CERN Education Programmes

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CERN
Research Physicist (Antimatter)
Head of Education

What are the goals ?

What makes CERN attractive ?

Communication vs Education

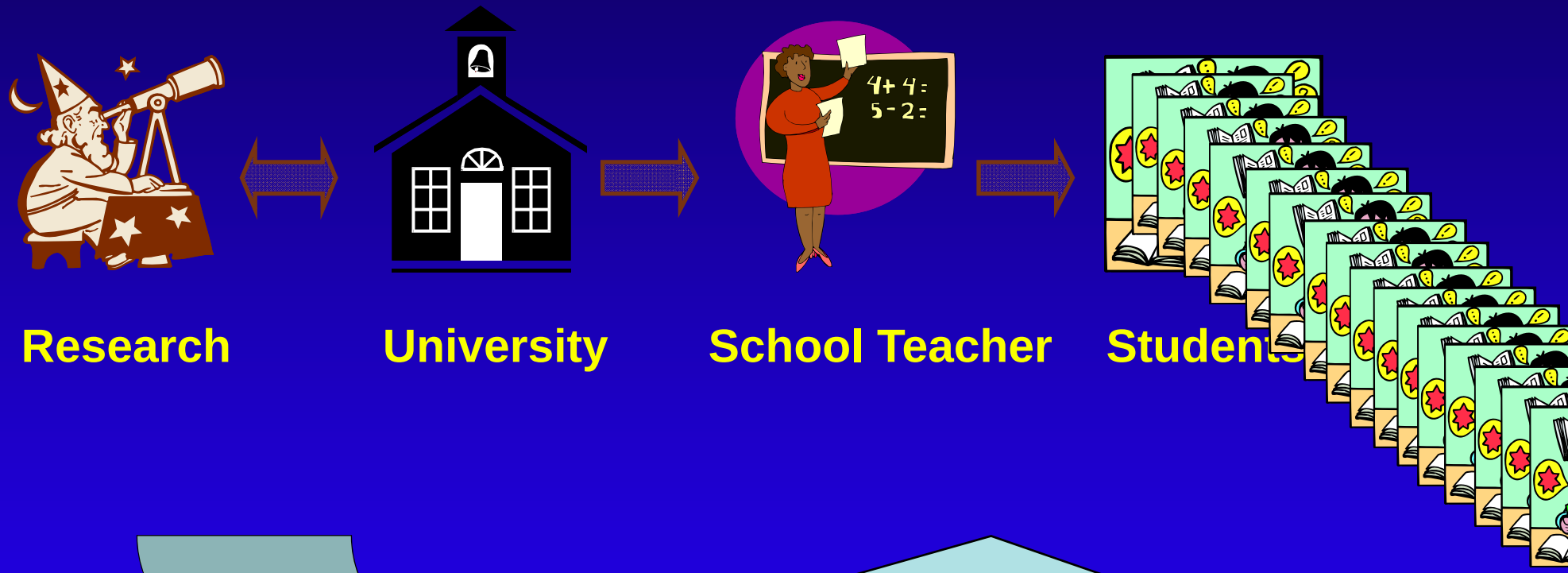
What is our approach?

CERN teacher programmes

EIROForum - CERN activities

1) Goals of CERN Teacher Education

x 1000: Multipliers



Research **University** **School Teacher** **Students**

Bring modern science into schools

Teachers are the crucial link

Big questions ...

understand how the laws of Nature evolved

understand the evolution of matter and of the iverse

... for the whole world

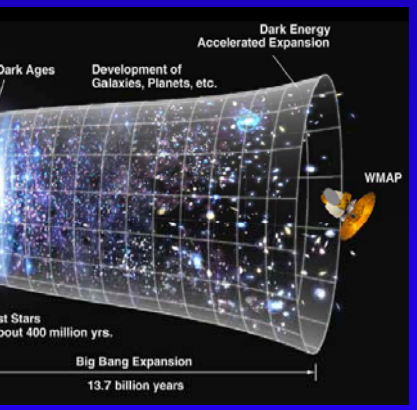
ERN provides infrastructure and tools for physicists world 100 countries) collaborating peacefully

Superlatives

- The largest … coldest …
- The most energetic …
- The closest to Big Bang …

“Wow” Factor

Once in a lifetime experience ….



How science works

Theories: mass/dark matter/no. of dimensions …

are tested experimentally

Real scientists! International atmosphe

ERN has a broad range of communication activities

800 media visits per year (TV, newspapers, radio)

sitor programme (60,000 visit requests - 25,000 accepted - 50 % schools)

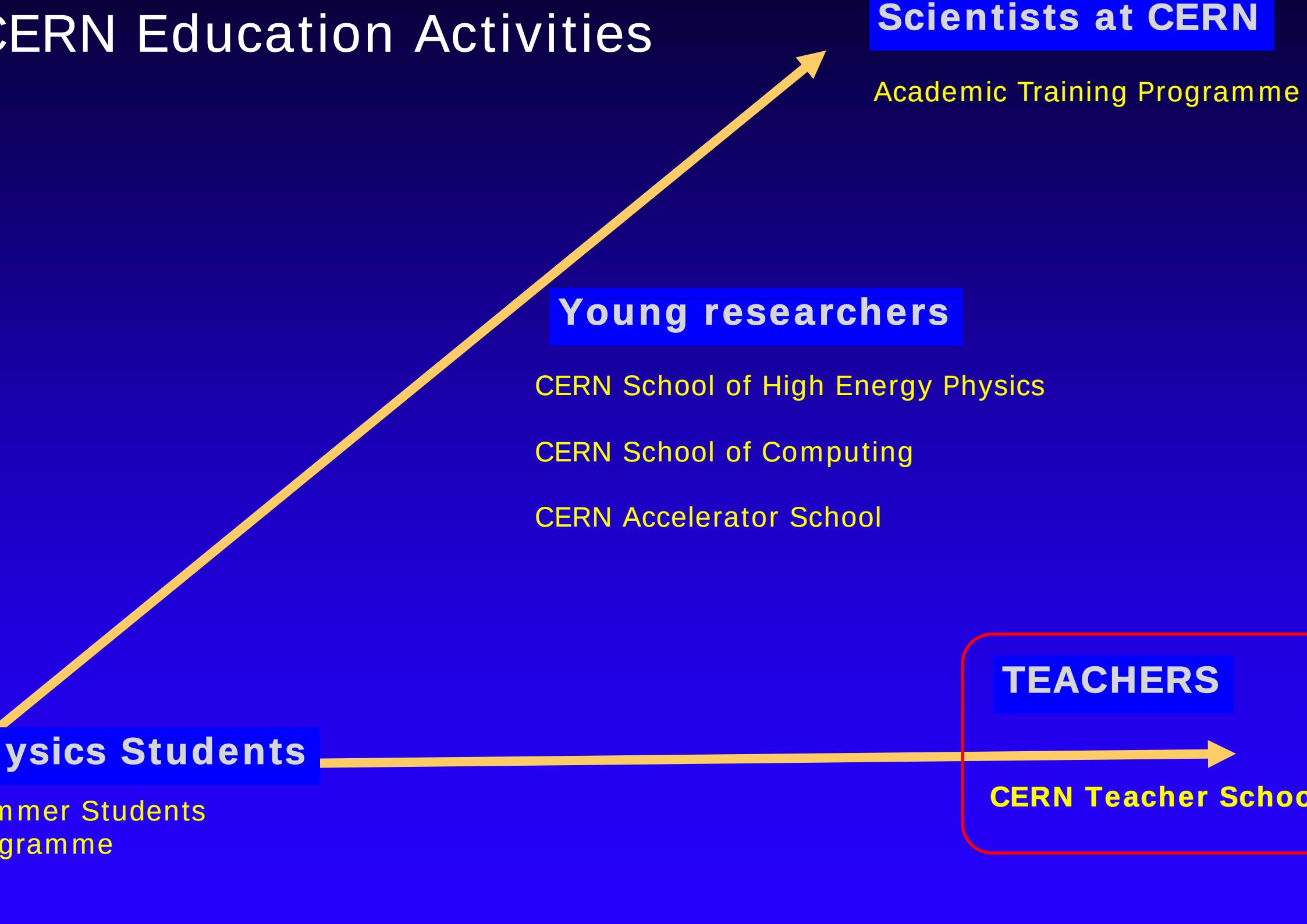
rmanent and temporary exhibitions (Microcosm, soon: ‘Globe’)

