20
Area	Double beta decay & electron neutrino mass	Future precision measurements of particle properties (e.g. EDM, g-2,)	Ongoing heavy ion physics	Astroparticle physics	Observational cosmology	HERA	Spectroscopy, muon/neutrino DIS (COMPASS...)	Detector R&D	Accelerator R&D	Others





**2-6<sup>th</sup> of May**  
**Strategy Group meeting outside Berlin**  
**-> Draft Strategy**



# Result from the Zeuthen Meeting

- **Consensus was reached on**
  - **Scientific activities**
  - **Organizational issues**
  - **Complementary issues**

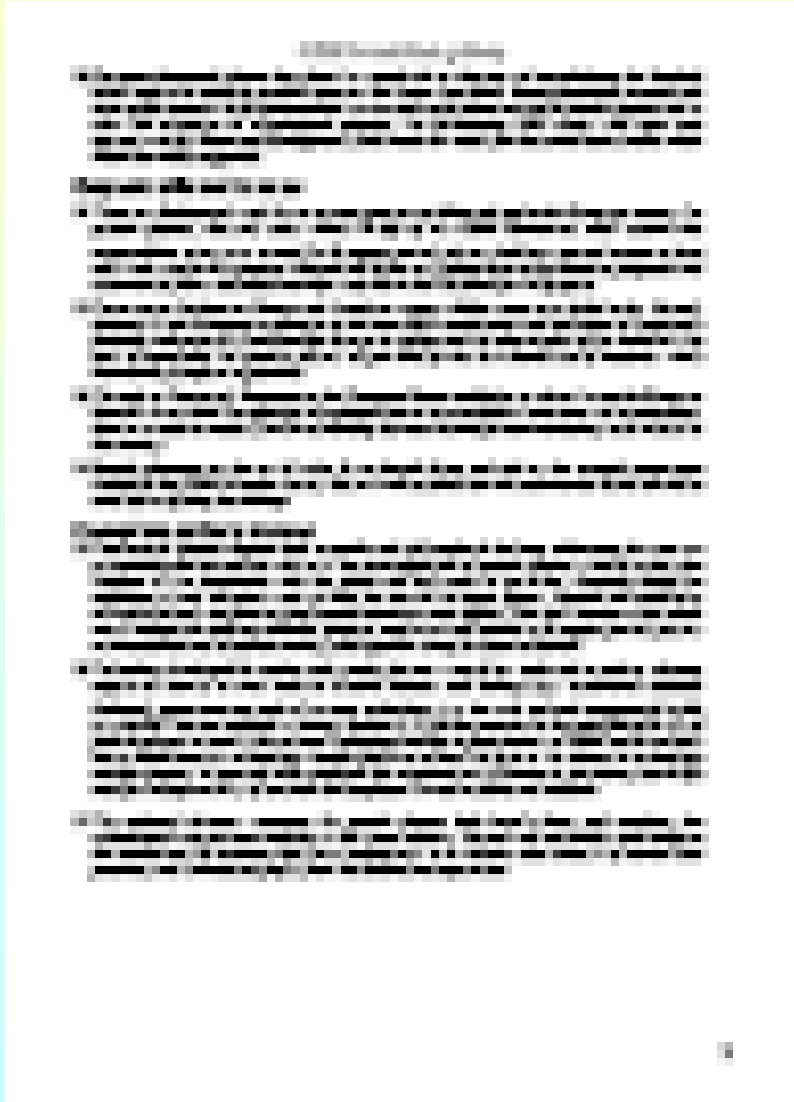
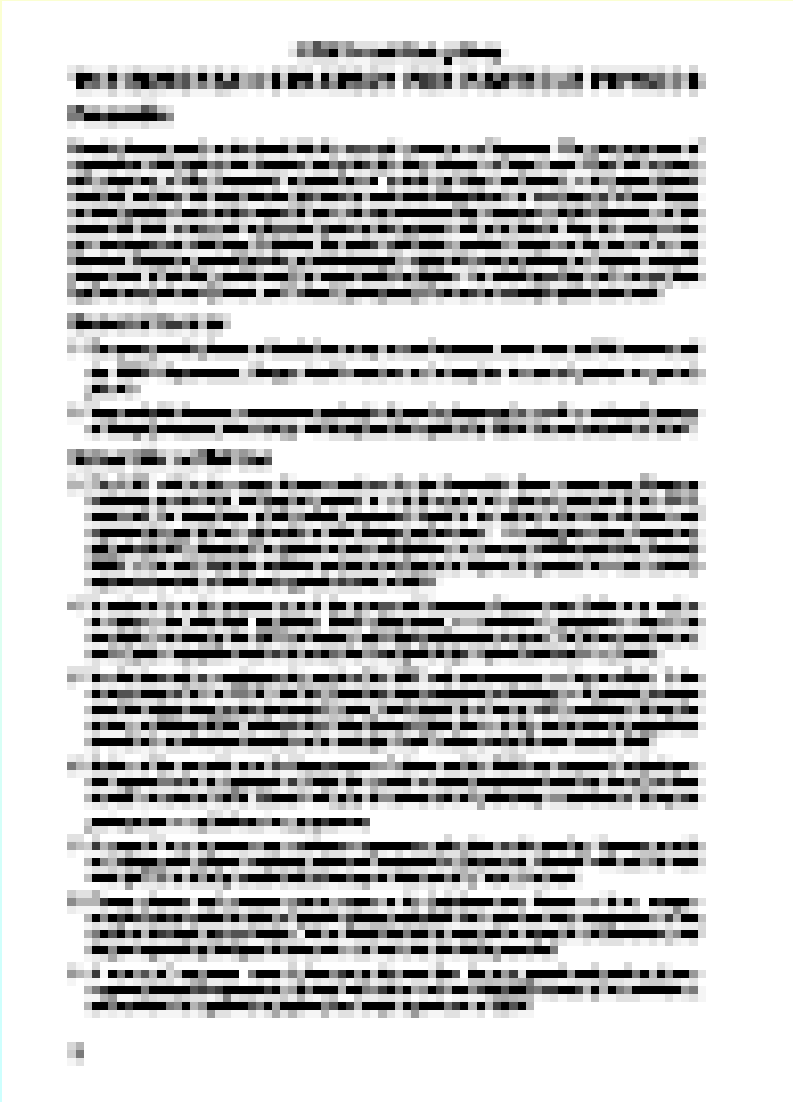
## **Documents**

