

CERN Education Programmes

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CERN
Research Physicist (Antimatter)
Head of Education

Overview

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What are the goals ?

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What makes CERN attractive ?

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Communication vs Education

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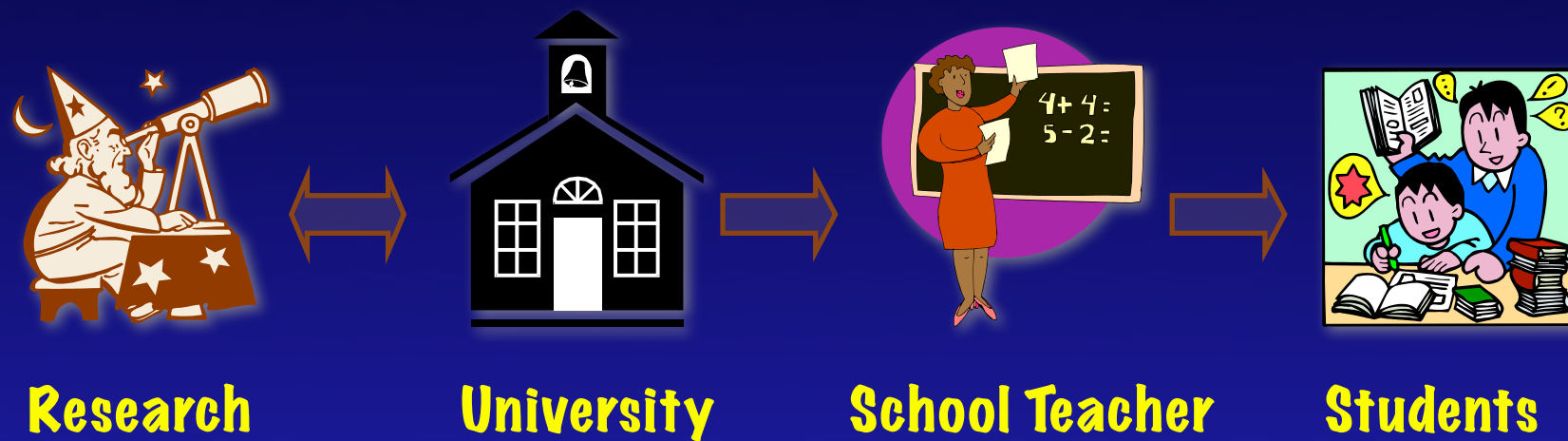
What is our approach?

