



CERN

Research

Technology

Training

Collaborating

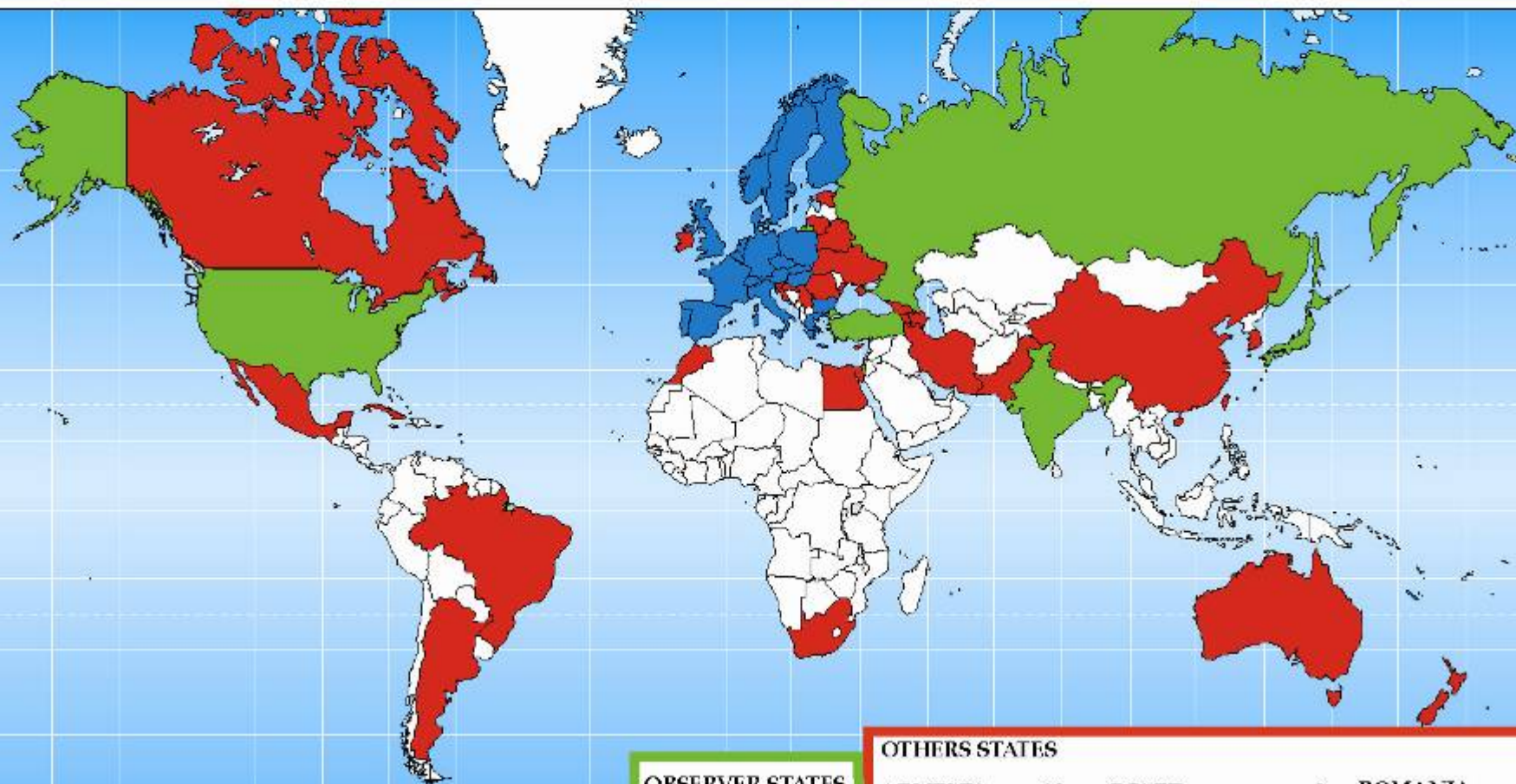
CERN in Numbers



- 2500 staff
- 6500 users
- 500 Fellows and Associates
- Budget (2005)
1340MCHF (840M Euro)

- Member States: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.
- Observers: India, Israel, Japan, the Russian Federation, the United States of America, Turkey, the European Commission and Unesco

Distribution of All CERN Users by Institute on 8 September 2004



MEMBER STATES

AUSTRIA	GERMANY	
BELGIUM	GREECE	
BULGARIA	HUNGARY	PORTUGAL
CZECH REPUBLIC	ITALY	SLOVAKIA
DENMARK	NETHERLANDS	SPAIN
FINLAND	NORWAY	SWEDEN
FRANCE	POLAND	SWITZERLAND
		UNITED KINGDOM