pen day (2004: 30,000 visitors; 6 April 2008: > 40,000 visitors)

ort, punctual ‘information’ (snapshots)

… not to be confused with ‘education’

CERN Education Activities



What approach for teachers (and students)

AISE INTEREST OF STUDENTS IN MODERN SCIENCE -

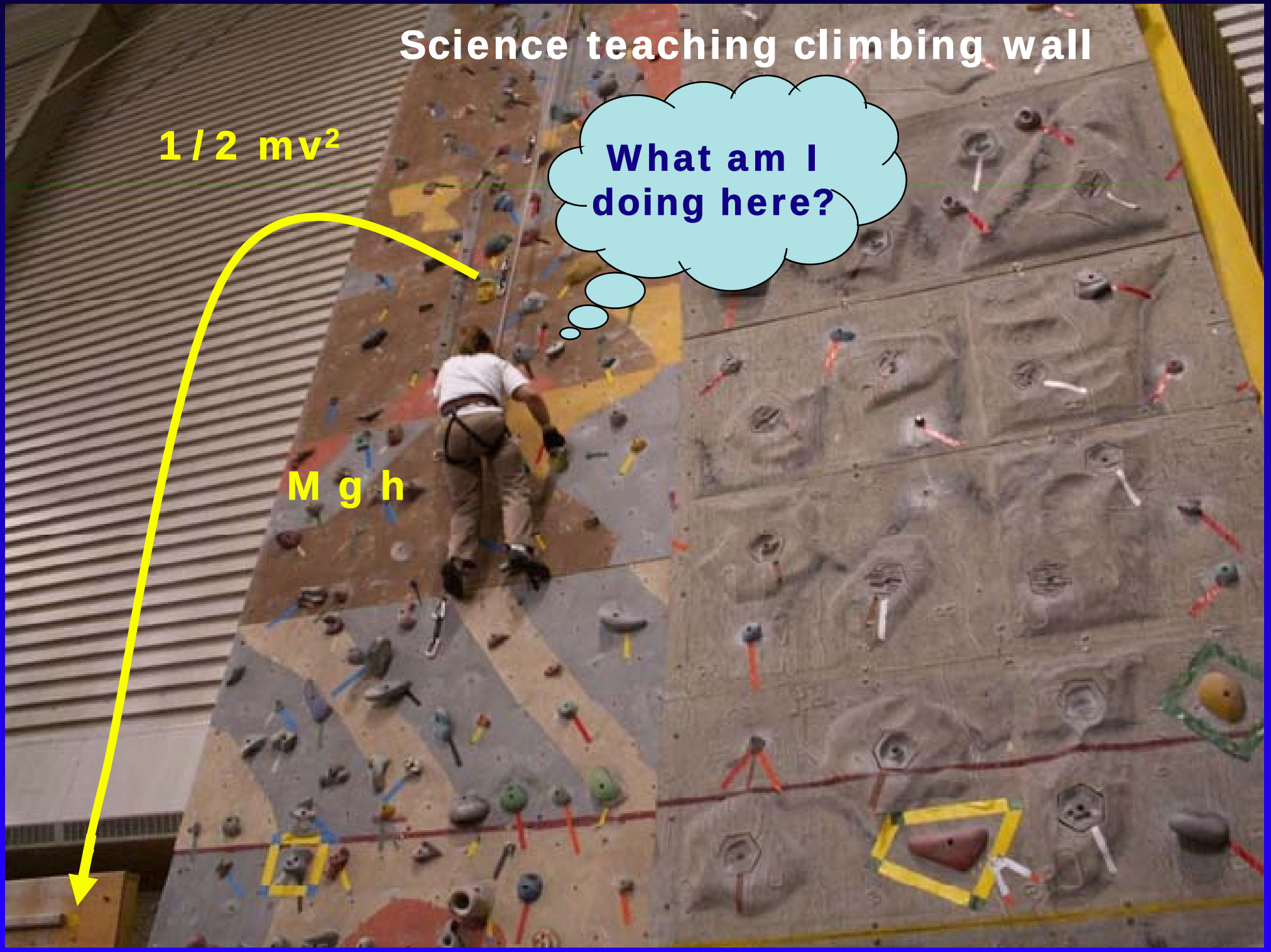
Motivate them to continue scientific education at school
Help them to better understand the physical world
*(**Scientific literacy**) (>95 % of students)*

NSTIL A FEELING OF MYSTERY AND DISCOVERY POTENTIAL

Motivate them to take up physics at universities
*(**Future generation of researchers**) (< 5 % of students)*

PHYSICS IS ... ALIVE !

A metaphore ...


