

# Infrastructure, an interface between disciplines, regions and academia/industry

## Example of CERN



Conseil **E**uropéen pour la **R**echerche  
**N**ucléaire  
Organisation Européenne pour la  
Recherche Nucléaire

ESF / ZWM Seminar  
“Future Leaders in European  
Science Policy and Research”

Strasbourg, 5 - 7 February 2009

Felicitas Pauss / CERN and ETH Zurich



# Founded in 1954 (12 European Member States)

Today:

20 European Member States  
1 Candidate for Accession to Membership

8 Observers:

USA, Japan, India, Russia,  
Israel, Turkey, EU and  
UNESCO

## The Twenty Member States of CERN



6000  
scientists

### Member States (Dates of Accession)

AUSTRIA (1959)	DENMARK (1953)	GREECE (1953)	NORWAY (1953)	SPAIN (1/1961-12/1968-1/1983)
BELGIUM (1953)	FINLAND (1991)	HUNGARY (1992)	POLAND (1991)	SWEDEN (1953)
BULGARIA (1999)	FRANCE (1953)	ITALY (1953)	PORTUGAL (1986)	SWITZERLAND (1953)
CZECH FR (1993)	GERMANY (1953)	NETHERLANDS (1953)	SLOVAK FR (1993)	UNITED KINGDOM (1953)

CERN AC/DI/MM - E5368 1999 - 15/6/99

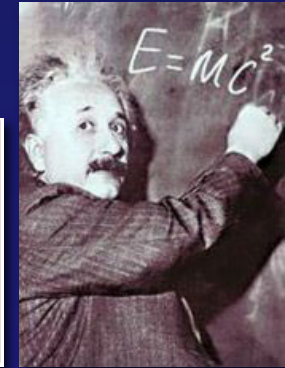
World's largest Particle Physics Laboratory:  
9500 Scientists from 60 countries use CERN's large infrastructure (Jan 2009)



# The Mission of CERN

- To **push back** the frontiers of knowledge

E.g. the secrets of the Big Bang ...what was the matter like within the first moments of the Universe's life?

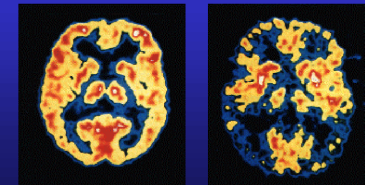


- To **develop** new technologies

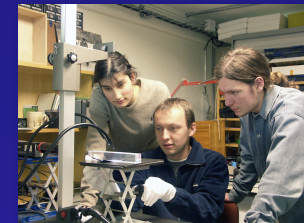
Information technology - the Web and the GRID  
Medicine - diagnosis and therapy