4419

OBSERVER STATES

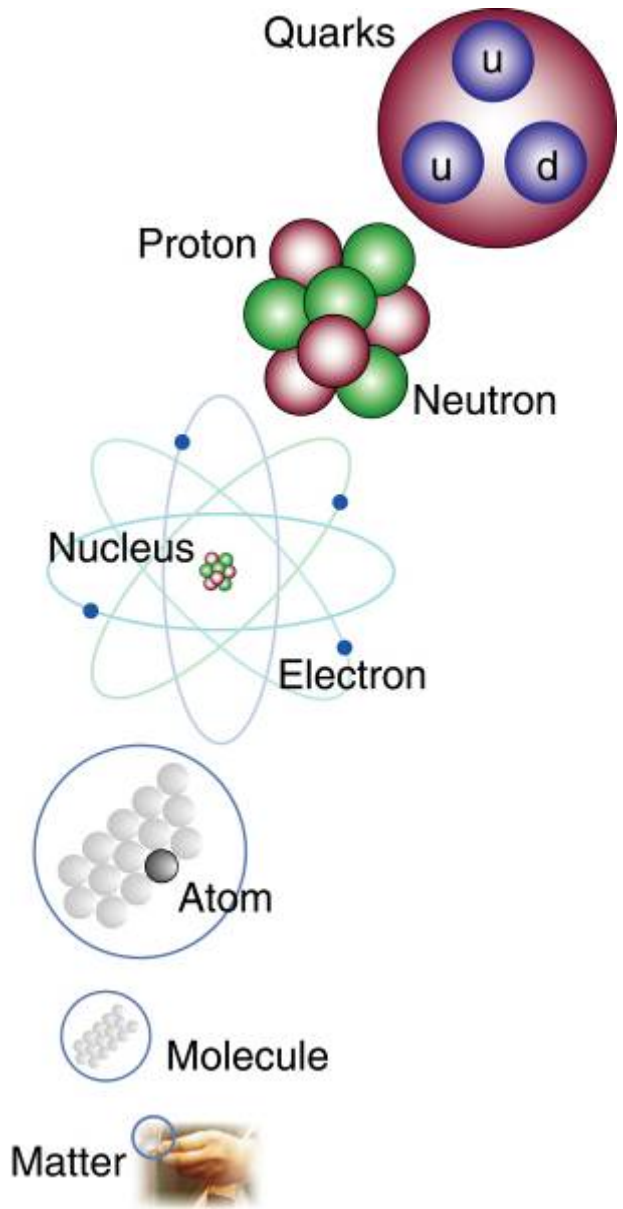
INDIA	62
ISRAEL	33
JAPAN	94
RUSSIA	774
TURKEY	24
USA	631

1621

OTHERS STATES

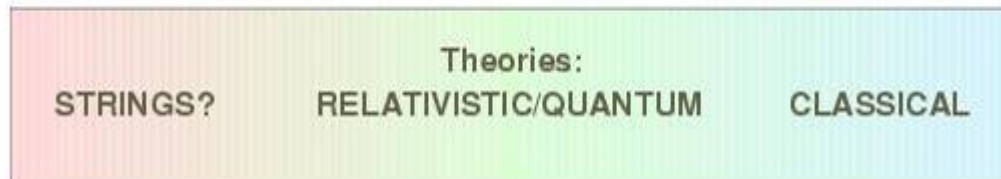
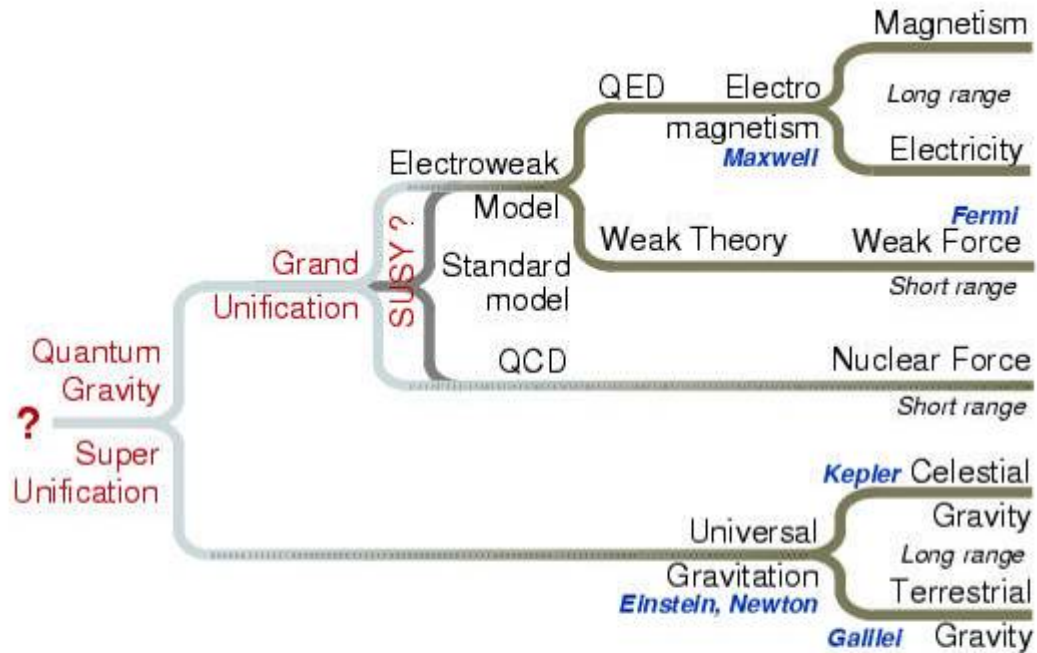
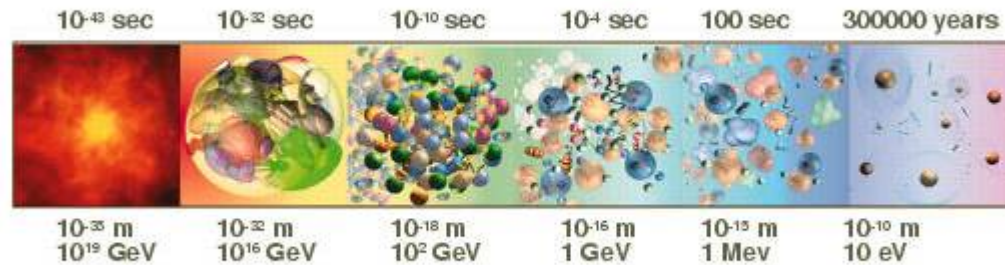
ARMENIA	10	EGYPT	3	ROMANIA	19
ARGENTINA	1	GEORGIA	6	SLOVENIA	6
AUSTRALIA	10	CROATIA	15	TAIWAN	20
AZERBAIJAN	2	IRELAND	6	UKRAINE	11
BRAZIL	29	IRAN	4	YUGOSLAVIA	11
BELARUS	14	KOREA	19	SOUTH AFRICA	2
CANADA	69	LITHUANIA	1		
CHINA	55	MOROCCO	8		
CUBA	3	MEXICO	15		
CYPRUS	5	NEW ZEALAND	2		
ESTONIA	6	PAKISTAN	11		