CERN teacher programmes

Polish teachers at CERN

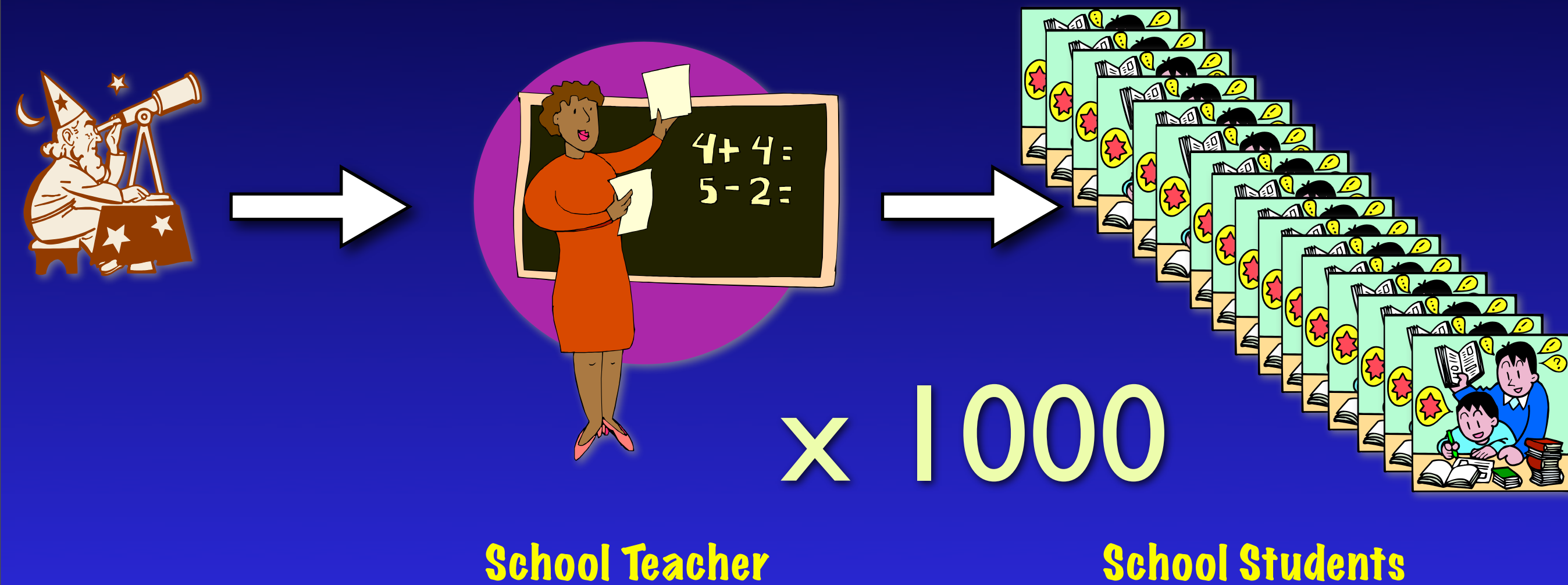
EIROForum - CERN activities

1) Goals of CERN Teacher Education



Bring modern science into schools
Teachers are the crucial link

Teachers are multipliers

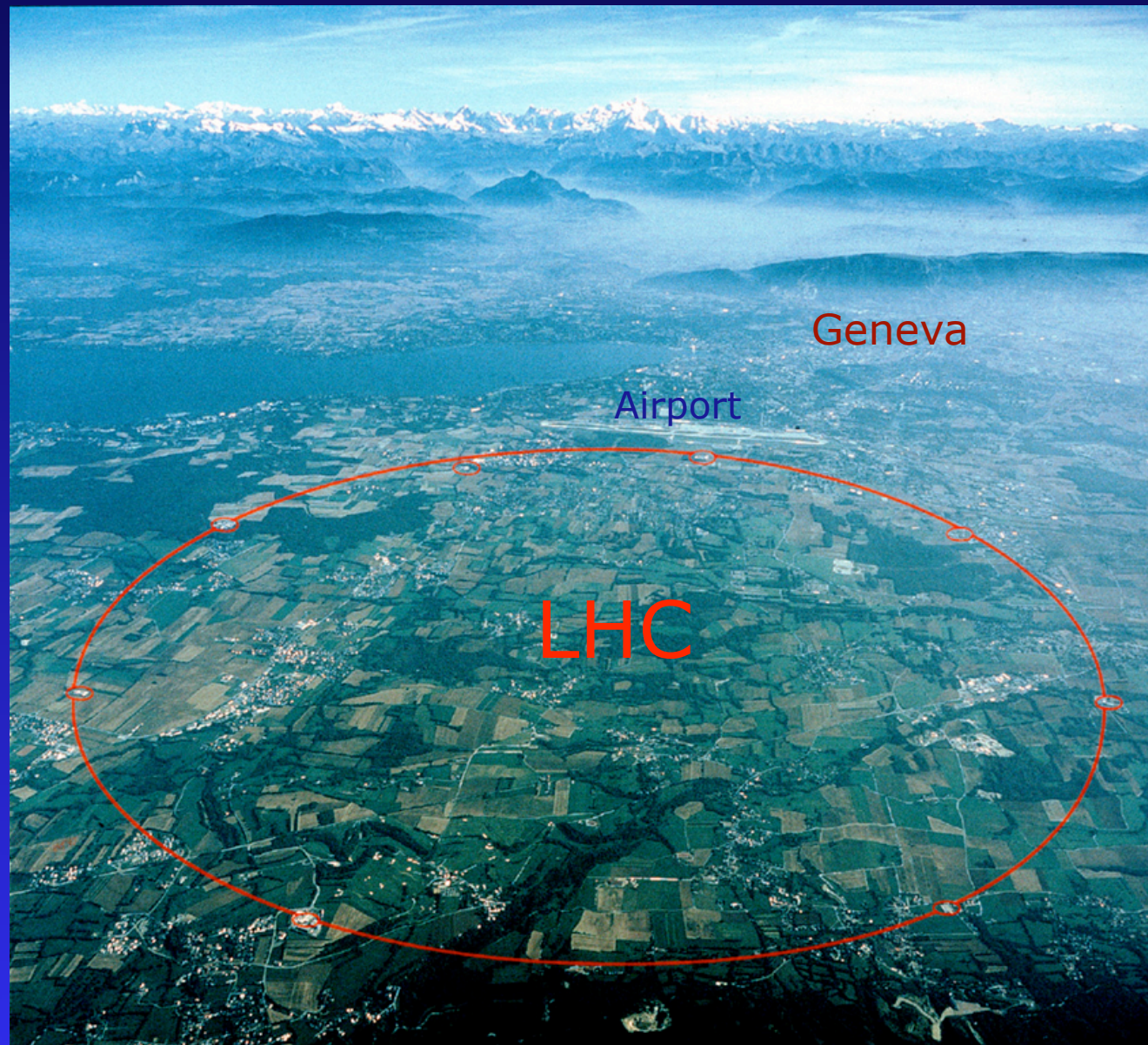


2) What makes CERN attractive ?

Largest science laboratory in the world

The largest particle accelerator in history - the LHC