Science teaching climbing wall
1/2 mv²
What am I doing here?
M g h

Big Bang

Dark Energy

Black Holes

Dark Matter

Antimatter

Dark Universe

180,000 copies per month

modern physics to inspire and motivate school teachers (and their studen
ontact with frontier science (self-confidence, develop/exchange ideas)
*ncrease attractiveness of science lessons (**13-15 yrs**)*

nternational “High School Teacher” school (3 weeks)

Fully funded by CERN for MS participants (programme, travel, accommodation)
Participants from US, Asia, South America (HELEN) funded externally
In English

National schools (1 week)

In their mother tongue (speakers from the national science community)
External funding of travel, accommodation
Build networks between teachers and with scientists inside country

nternational weekend schools (3 days)

Partially funded by CERN for MS participants (programme, accommodation)
In English

ures:

cle Physics

ology

erators (LHC)

ctors

cations (IT, Medicine)

Guided tours:

LHC experiments

Antimatter factory (AD)

PS/LEIR

CLIC

Computing Centre - GRID

Activities:

Interactive teacher lab

Educational Resources

Games, Quiz

Lesson reviews (Q+A)

Participants from	Number	Date
Europe, World (HST,3 wk)	43	2 - 21/ 7 / 2007
Europe (PhT, 3 d)	50	March 2007
UK (Science Learning Centres, 3d)	48	10 - 13 / 4 / 2007
Poland (2 schools)	83	April, May 2007
Slovak Republic	44	22 - 28 / 4 / 2007
Finland (4 schools)	62	April, June 2007
Germany (3 schools)	120	June, Sep, Oct 2007
Spain (Catalonia)	40	22 - 28 / 7 / 2007
Hungary	40	19 - 25 / 8 / 2007
Portugal	40	9 - 15 / 9 / 2007
Denmark	30	21 - 26 / 10 / 2007
UK (Science Learning Centres, 3d)	26	23 - 26 / 10 / 2007
Norway	40	12 - 16 / 11 / 2007
Poland	40	26 - 30 / 11 /2007

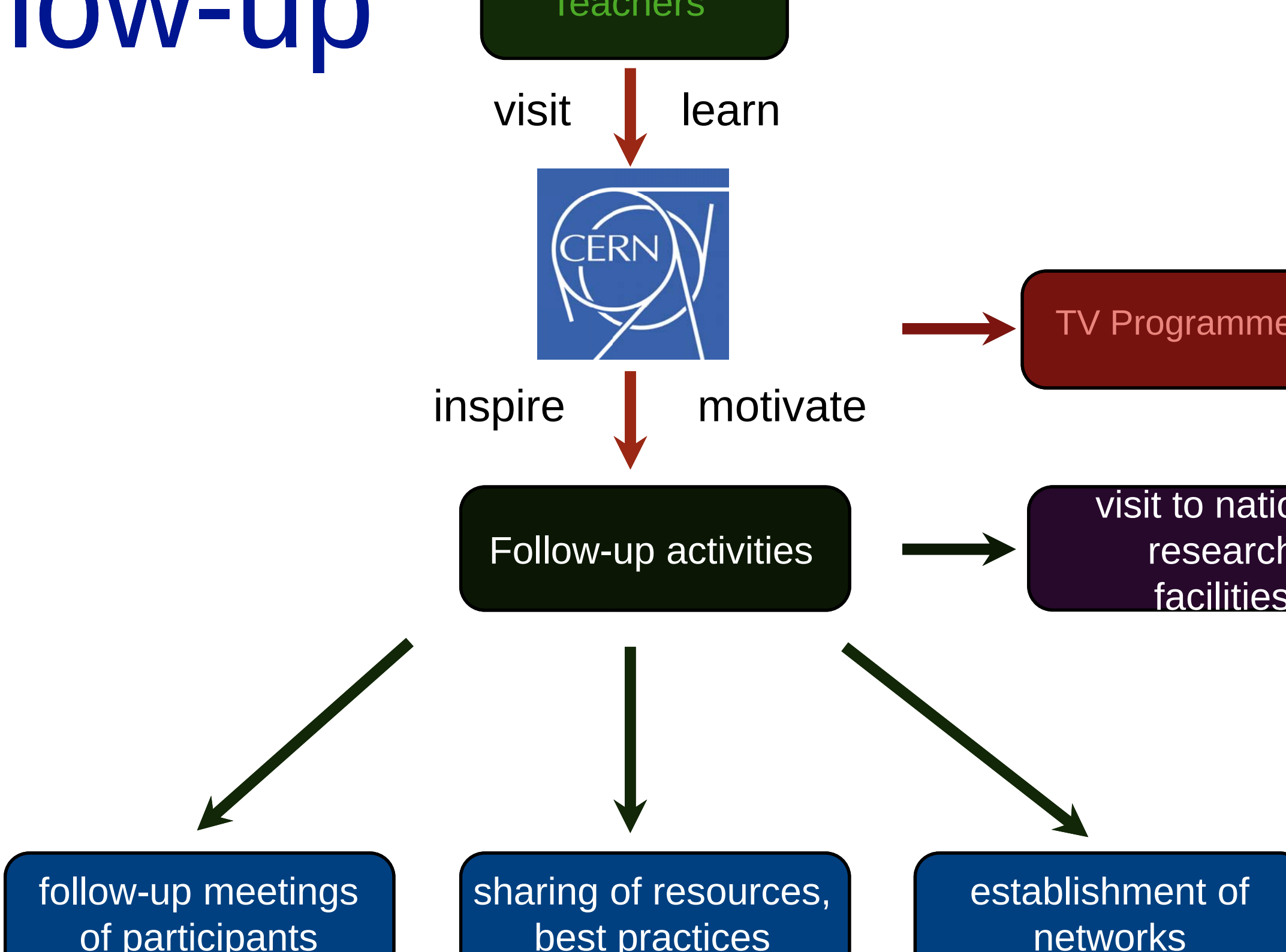
706 teachers

eview 2008: ~25 CERN Teacher Schools, ~1000 participants

Partners


Physicists,
engineers,
ducation Group
organize
teach
Teacher
community
support
finance
Local authorities
Physics Institute

ollow-up

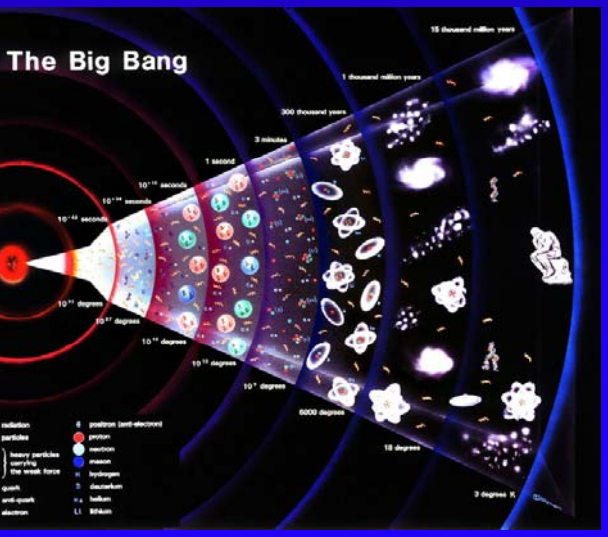

Teachers
visit
learn
CERN
TV Programme
inspire
motivate
Follow-up activities
visit to natio
research
facilities
follow-up meetings
of participants
sharing of resources,
best practices
establishment of
networks