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In 50 years, we've come a long way, but there is still much to learn...

Summary



Forces

Strong

Gluons (8)



Quarks



Mesons
Baryons



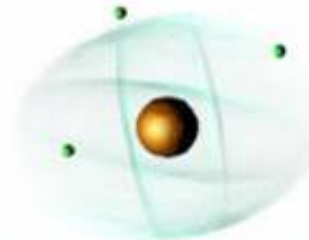
Nuclei

Electromagnetic

Photon



Atoms
Light
Chemistry
Electronics

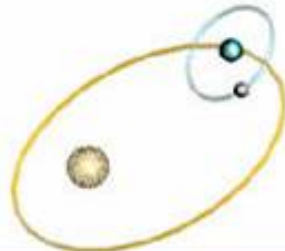


Gravitational

Graviton ?

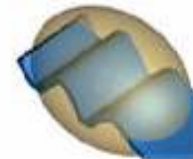


Solar system
Galaxies
Black holes

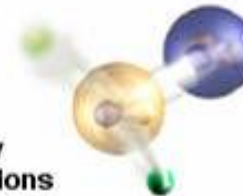


Weak

Bosons (W,Z)



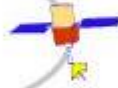
Neutron decay
Beta radioactivity
Neutrino interactions
Burning of the sun



Unification of forces



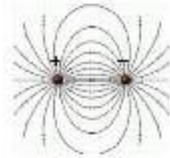
Terrestrial mechanics



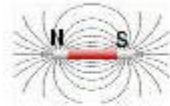
Celestial mechanics

Universal Gravitation

Inertial vs. Gravitational mass
(I. Newton, 1687)



Electricity



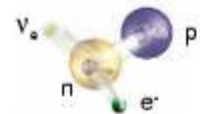
Magnetism

Electromagnetism

Electromagnetic waves (photon)
(J.C. Maxwell, 1860)