The LHC will produce particles that existed only shortly after the Big Bang



Big questions ...

To understand how the laws of Nature evolved

To understand the evolution of matter and of the Universe

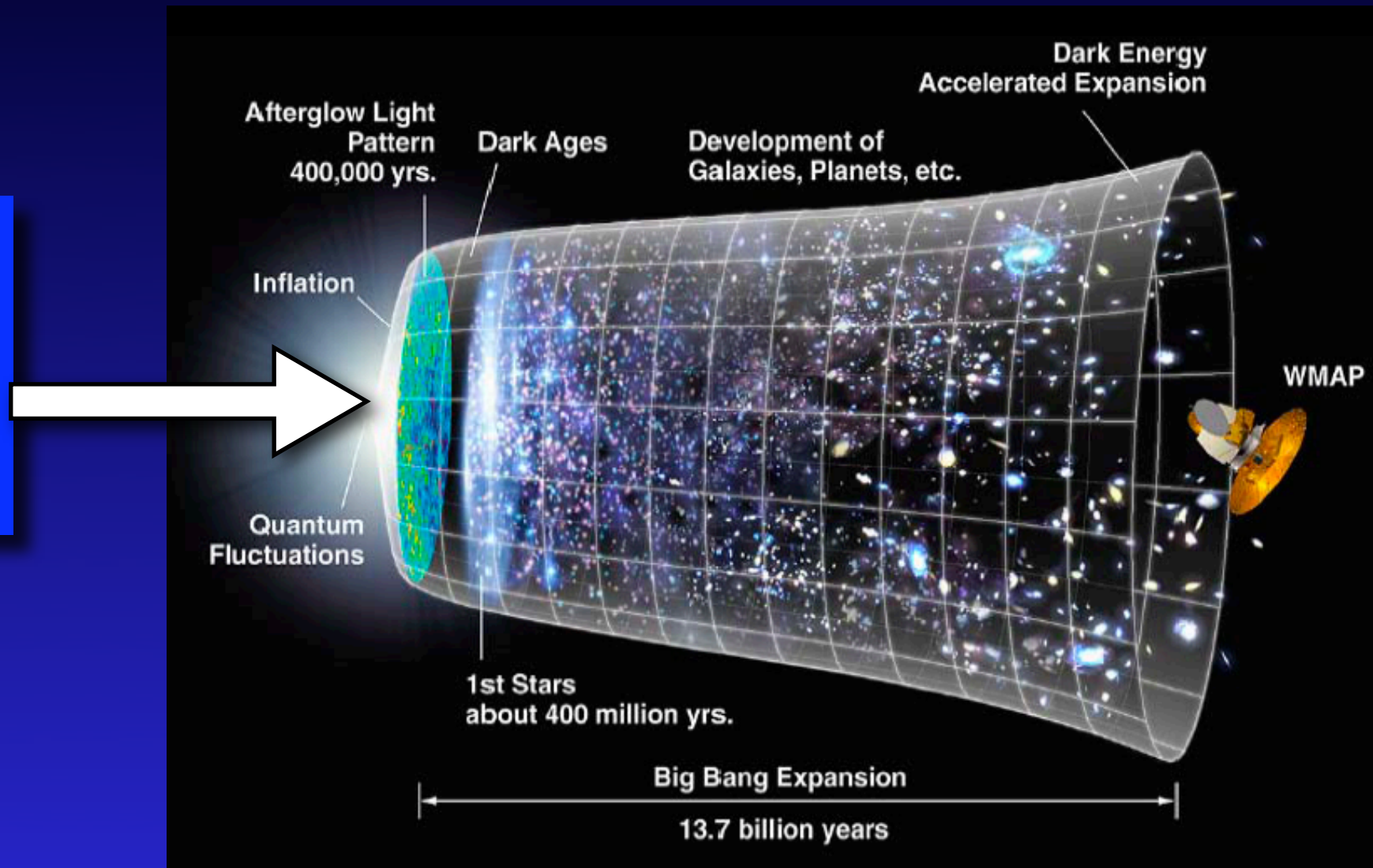
... for the whole world

CERN provides infrastructure and tools for physicists world-wide (> 100 countries) collaborating peacefully