Brain Metabolism in Alzheimer's Disease: PET Scan



- To **train** scientists and engineers of tomorrow



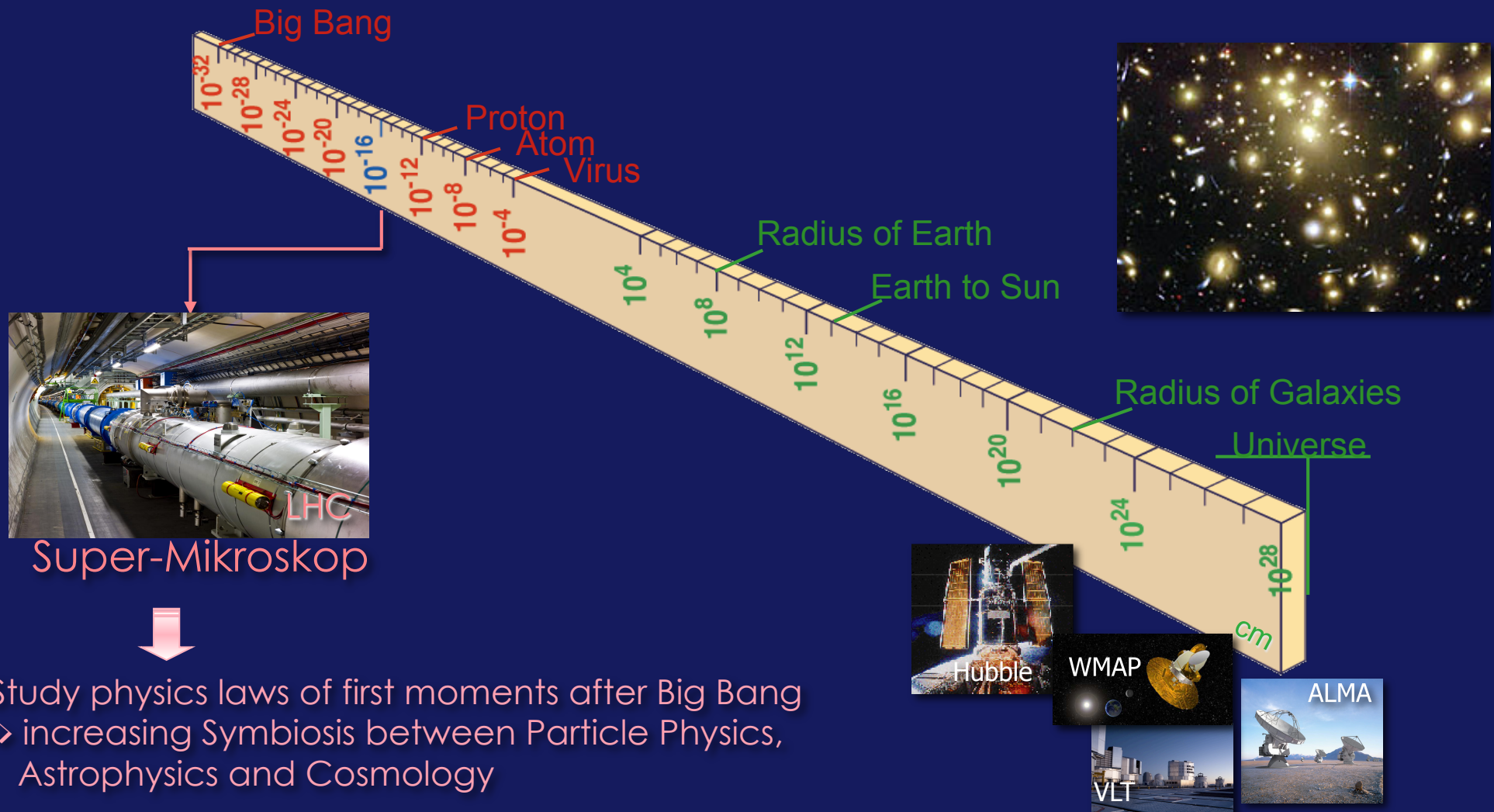
- To **unite** people from different countries and cultures





# Particle Physics

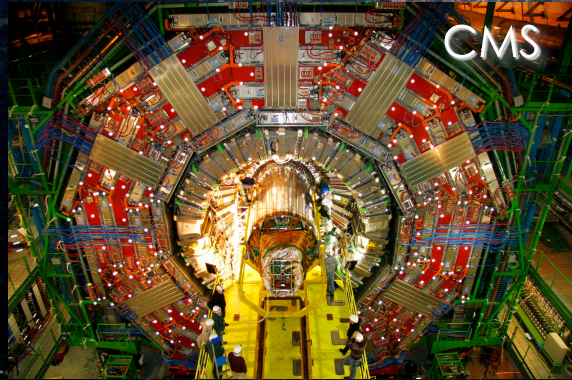
Study the structure of the Universe at its most fundamental level: explore the basic physics laws which govern the fundamental building blocks of matter and the structure of spacetime