Electromagnetism



Weak force

Electroweak

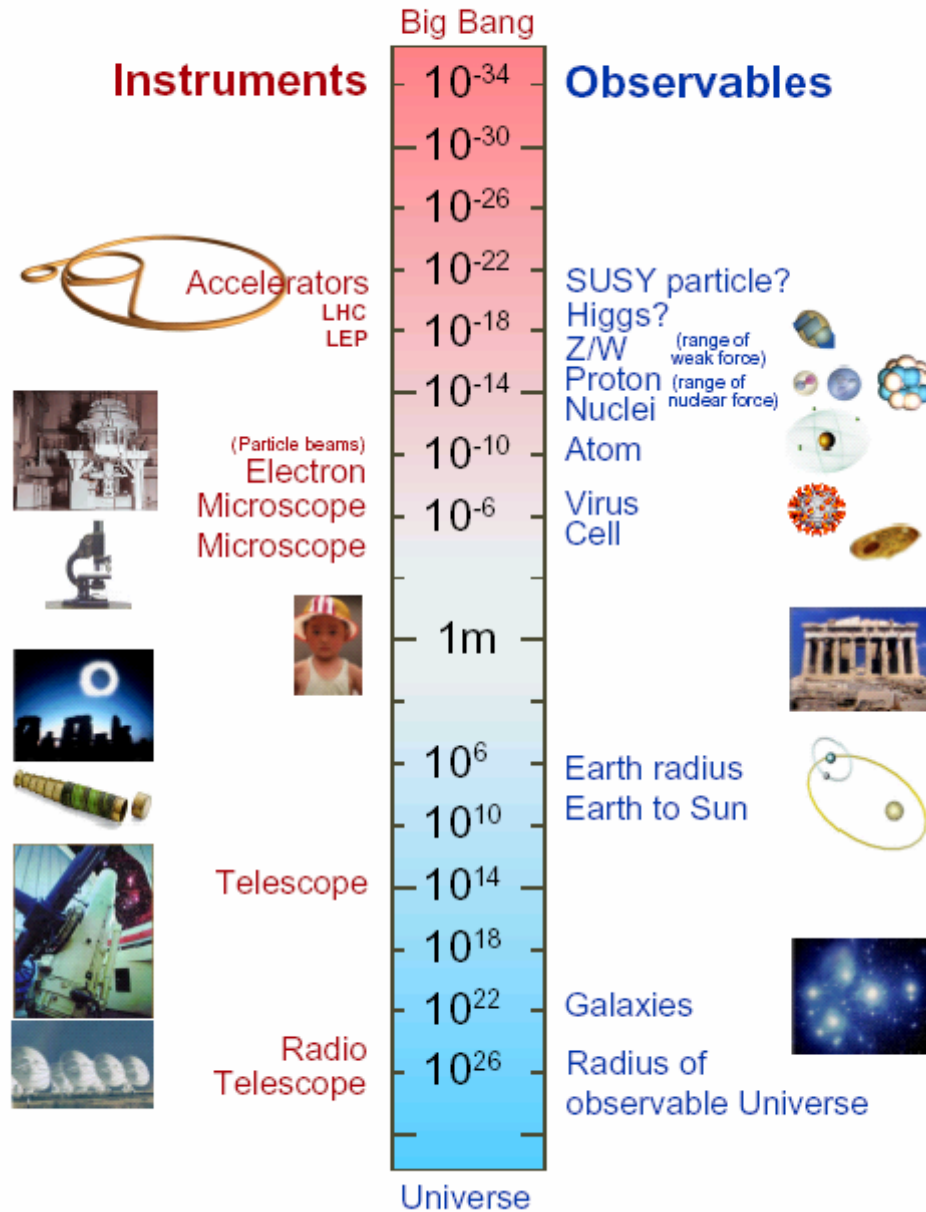
Intermediate bosons W, Z
(1970-83)

?