How science works

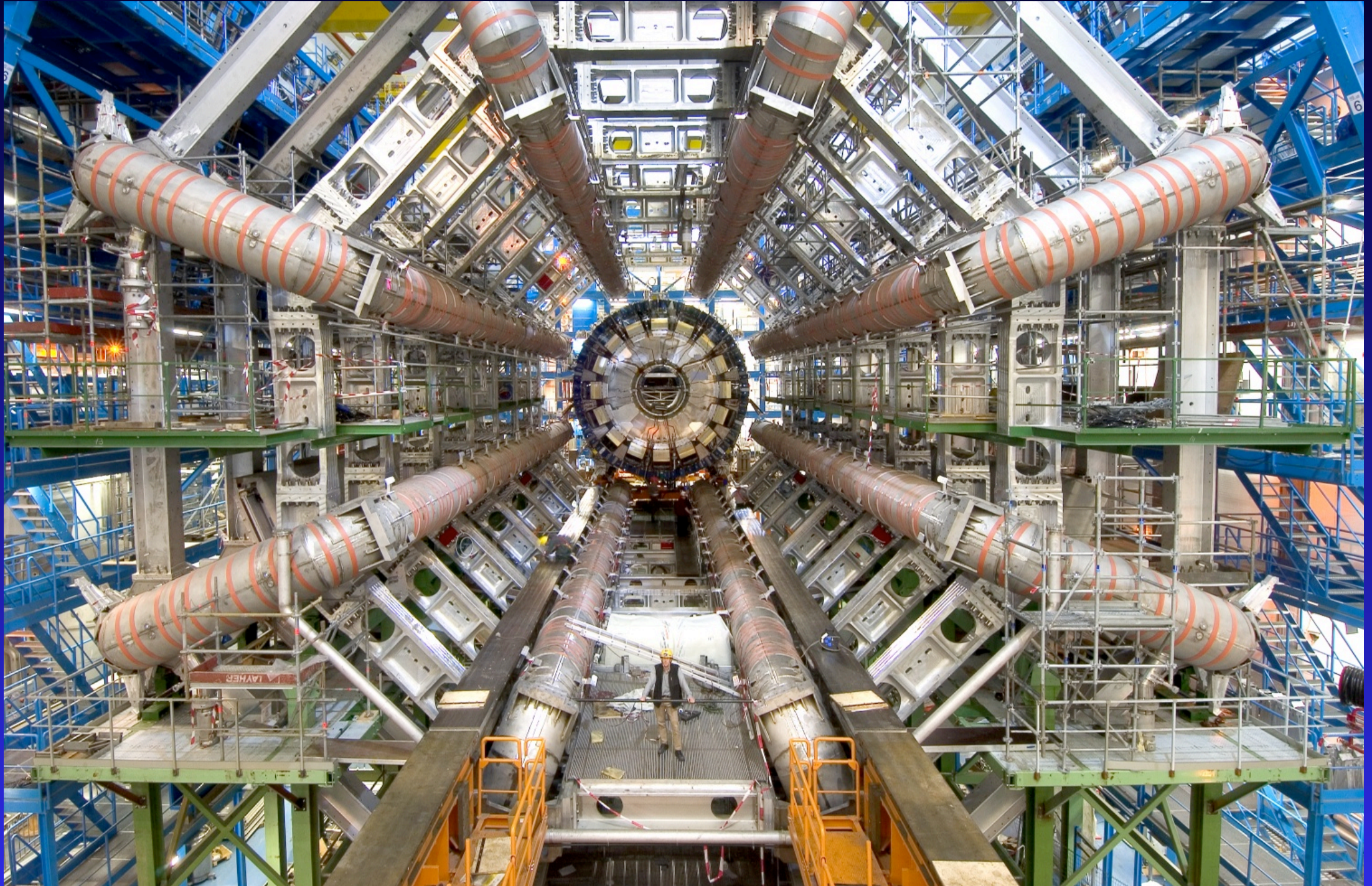
Theories

- origin of mass
- Dark matter
- extra-dimensions



...are tested experimentally by
reproducing conditions
 $\sim 10^{-12}$ sec after the Big Bang