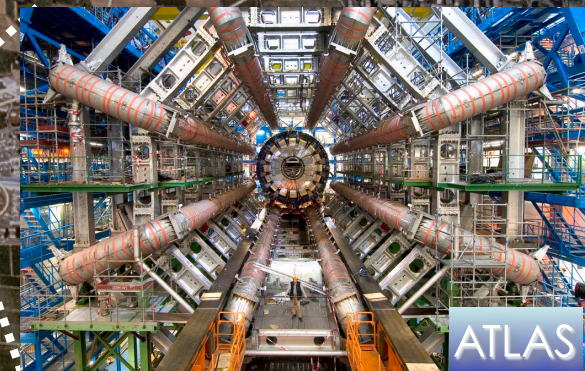
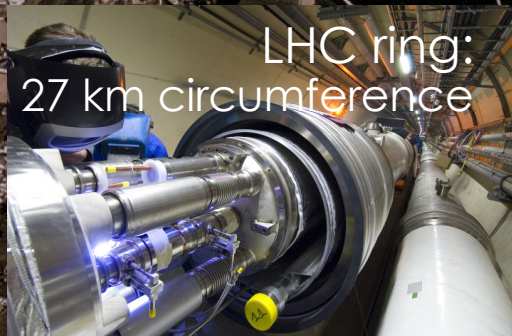
Study physics laws of first moments after Big Bang  
⇒ increasing Symbiosis between Particle Physics, Astrophysics and Cosmology

# Enter a New Era in Fundamental Science

Start-up of the Large Hadron Collider (LHC), one of the largest and truly global scientific projects ever, is the most exciting turning point in particle physics.



Exploration of a new energy frontier ( $E_{CM} = 14 \text{ TeV}$ )  
The results will have a profound impact on the way we see our Universe