Probing shorter distances
reveals
deeper regularities

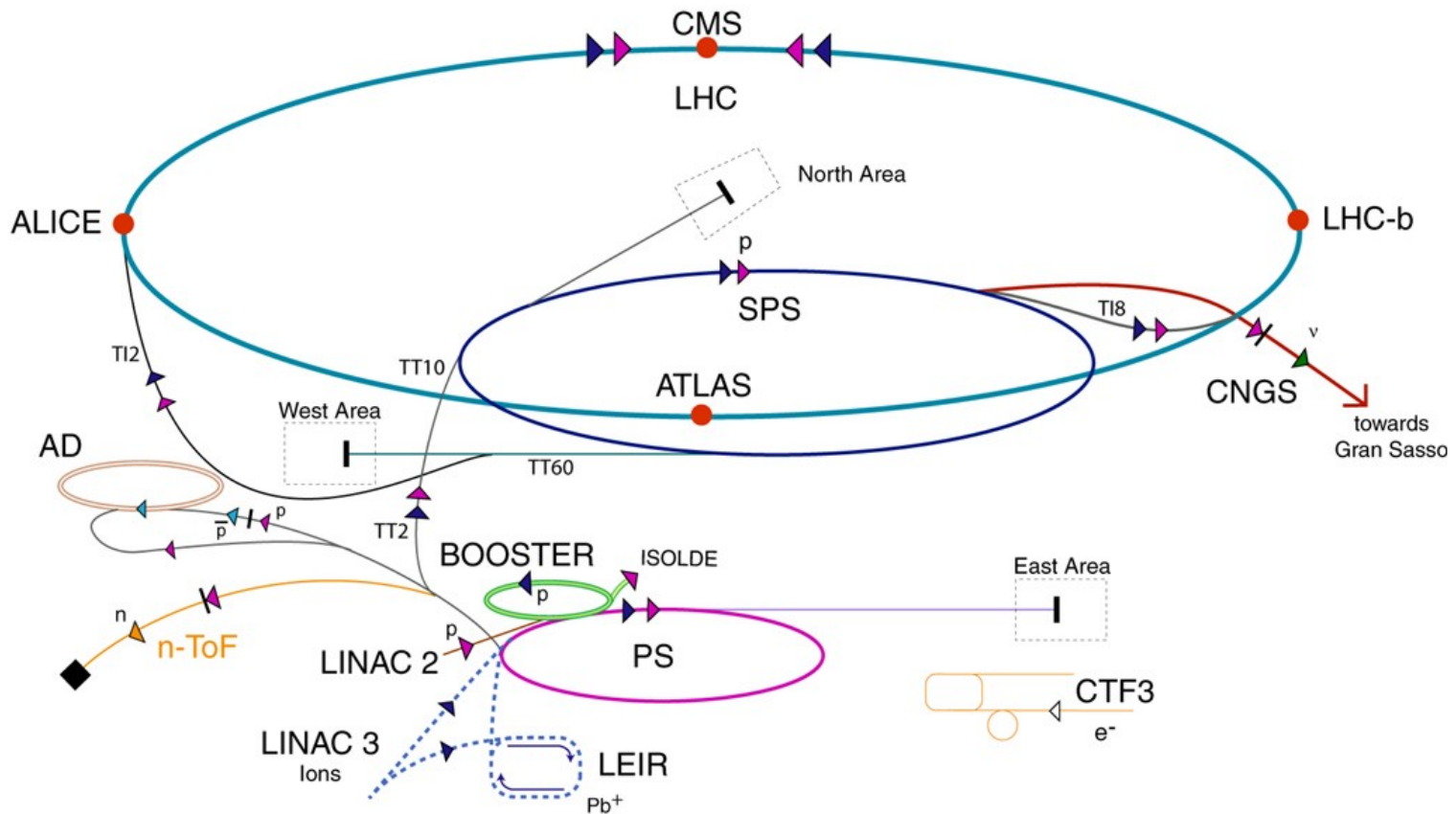
UNIFIED DESCRIPTIONS

The size of things



CERN: the World's Most Complete Accelerator Complex

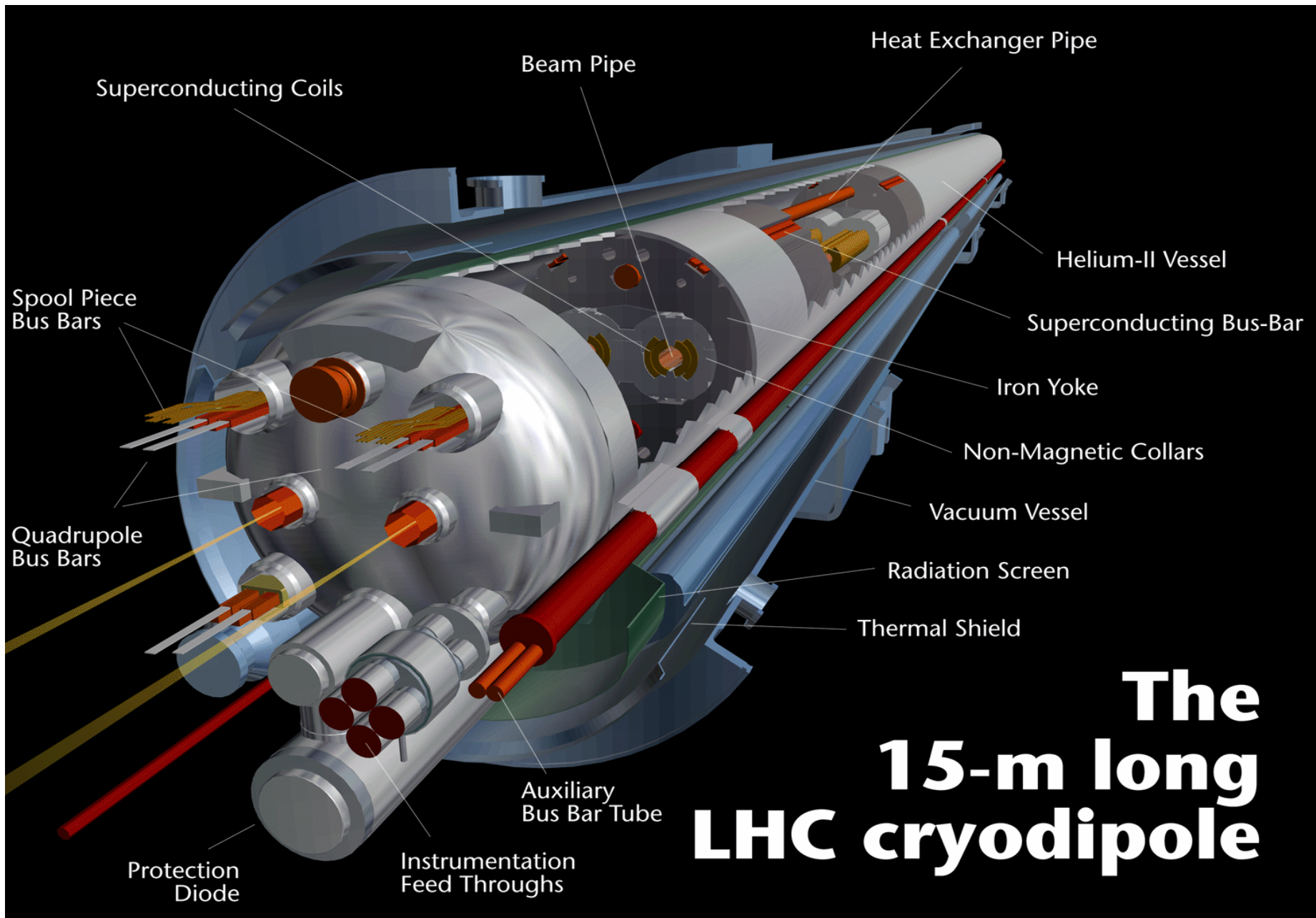
(not to scale)