**Draft Strategy Document of 2 pages ← For Council decision**  
**Discussion Document of 25 pages ← Background material**

## DSD: General format

- **Four sections**
  - **General issues**
  - **Scientific activities**
  - **Organizational issues**
  - **Complementary issues**
- **Style**
  - **Statement; *consequence.***

# Draft Strategy Document



# The European Strategy for Particle Physics

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## 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.*

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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.*
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.*

### 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.*
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*

# Special Restricted CERN Council Lisbon 14 July 2006

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## Press release 14<sup>th</sup> of July 2006

### **CERN Council adopts European strategy for particle physics**

**Lisbon, 14 July 2006.**

**At a special meeting in Lisbon today, the CERN Council unanimously adopted a European strategy for particle physics. This is an important step for the field, outlining a leading role for Europe in this increasingly globalised endeavour.**

**The strategy adopted by the Council today provides for European engagement and leadership in the field. It builds on European strengths at Universities, in national laboratories – frequently of international standing – and at the CERN laboratory.**



# The European Strategy for Particle Physics

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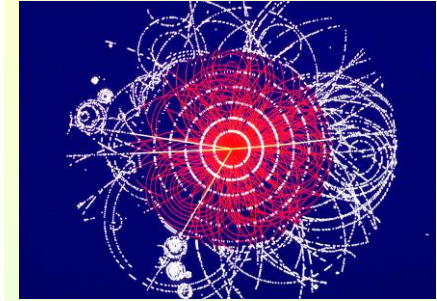
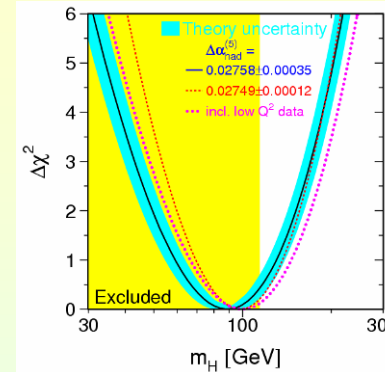
# Preamble

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.*

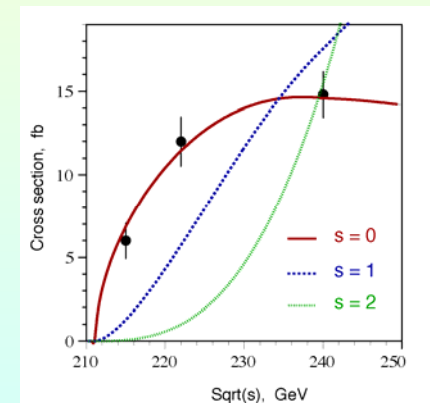


# “a new and exciting era of discovery”

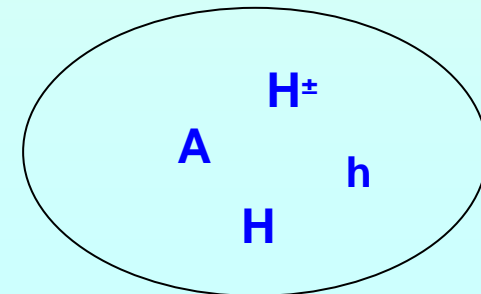
- How is mass generated?
  - Is the Higgs particle there?