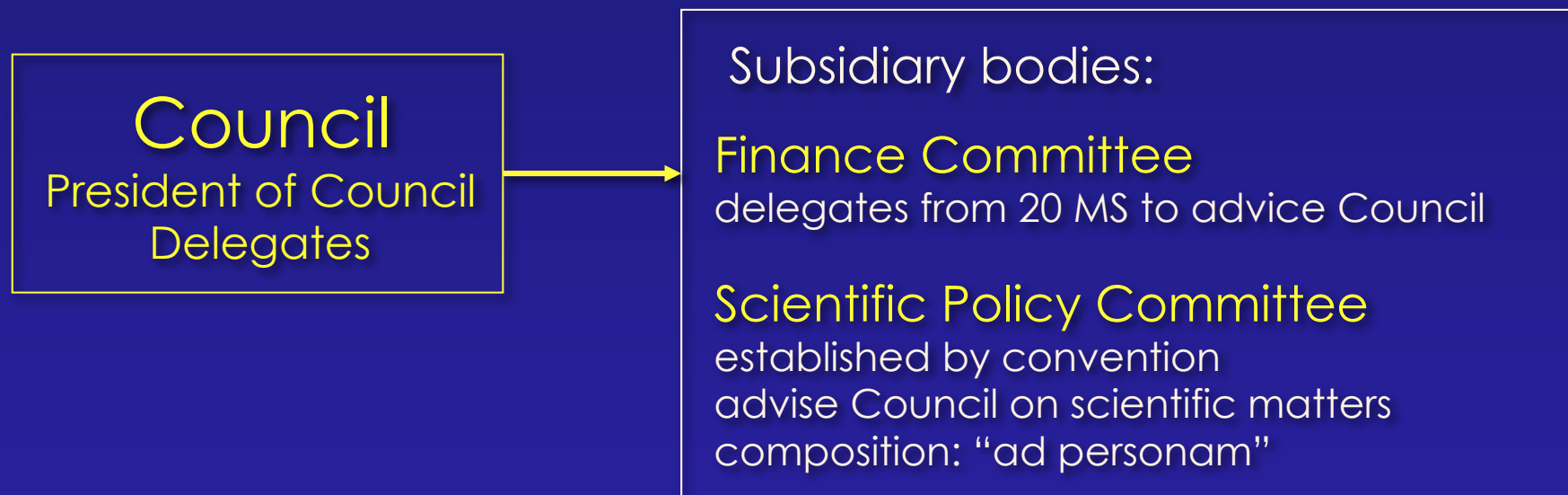




# CERN - Intergovernmental Organisation Governance

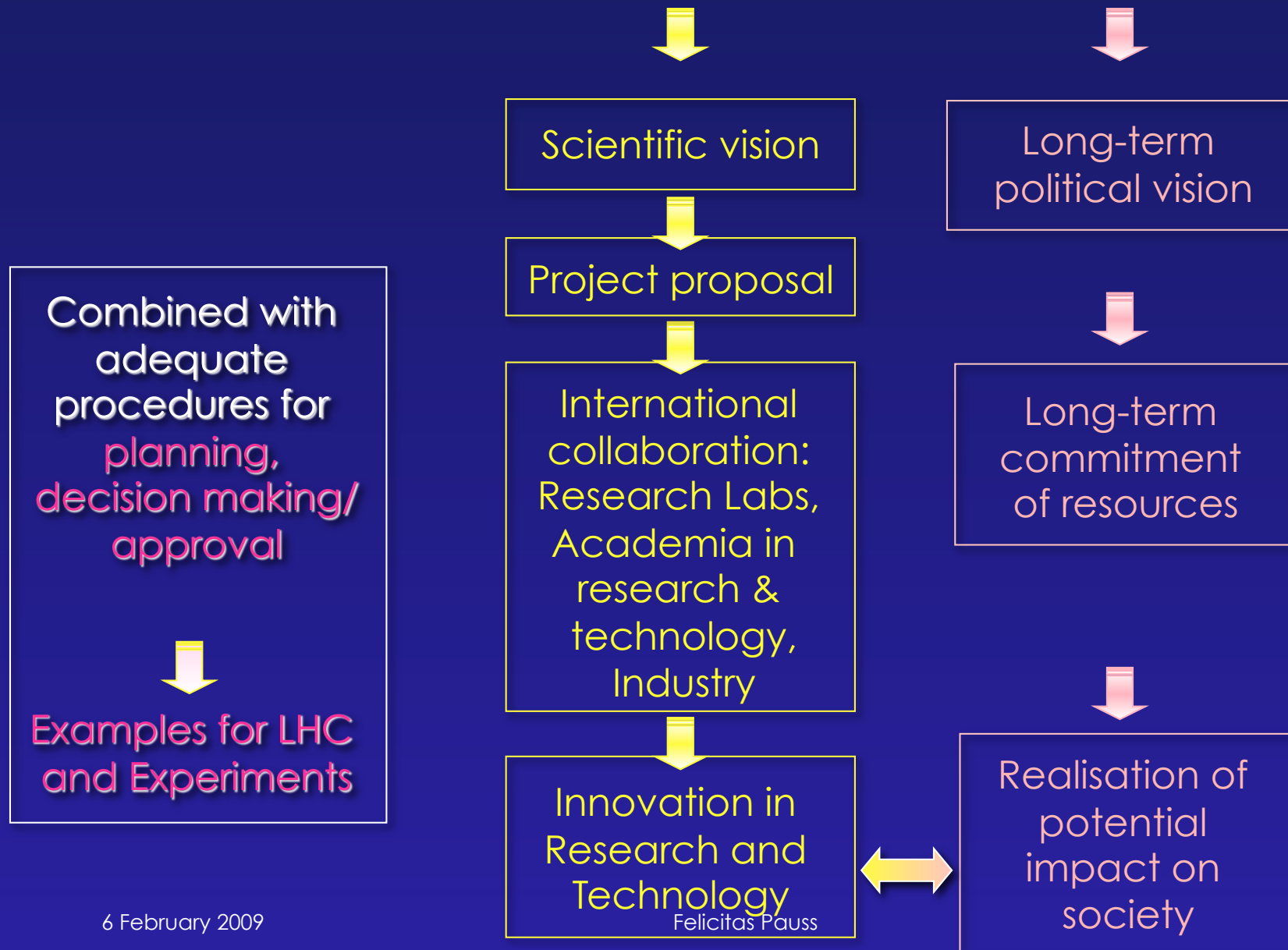
**Council** - the governing body of CERN, comprising government representatives (delegates) of 20 European Member States defining

- CERN's strategic programmes
- setting and following up its annual goals
- approving its budget
- appointing its Management led by the Director-General