- | | | | |
|------------|---------------|------------------------------|--------------------------------|
| ▶ protons | ▶ antiprotons | AD Antiproton Decelerator | LHC Large Hadron Collider |
| ▶ ions | ▶ electrons | PS Proton Synchrotron | n-ToF Neutron Time of Flight |
| ▶ neutrons | ▶ neutrinos | SPS Super Proton Synchrotron | CNGS CERN Neutrinos Gran Sasso |
| | | | CTF3 CLIC Test Facility 3 |

CERN Technologies





Magnet – Cryostat Assembly



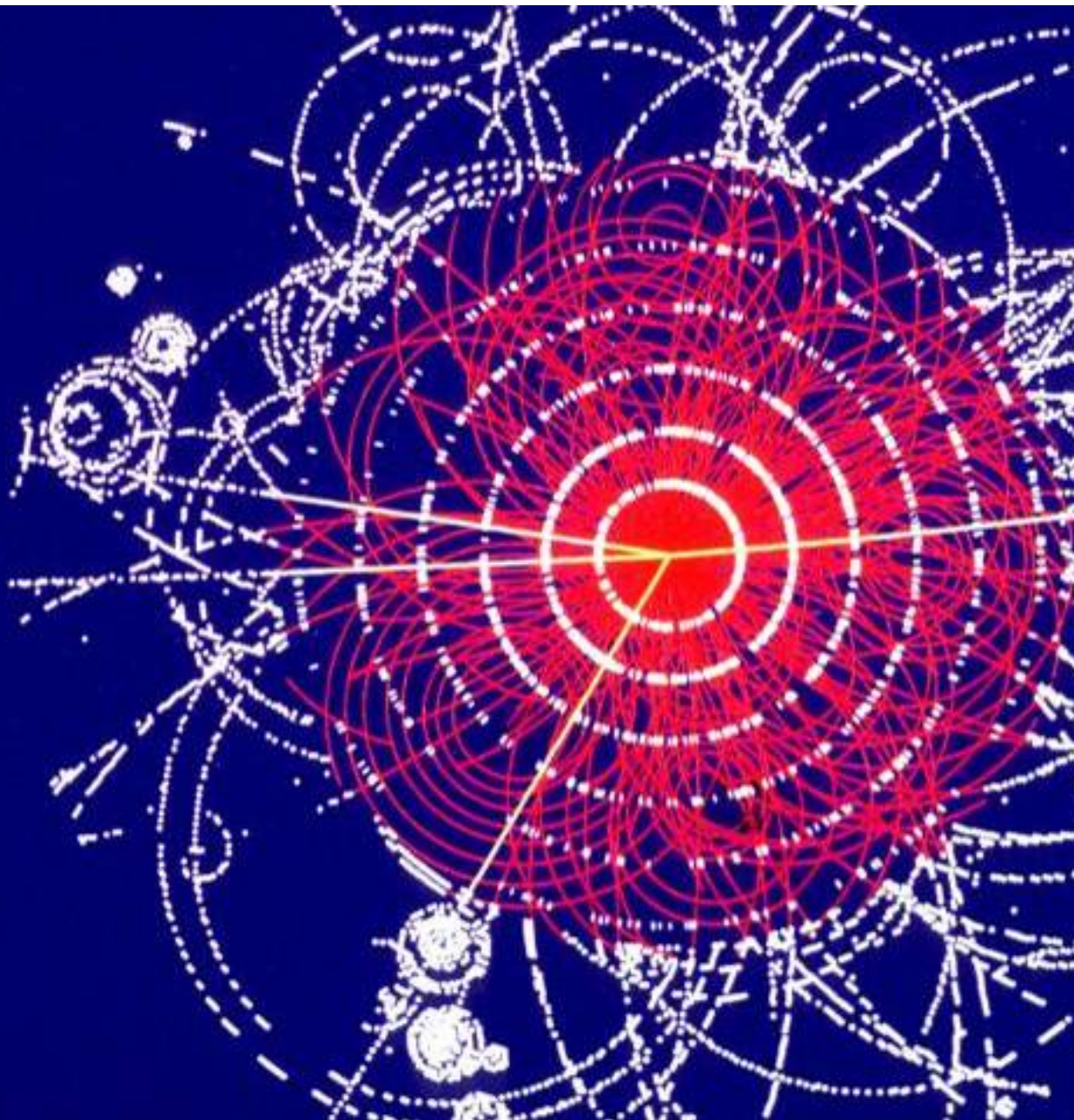


Magnet installation



ATLAS Cavern 15

Data in Large Quantities



Balloon
(30 Km)