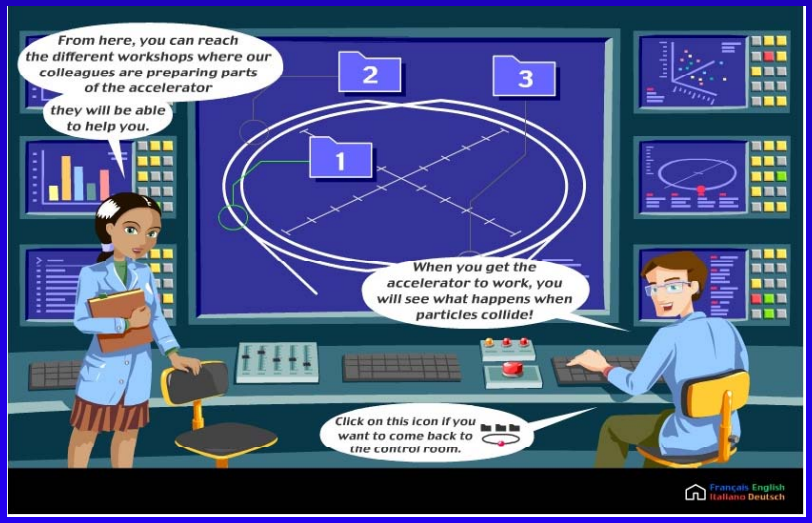
ll teacher courses and materials are recorded and archived

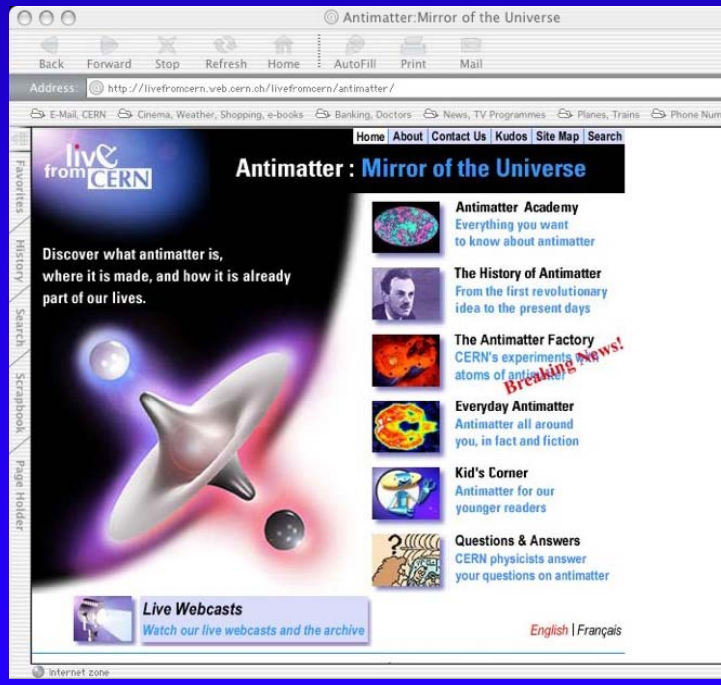
pecial school materials, video clips, animations, games are produced

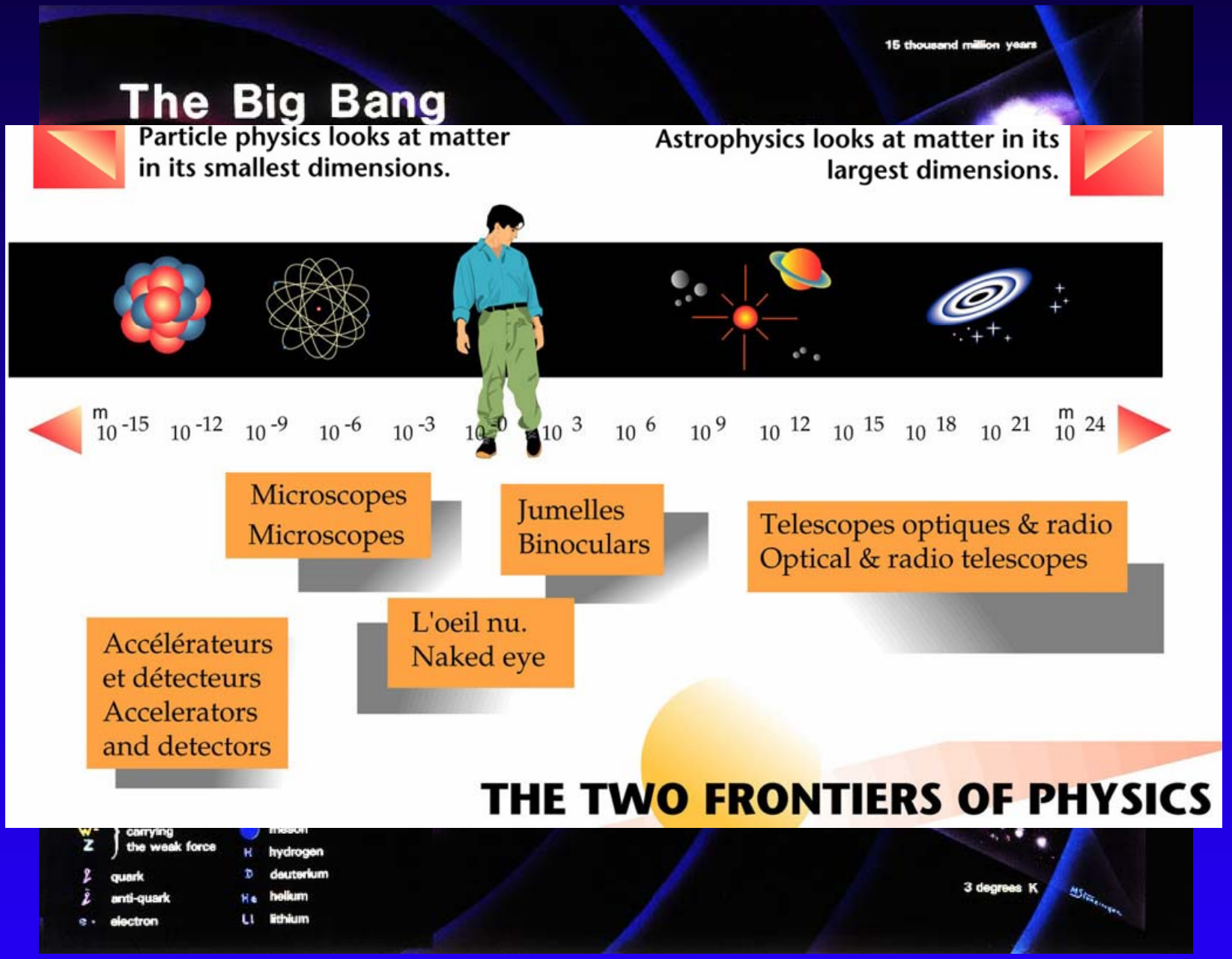
ideo-Conferences between school classes and CERN scientists