# Very large-scale international projects: combination of **bottom-up** and **top-down** approach





# LHC experimental Programme: Planning

- 1984 Lausanne workshop official starting point for work at the LHC
- 1987 La Thuille workshop: comparison of LHC (p-p), CLIC (e<sup>+</sup>e<sup>-</sup>), e-p option and physics potential

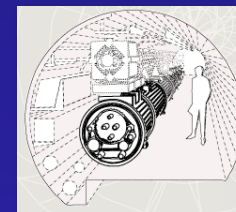
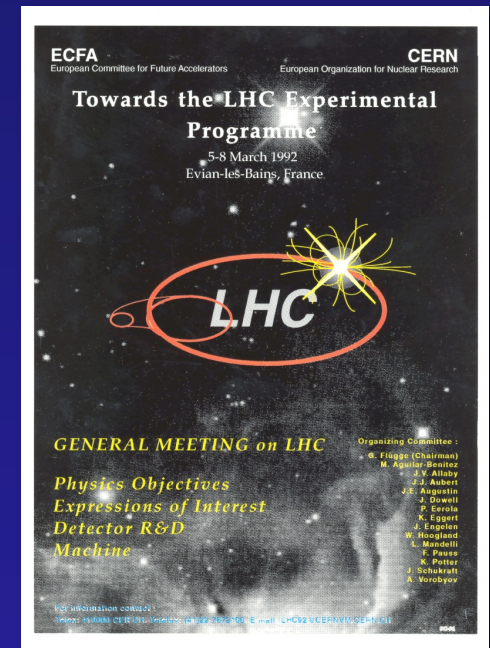
End 1980's the first embryonic collaborations started

- 1990 Aachen workshop (physics and instrumentation)  
first LHC operation in 1998 proposed

- 1992 Evian workshop presentation of **EoI** (in March)  
proto-collaborations  
**LoI** presentation at CERN (in October)

- 1995 LHC conceptual design: 14 TeV,  $L = 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$

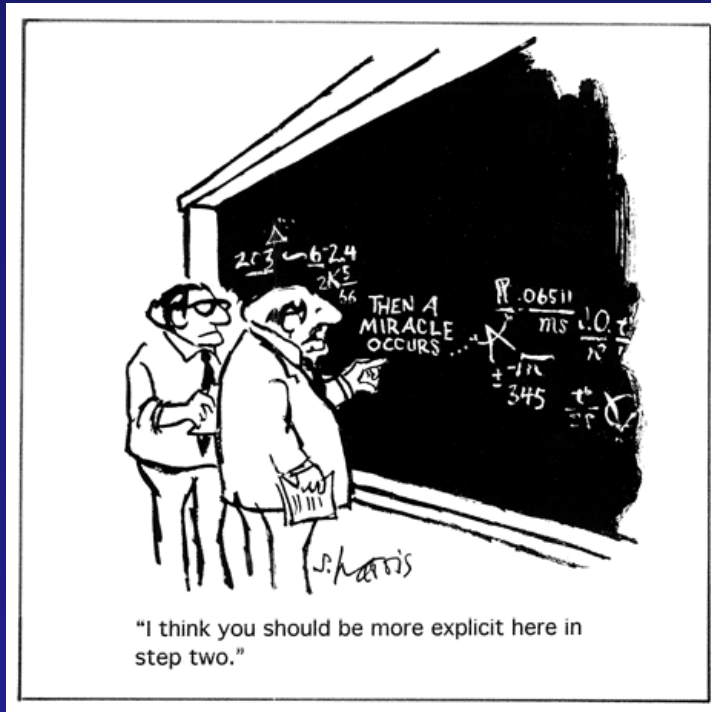
- 1993 SSC cancelled





# Evaluation Procedures

Based on **peer review**: independent advisory bodies



LHC: **MAG** Committee

Experiments:

- **LHCC**: for technical and scientific matters
- **CORE**: for financial issues