CD stack with
1 year LHC data!
(~ 20 Km)

Concorde
(15 Km)

Mt. Blanc
(4.8 Km)



What is the Grid?

- The **World Wide Web** provides seamless access to information that is stored in many millions of different geographical locations
- In contrast, the **Grid** is an emerging infrastructure that provides seamless access to computing power and data storage capacity distributed over the globe.



Technology Transfer

www

CERN^{CH}

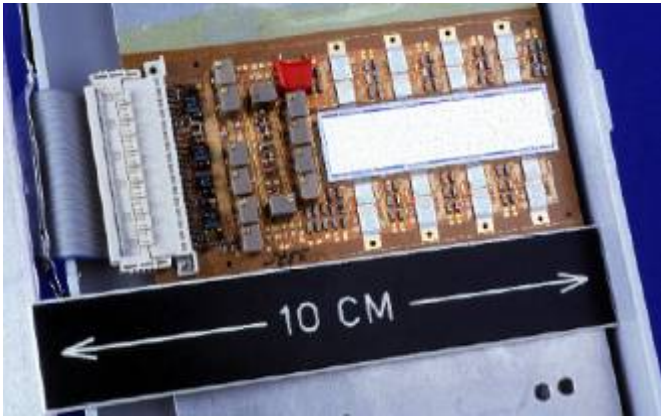
The world's largest physics laboratory,
where the World Wide Web was born...

Particle Accelerator
(underground)

... 5 minutes from here!

Sign in Geneva airport

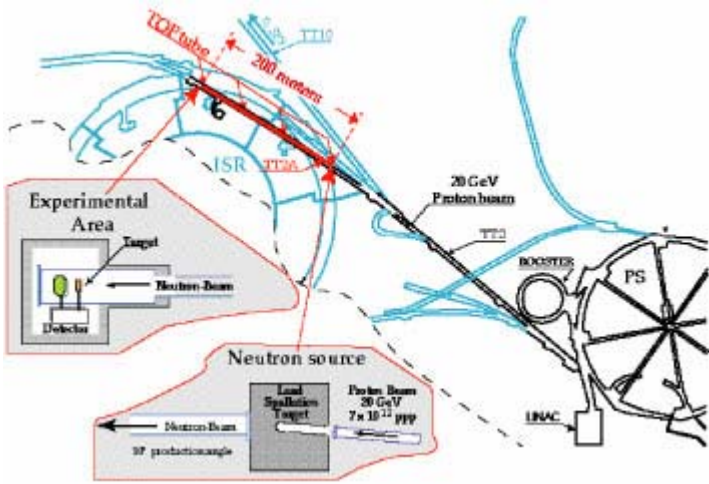
Technology Transfer Projects



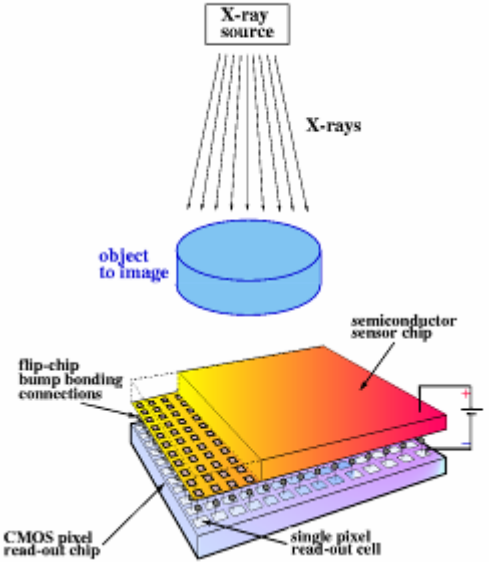
Silicon detector for a Compton camera in nuclear medical imaging