- Properties of the Higgs particle if found?

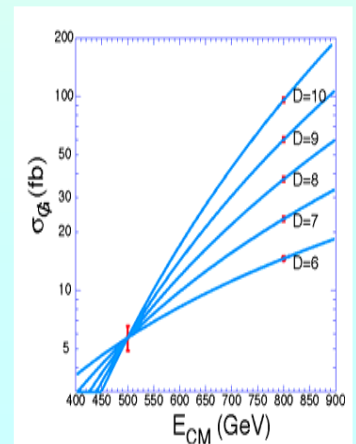
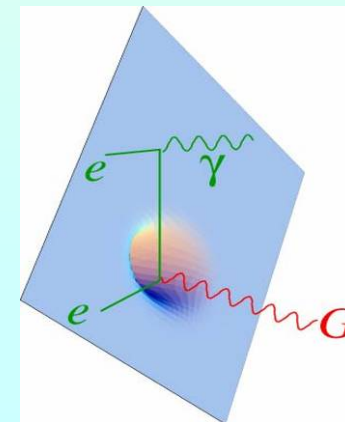
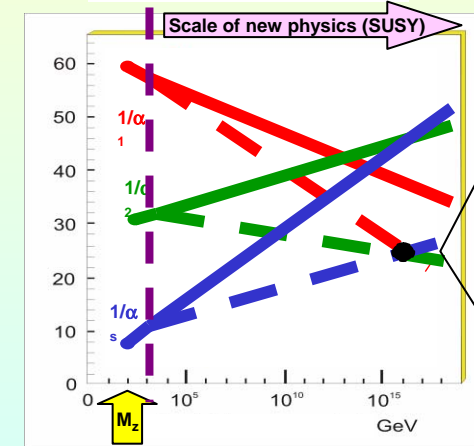
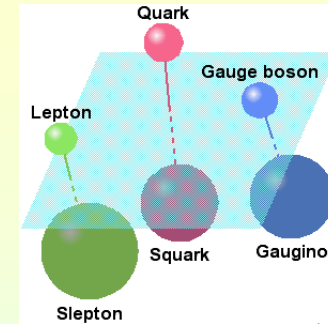


- Several Higgs particles?
  - As suggested by SUSY?



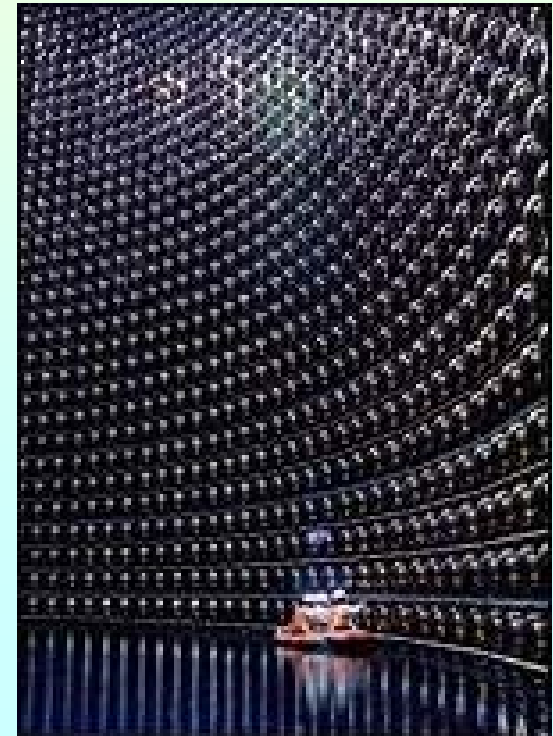
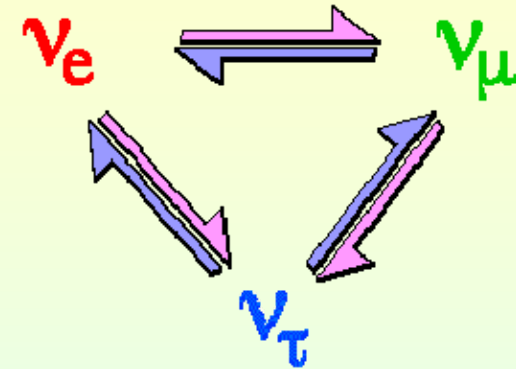
# “a new and exciting era of discovery”

- Are there new forces and symmetries?
  - Is the dark matter from here?
- Do all forces become one?
- Are there more spatial dimensions?