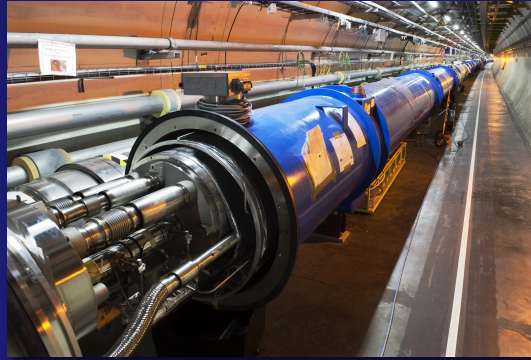
⇒ Recommendation to CERN management for approval

⇒ final approval by CERN Council

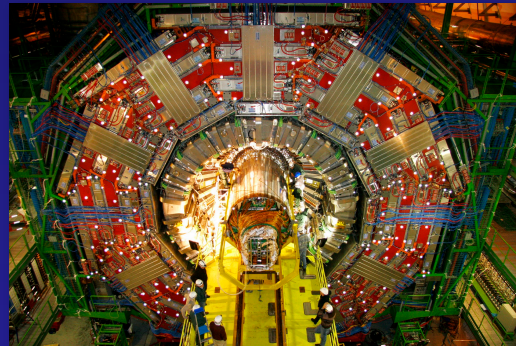
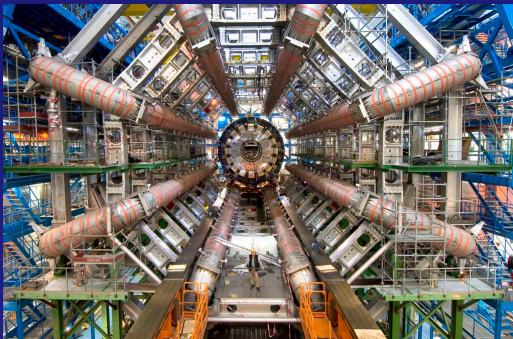
Remark: **LHCC** follows experiments till termination of project, any major technical changes need to be evaluated by LHCC  
**RRB** (all funding agencies of experiments) monitors evolution of experiments and approves budgets on a yearly basis



# Approval Procedures



December 1994: LHC  
approved by CERN  
Council



February 1996:  
ATLAS and CMS are officially  
approved  
Other LHC experiments followed

**MoU** for experiments signed by different funding agencies /  
collaborating institutes

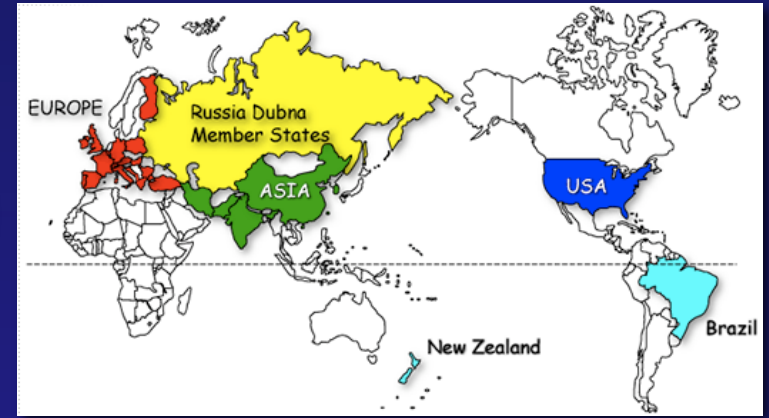
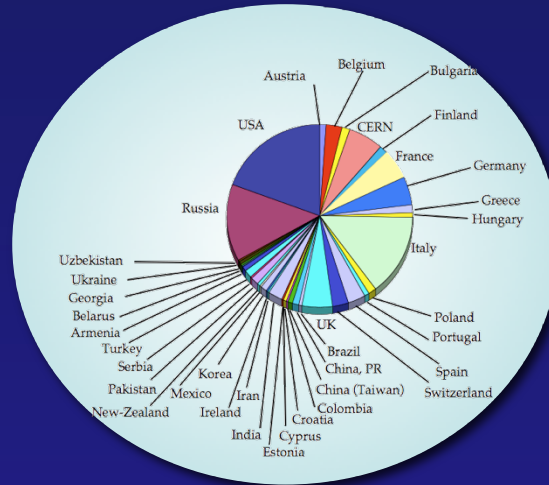
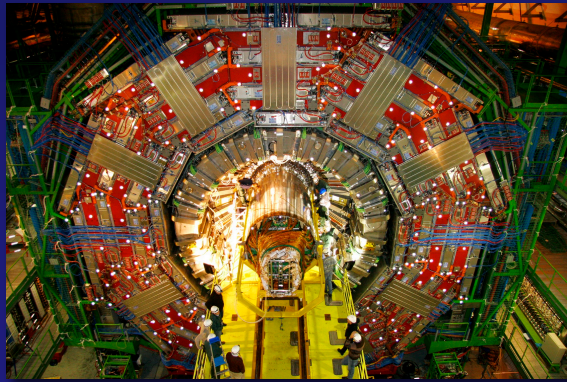
Lesson learnt: have ambitious projects but be realistic w.r.t. proposed  
time schedule of project