ERN education website: education.web.cern.ch/education

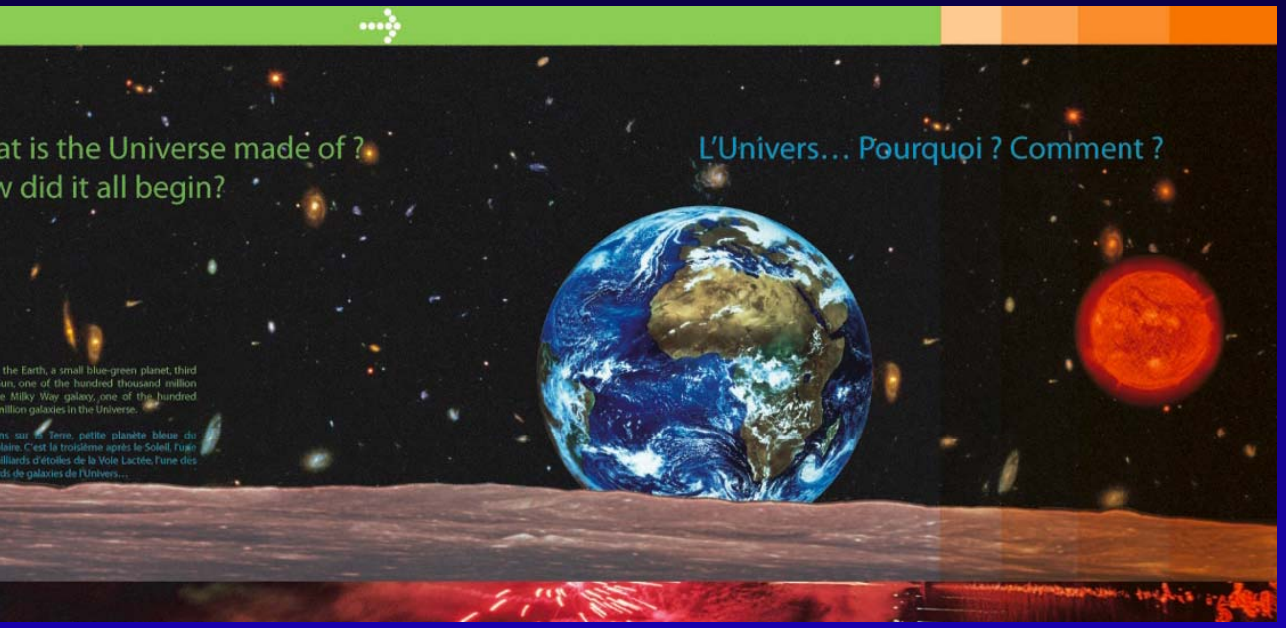






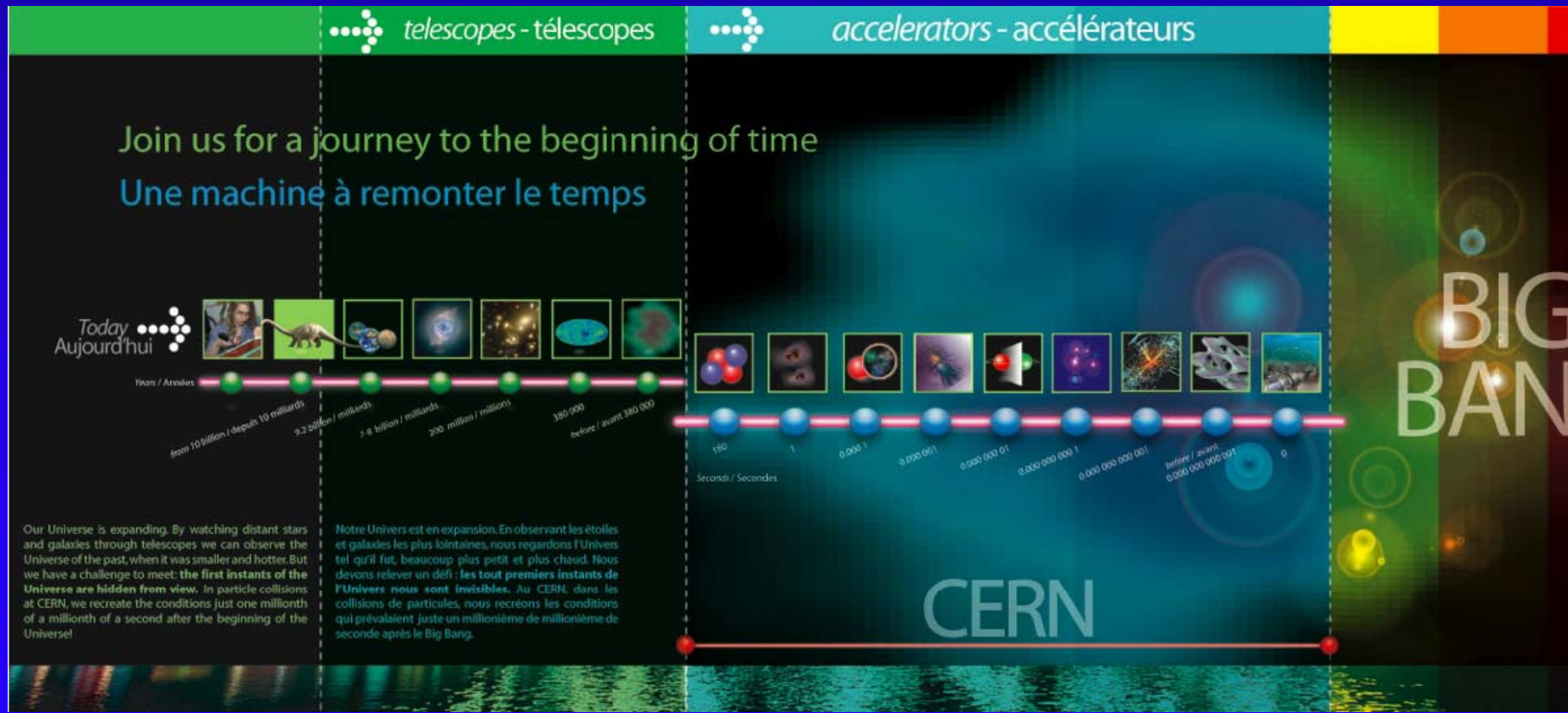


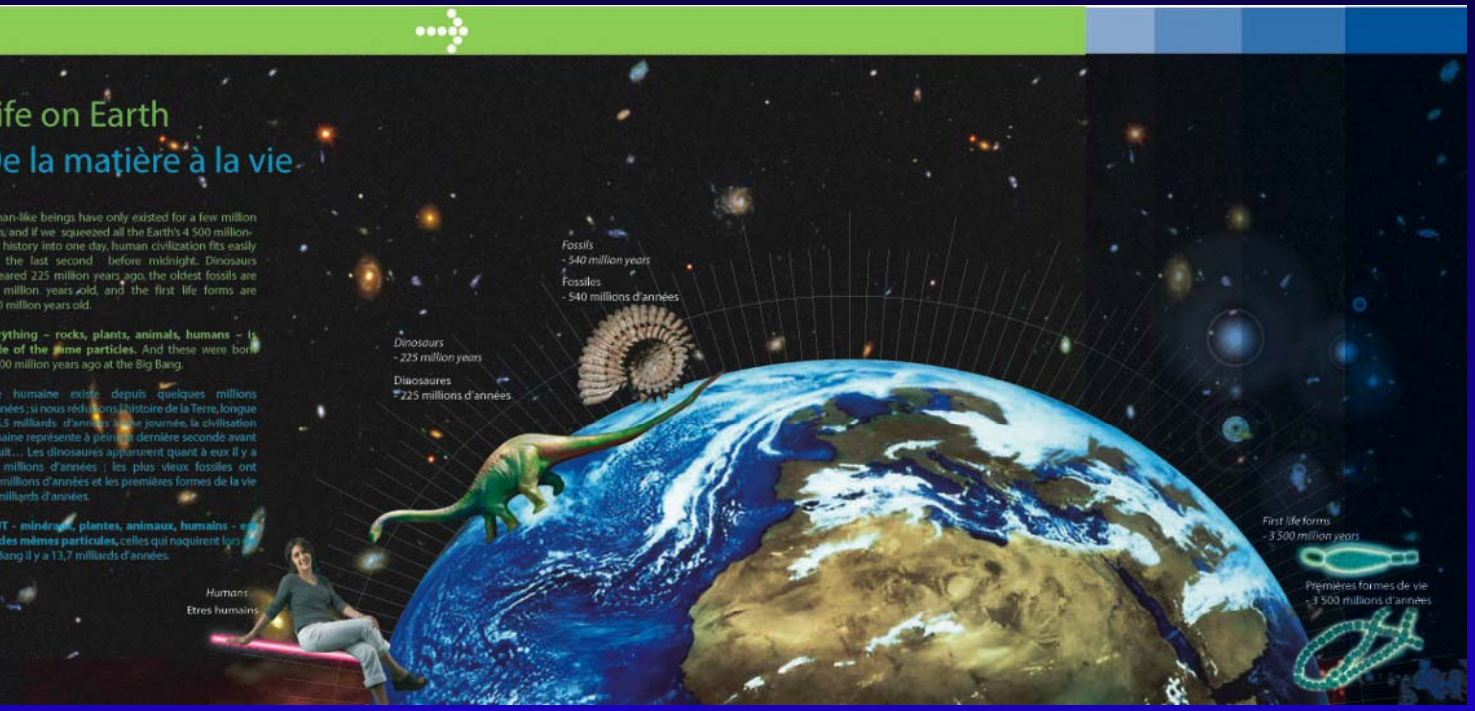
press.web.cern.ch/press/PhotoDatabase/welcome.html



17 posters

Key concepts of
the evolution of matter




ife on Earth
e la matière à la vie
an-like beings have only existed for a few million
, and if we squeezed all the Earth's 4 500 million-
history into one day, human civilization fits easily
the last second before midnight. Dinosaurs
eared 225 million years ago, the oldest fossils are
million years old, and the first life forms are
million years old.
ything – rocks, plants, animals, humans – is
e of the same particles. And these were born
00 million years ago at the Big Bang.
humaine existe depuis quelques millions
nées ; si nous réduisons l'histoire de la Terre, longue
,5 milliards d'années à une journée, la civilisation
aine représente à peine la dernière seconde avant
uit… Les dinosaures apparurent quant à eux il y a
millions d'années ; les plus vieux fossiles ont
millions d'années et les premières formes de la vie
milliards d'années.
T - minéraux, plantes, animaux, humains - sont
des mêmes particules, celles qui naquirent lors
Bang il y a 13,7 milliards d'années.
Humans
Etres humains
Fossils
- 540 million years
Fossiles
- 540 millions d'années
Dinosaurs
- 225 million years
Dinosaures
- 225 millions d'années
First life forms
- 3 500 million years
Premières formes de vie
- 3 500 millions d'années


A star is born Une étoile est née
Our journey back in time continues… The formation of the Earth and the solar system happened about 4500 million years ago. The Solar System formed from a cloud of interstellar dust made of hydrogen and helium with just 1 % of heavier elements.