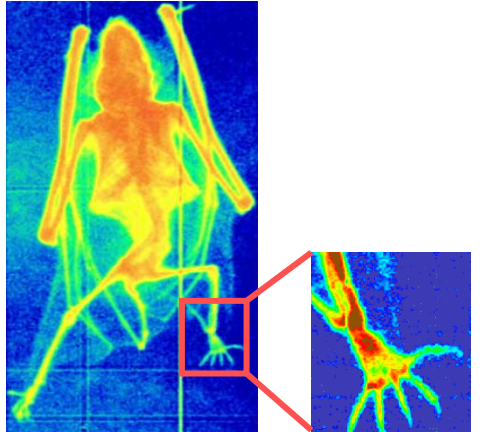
Thin films by sputtering or evaporation



Radio-isotope production for medical applications



Medipix: Medical X-ray diagnosis with contrast enhancement and dose reduction



Radiography of a bat, recorded with a GEM detector

CERN as Educator



Visits

Accelerator School

Doctoral Student

Language Training

Exhibitions

Academic Training

Physics School

Communications Training

Apprentices

CERN-Latin America School

Technical Training

Computing School

Teachers programmes

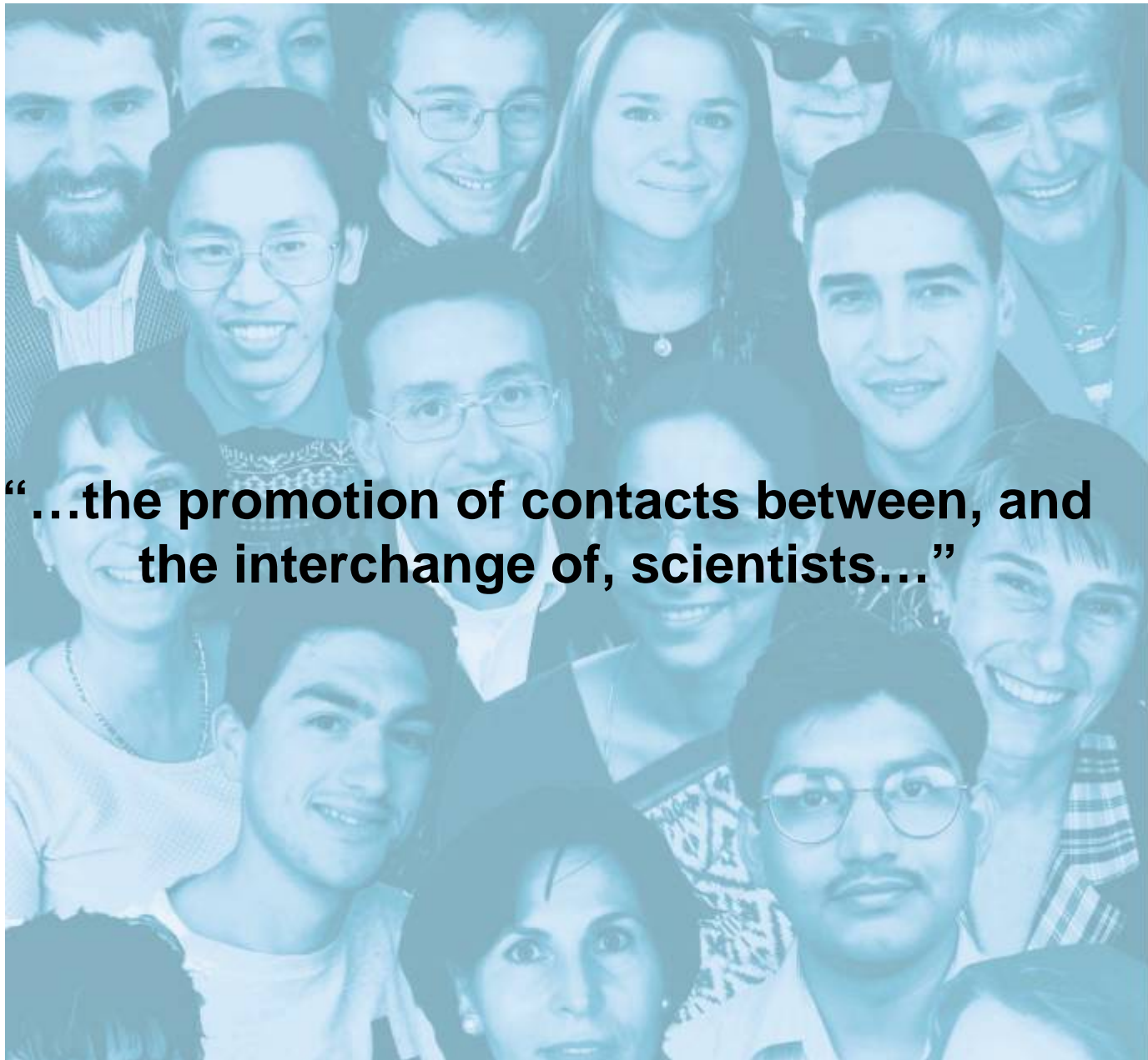
Technical Student

Summer Student

Fellows

Management Training

Bringing Nations Together



“...the promotion of contacts between, and the interchange of, scientists...”

CERN...

An aerial photograph of the CERN facility in Switzerland, showing a vast landscape of agricultural fields and forests. A large, circular particle accelerator track is overlaid on the image, stretching across the terrain. The sky is clear and blue.

- Seeking answers to questions about the Universe
- Advancing the frontiers of technology
- Training the scientists of tomorrow
- Bringing nations together through science