# Organisation of Experiments



## CMS Example



### Main structures:

Collaboration Board: governing body

Management Board: submits recommendations to the CB

Finance Board: all important issues related to resources

### CMS Collaboration

~2000 authors  
 ( 50% from MS, 50 % from NMS)  
 38 countries  
 181 institutes



1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008



# Basis of CERN's success

European scientific and political leaders with visionary minds created CERN more than 50 years ago:

- Tying together human and financial resources for a **common scientific goal that only could be realized by constructing large infrastructures (accelerators)**
- Building **strong links** between scientists of large and small countries
- Realization of **long-term goals** with strong support from all Member States

Sir Ben Lockspeiser, first president of the CERN Council:

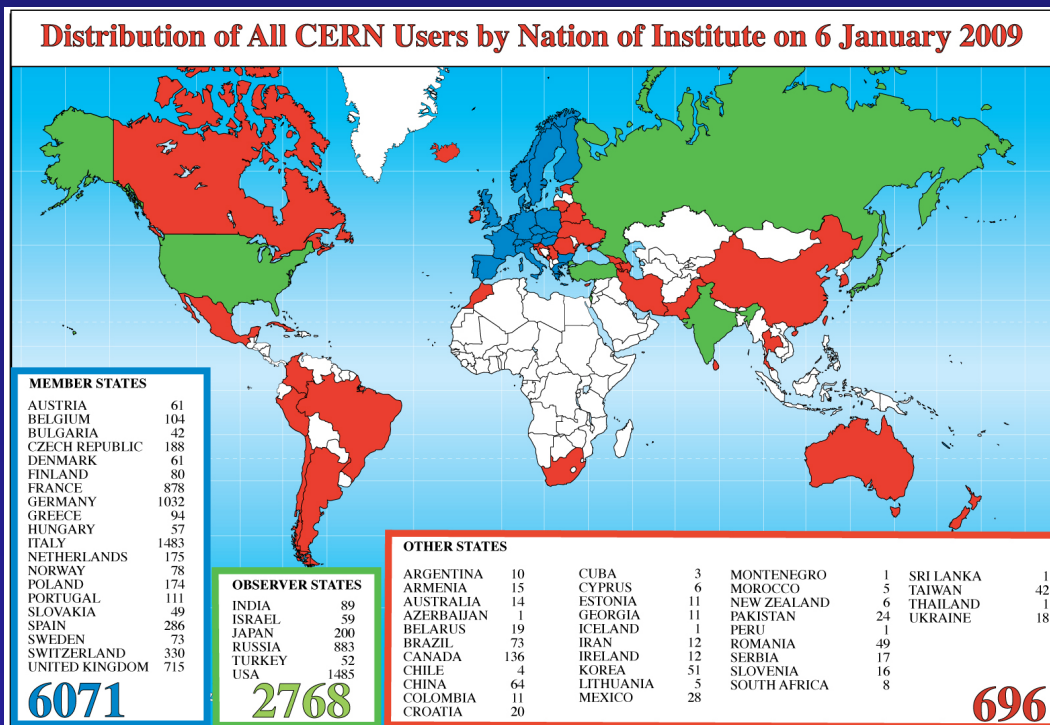
*“Scientific research lives and flourishes in an **atmosphere of freedom** – freedom to **doubt**, freedom to **enquire** and freedom to **discover**. These are the conditions under which this new laboratory has been established.”*