Remontons encore le fil du temps… Il y a environ 4,5 milliards d'années apparurent la Terre et le système solaire - fruits d'un nuage de poussière interstellaire, constituée d'hydrogène, d'hélium, et de 1% seulement d'éléments lourds.
TODAY
BIG BANG

Seeing in the dark
L'âge obscur

Looking out into space telescopes can take us back to 380,000 years but not before. Earlier than this, matter existed mostly in the form of protons, helium nuclei, and electrons. It was too hot for atoms to be stable. Light was continually absorbed and re-emitted by the jostling particles: **the Universe was opaque.** To go further back in time, scientists recreate the conditions that existed at the time using particle accelerators in laboratories like CERN.

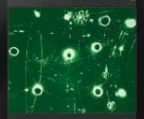
Les **télescopes nous permettent d'observer l'Univers jusqu'à 380 000 ans**, mais pas au-delà. Auparavant, la matière existait sous forme de protons, de noyaux d'hélium et d'électrons. Il faisait trop chaud pour que les atomes soient stables. La lumière était constamment absorbée et ré-émise par les particules agitées : **l'Univers était opaque.**
Pour remonter toujours plus loin dans le temps, les scientifiques recréent les conditions d'alors dans des laboratoires comme le CERN et ce, grâce aux accélérateurs.

BIG BANG

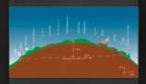
Les neutrinos, témoins fantômes de la naissance
Neutrinos – ghostly messengers from the early Universe

We are now one second from the Big Bang: particles called neutrinos are being produced in the radioactive decay of particles.
Right now, there are about 300 neutrinos from the Big Bang in every cubic centimetre of your body!
Neutrinos are similar to electrons, but without electric charge and very little mass. They could travel for years through matter without being stopped.