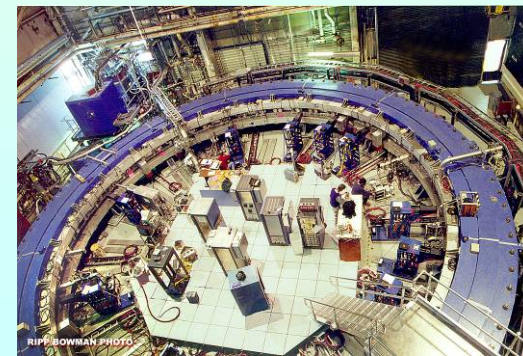
# “a new and exciting era of discovery”

- Which are the masses and nature of the neutrinos?
- Are they responsible for the matter/antimatter imbalance?



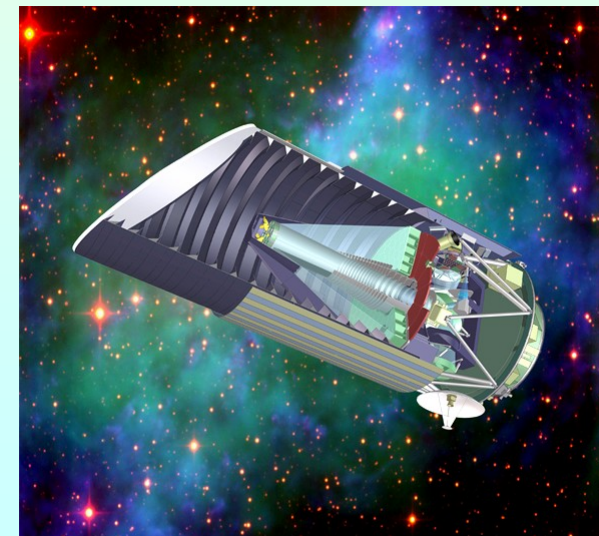
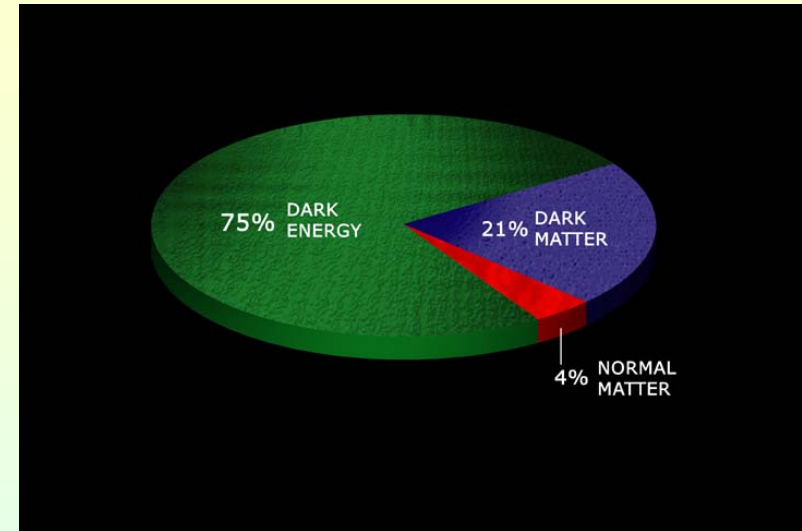
# “a new and exciting era of discovery”

- Do rare processes and precision measurements reveal new physics at extreme energies?
  - **Factories**
  - **Rare decays**
  - **Precision measurements**



# “a new and exciting era of discovery”

- What is dominating the energy in our world?
- Does the Dark Energy change with time?



# The European Strategy for Particle Physics

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# The European Strategy for Particle Physics

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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.*

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# Scientific Activities (3)

“fundamental” = “absolutely necessary for advancement”

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## 1. Scientific importance of the infrastructure

### Fundamental

Project/infrastructure that is absolutely necessary for advancement. It is hoped to deliver a suite of results that will form our broad understanding of elementary particle physics. There is, or could be, a danger of stagnation without this project/infrastructure.

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# Final remarks

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- **In adopting the European Strategy for Particle Physics, the CERN Member States have through the CERN Council realised the vision set out in the CERN Convention to promote and co-ordinate the research activities of the CERN laboratory and of the national particle physics laboratories and institutes**
  - **Europe stand therefore better prepared to engage with the other regions in the world in the increasingly globalized research environment**
  - **Elementary particle physics in Europe is in an excellent position to enter the exciting era of discoveries that lays in front of us**