# Push back the frontiers of knowledge

Fascination of basic science questions has resulted in a common goal:

- LHC + experiments necessary for the next step in advancement of fundamental science
- In national roadmaps: LHC programme as top priority



⇒ CERN became a GLOBAL LABORATORY

Increase of users over last 4 years:

MS 27 %

OS 41 %

NMS 48 %



# The Future of CERN

From CERN Council Strategy Document <sup>1)</sup>

“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.**”



<sup>1)</sup> The European Strategy for Particle Physics was approved by CERN Council in 2006



# The challenge

From CERN Council Strategy Document

“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.”



**Council Working Group** has been set up during the December 2008 Council Session **on the Scientific and Geographical Enlargement of CERN**



# Instruments for Science & Technology Cooperation at European level

- Objective of Lisbon Summit in March 2000: Europe should become the most **competitive** and dynamic **knowledge-based economy** in the world
  - ⇒ requires excellent coordination
- Presently, major instruments for pan-European cooperation in S&T, co-funded by EU and other European States, are implemented via:
  - 7th Research Framework Programme (FP7)
  - Competitiveness and Innovation Programme (CIP)
  - European Technology Platforms and Joint Technology Initiatives, and the EUREKA framework
  - **European inter-governmental research organisations (EIROs)**

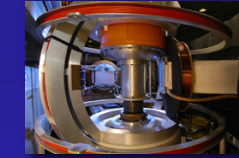
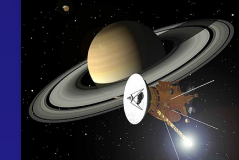
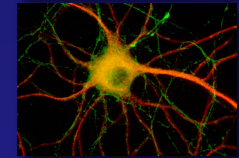




# EIROforum

European Intergovernmental Research Organisations Forum

- CERN (European Organisation for Nuclear Research)
- EFDA (European Fusion Development Agreement)
- EMBL (European Molecular Biology Laboratory)
- ESA (European Space Agency)
- ESO (European Organisation for Astronomical Research in the Southern Hemisphere)
- ESRF (European Synchrotron Radiation Facility)
- ILL (Institute Laue-Langevin)





# EIROforum

## European Intergovernmental Research Organisations Forum

- All **EIROs** are established by means of **intergovernmental agreements**
- **EIROs**: different conventions, legal status & memberships
  - governed by international law: CERN, ESA, ESO, EMBL
  - governed by national law: ESRF, ILL
- With strong support by their Member States, EIROs have become **world-leaders in their respective research fields**
- **Major differences** between **EIROs** and **EU** programmes (FP7, CIP):
  1. **EIROs**: well coordinated long-term scientific programmes, focused in one discipline.  
**EU programmes**: support large number of short-term projects in variety of fields
  2. **EIROs** funded by sub-set of European countries (Member States)  
**EU**: funded by all EU member states and other countries associated to FPs



# EIROforum

European Intergovernmental Research Organisations Forum

- EIROs have been very successful and will continue to play a key role for science & technology in Europe
- First European intergovernmental Organisation: CERN in 1954  
ESRF was the last one, created in 1988  
⇒ why no new ones created?
- Need for new European centers of excellence  
⇒ First European Roadmap for Research Infrastructure (ESFRI roadmap in 2006, update 2008):  
A few open questions:
  - How will projects be realized and funded?
  - What will be the legal status, organisational model?
  - etc



# Concluding Remarks

CERN: first large European intergovernmental organisation in fundamental science (Convention ratified in 1954)

Since 1988: 7 European intergovernmental organisation in fundamental science (EIROs)

## Why have EIROs been successful

- Long-term stability and strong support from Member States
- Efficient organisational and management models
- Managed to become world-class centers of excellence
- Scientific programmes defined by the scientific community
- Attract the best scientists from their Member States and world-wide
- Connect Europe to the rest of the world via scientific cooperation programmes