Nous sommes maintenant à une seconde du Big Bang : à ce moment-là, les neutrinos sont produits par la désintégration des particules.
Alors même que vous lisez ces mots, ces neutrinos sont toujours là, y compris dans votre corps, à raison de 300 par cm³ !
Les neutrinos sont semblables aux électrons, mais sans charge électrique, et leur masse est très faible. Ils pourraient ainsi voyager des années durant sans être arrêtés par la matière.



These particle tracks, photographed in the Gargamelle experiment at CERN in 1973, are important evidence in the quest to understand nature's particles and forces.
CERN 1973, expérience Gargamelle : cette photographie de traces de particules fut décisive pour leur compréhension et celle des forces de l'Univers.



CERN is sending a neutrino beam through 732 km of solid rock to the Gran Sasso laboratory in Italy, to better understand the properties of these mysterious particles.
Pour mieux comprendre le comportement de ces particules mystérieuses, le CERN envoie un faisceau de neutrinos à travers la terre sur 732 km, vers le Laboratoire du Gran Sasso en Italie.

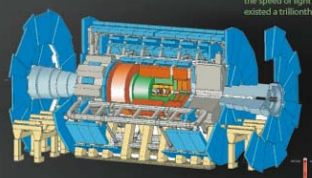
Pushing back the frontiers

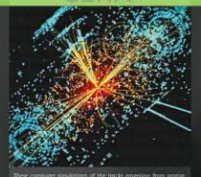
At one trillionth of a second, we reach the current frontier of knowledge. There are many things we don't know. **Gravity acts on mass, but so far science is unable to explain why elementary particles have the masses they have. Visible matter seems to account for just 4% of what must exist. What is the mysterious dark matter of the Universe?**

These are the kinds of questions that scientists will address with CERN's next research facility, the Large Hadron Collider (LHC). By colliding protons at almost the speed of light the LHC will recreate conditions that existed a trillionth of a second after the Big Bang.

The ATLAS detector measures 46 m long and 25 m high, with a mass of 7000 tons. It is being built by 1800 physicists and engineers from 150 institutions in 34 countries (as of end 2003).

Le détecteur d'ATLAS mesure 46 m de long et 25 m de haut, et pèse 7000 tonnes. Il a été conçu par 1800 physiciens et ingénieurs, de 34 institutions et 150 pays différents (état fin 2003).



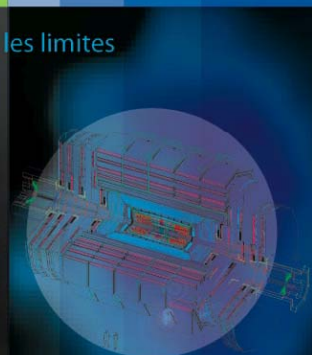


These computer simulations of the tracks emerging from proton collisions in the LHC contain tell-tale signs of a particle called Higgs, which may hold the key to understanding the origin of mass.
Ces simulations informatiques d'une collision entre protons montre la trace de la particule de Higgs : solution à l'énigme de l'origine de la masse ?

Repousser les limites

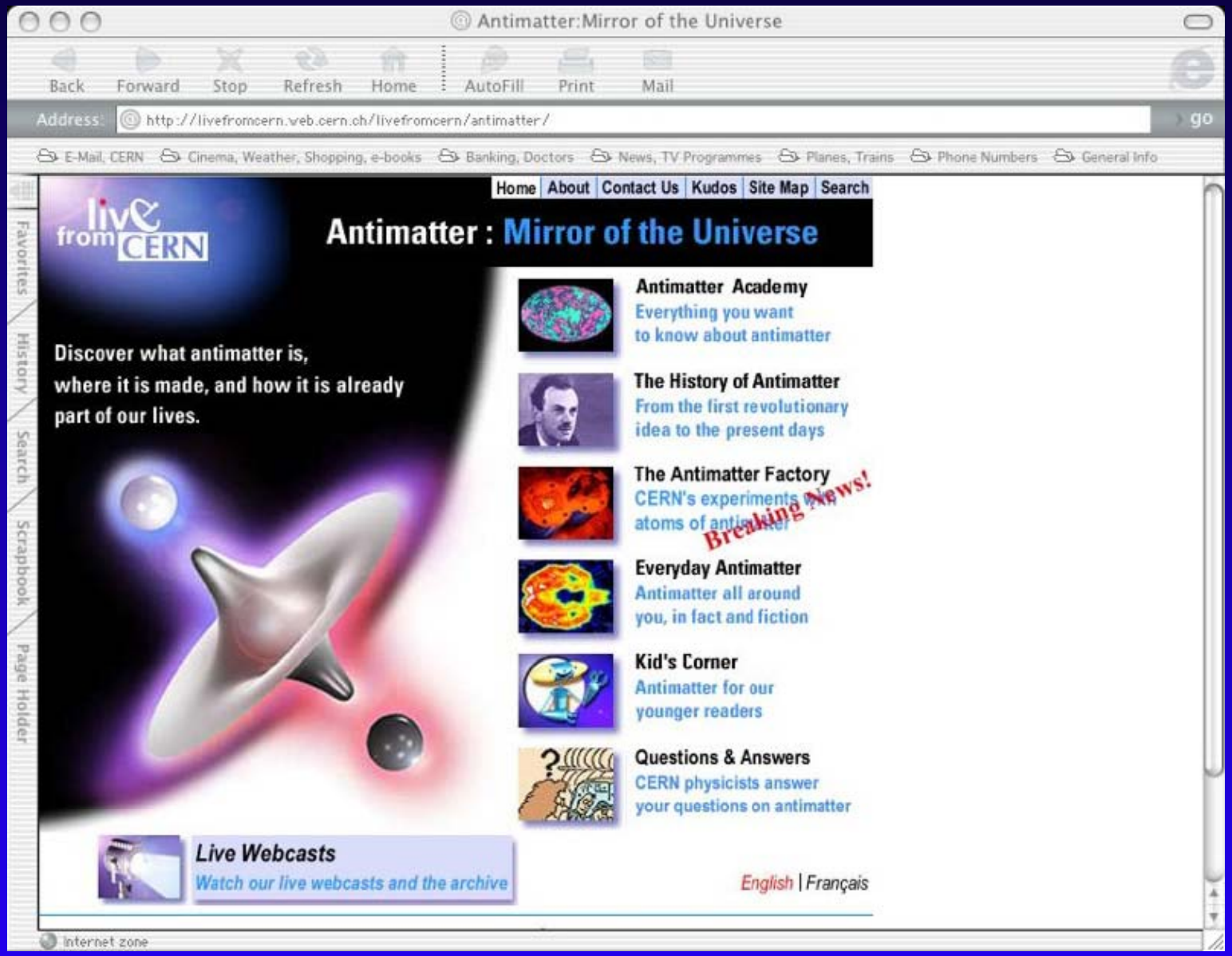
A un millième de milliardième de seconde, nous atteignons les limites du savoir actuel. Il y a encore bien des choses que nous ne connaissons pas. **La gravité agit sur la masse, mais on ne sait pas pourquoi les particules ont une masse. La matière visible ne représenterait que 4 % de la matière réelle... Qu'est-ce que la mystérieuse matière noire de l'Univers?**

Autant de questions que les scientifiques pourront peut-être résoudre avec la nouvelle machine du CERN, le LHC (Large Hadron Collider). En produisant des collisions de protons à des vitesses proches de celle de la lumière, le LHC va recréer les conditions existant un millième de milliardième de seconde après le Big Bang.

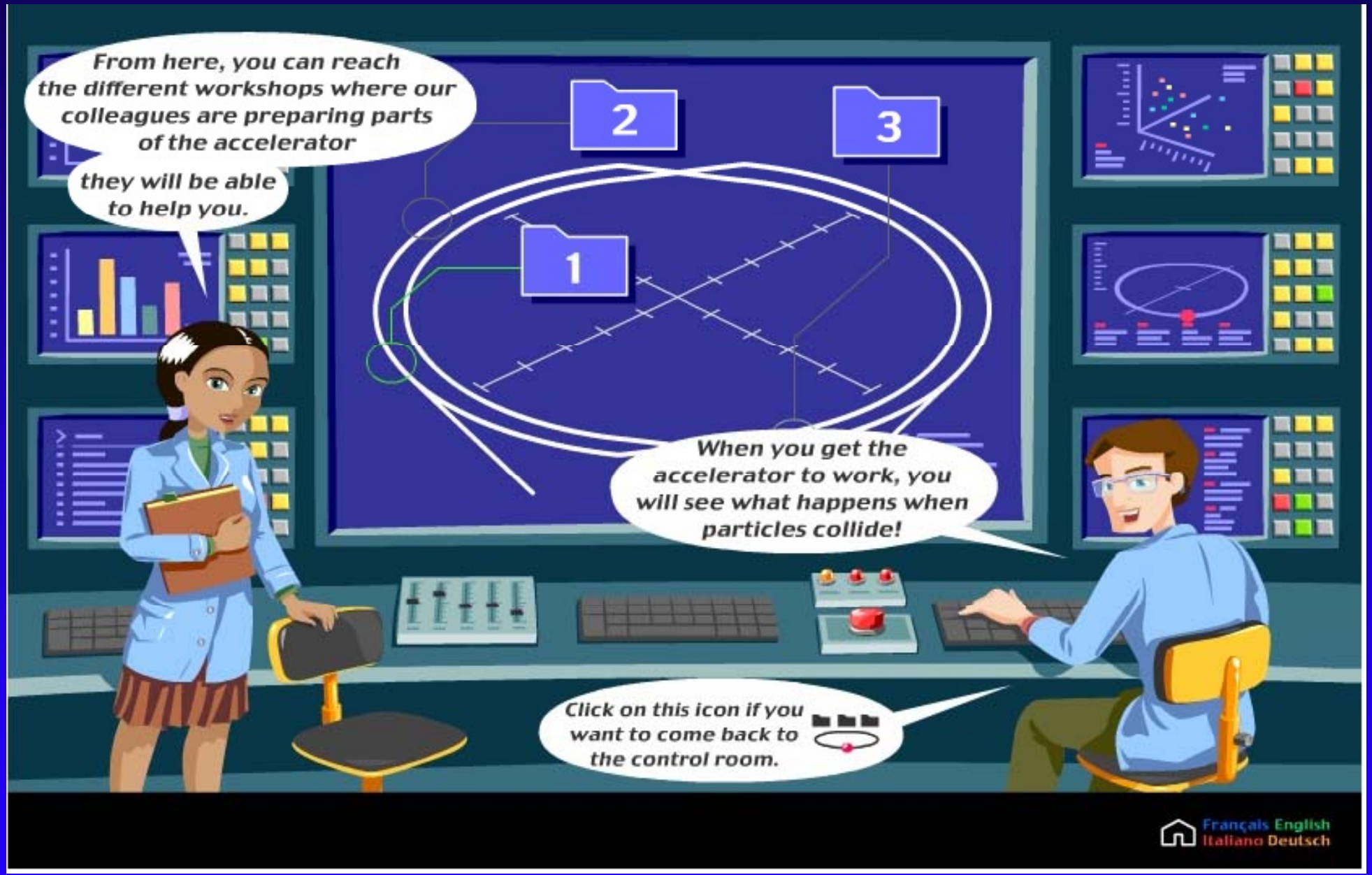


The CMS detector measures 21.5 m long and 15 m high, with a mass of 12,500 tons. It is built by 2000 physicists and engineers from 160 institutions in 36 nations (as of end 2003).

2000 physiciens et ingénieurs, de 160 institutions et 36 pays, ont élaboré le détecteur de CMS qui mesure 21,5 m de long et 15 m de haut, et pèse 12500 tonnes. (état fin 2003).



livefromcern.web.cern.ch/livefromcern/antimatter/



microcosm.web.cern.ch/microcosm/LHCGame/LHCGame.html

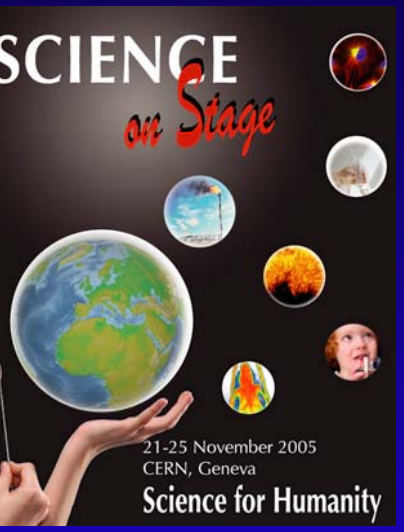
7) CERN - EIROForum* Education Programmes

Science On Stage

Science In School journal

*EIROForum = CERN + EFDA + EMBL + ESA + ESO + ESRF + ILL

Science On Stage



Increase attractiveness of science lessons!

Exchange of successful, innovative teaching methods

Multi-disciplinary SCIENCE TEACHING FAIR, workshops

29 countries organize **national** events (~ 2000 participants)

450 teachers meet at **international festival (awards)**

2005 CERN (Geneva)

2007 ESRF/ILL (Grenoble)

2008 Science on Stage Germany (Berlin)

(Physics on Stage: 2000 CERN, 2002 ESA, 2003 ESA)

nce March 2006 - now at Issue 9

ssues/year, 88 pages; English (print); articles in 25 languages (websi

Summary

CERN teacher schools ...

- ncrease motivation of teachers (hence students)
- use CERN as exciting example, “big questions” inspire
- shows how science works
- No emphasis on mathematical/deductive approach
- Easy availability of suitable material on web

Education is a priority for CERN