CERN dimensions are huge



3) Communication vs Education

CERN has a broad range of communication activities

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

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

Permanent and temporary exhibitions (Microcosm, soon: 'Globe')

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

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short, punctual 'information' (snapshots)

... not to be confused with 'education'

CERN Education Activities

Scientists at CERN

Academic Training Programme

Young researchers

CERN School of High Energy Physics

CERN School of Computing

CERN Accelerator School

Physics Students

Summer Students
Programme

TEACHERS

CERN Teacher Schools

4) What approach for teachers (and students) ?

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RAISE 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)

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

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PHYSICS IS ... ALIVE !

A metaphore ...

How researchers view science

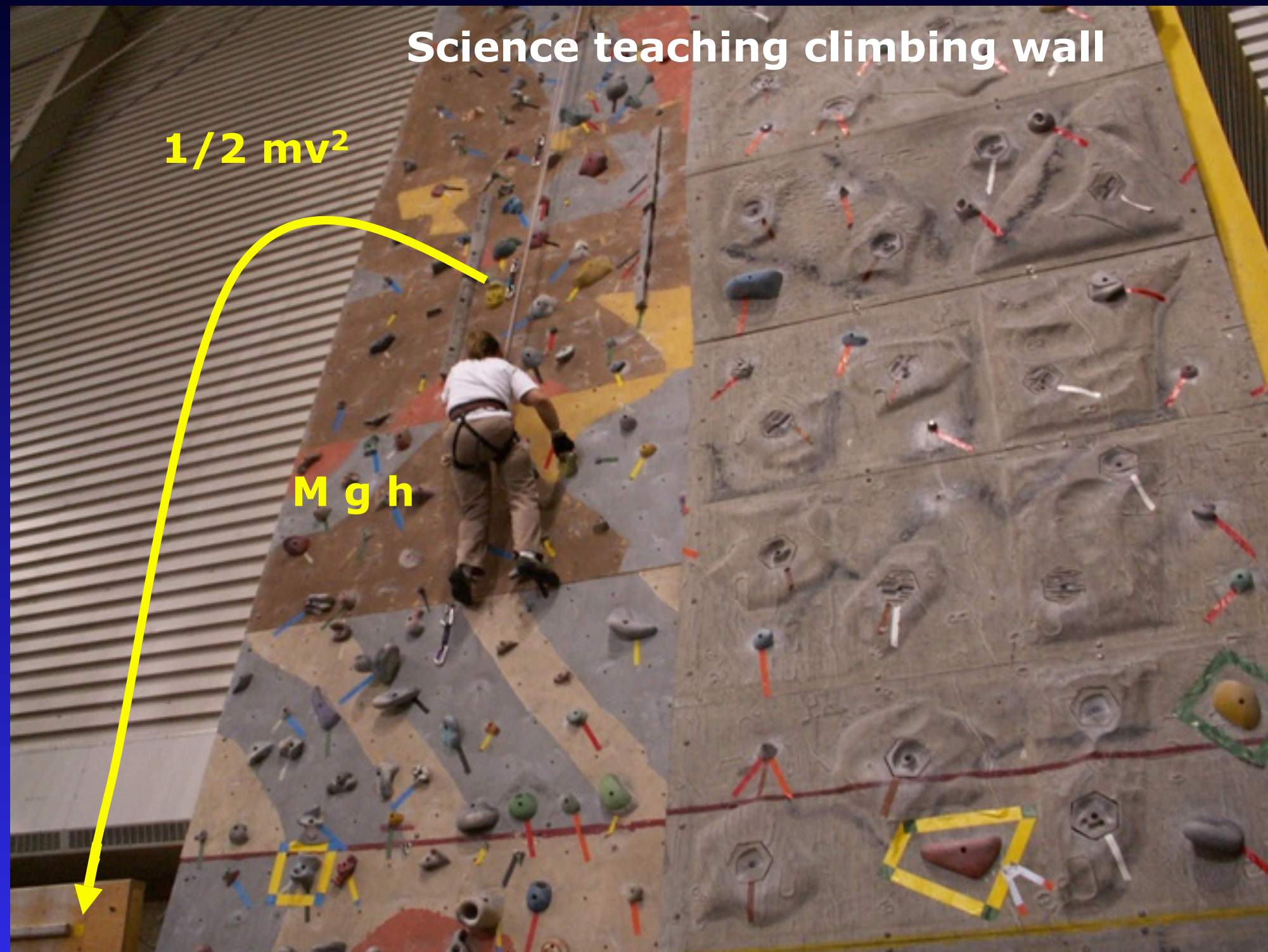


How school students view science

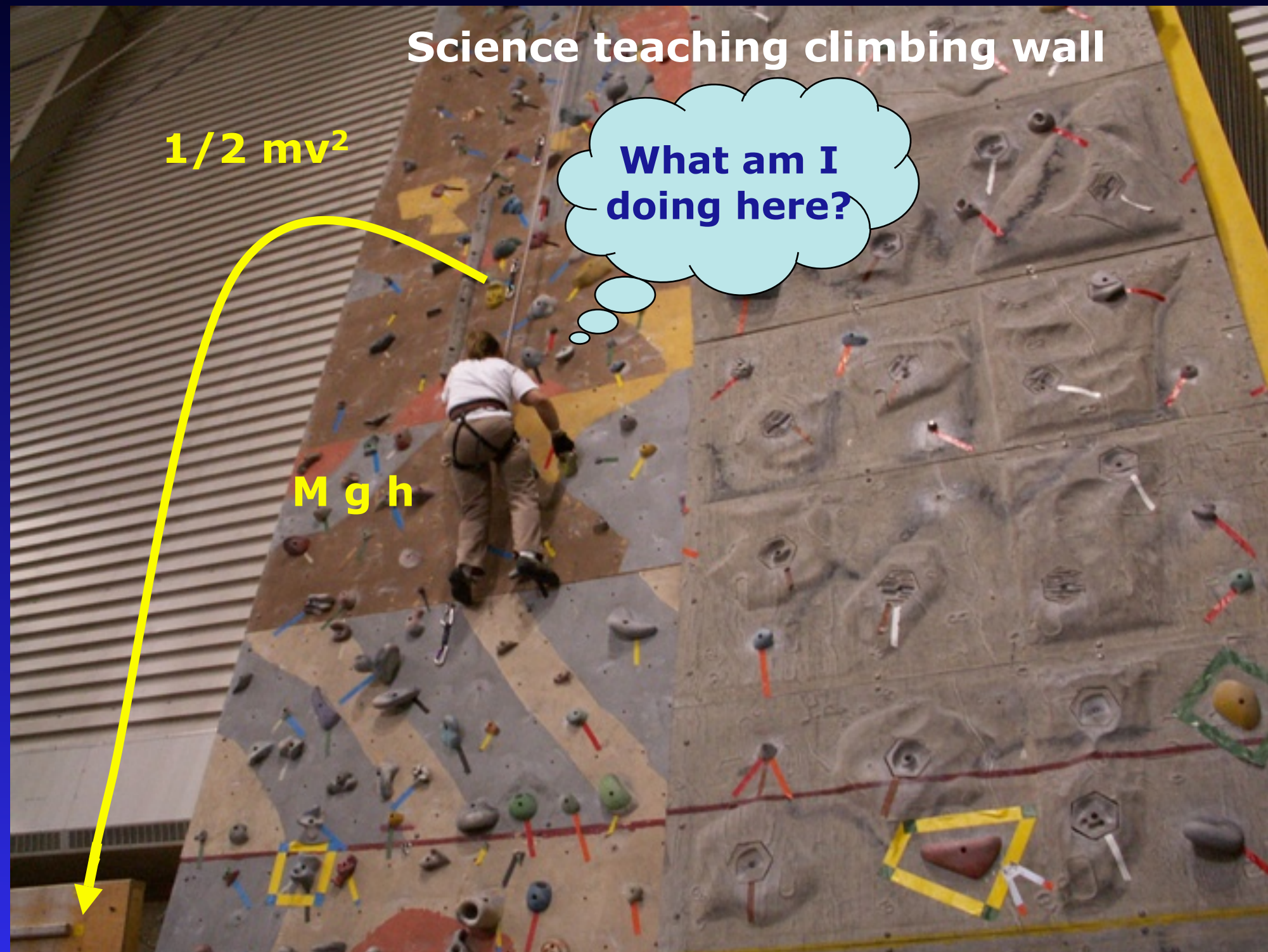
How school students view science



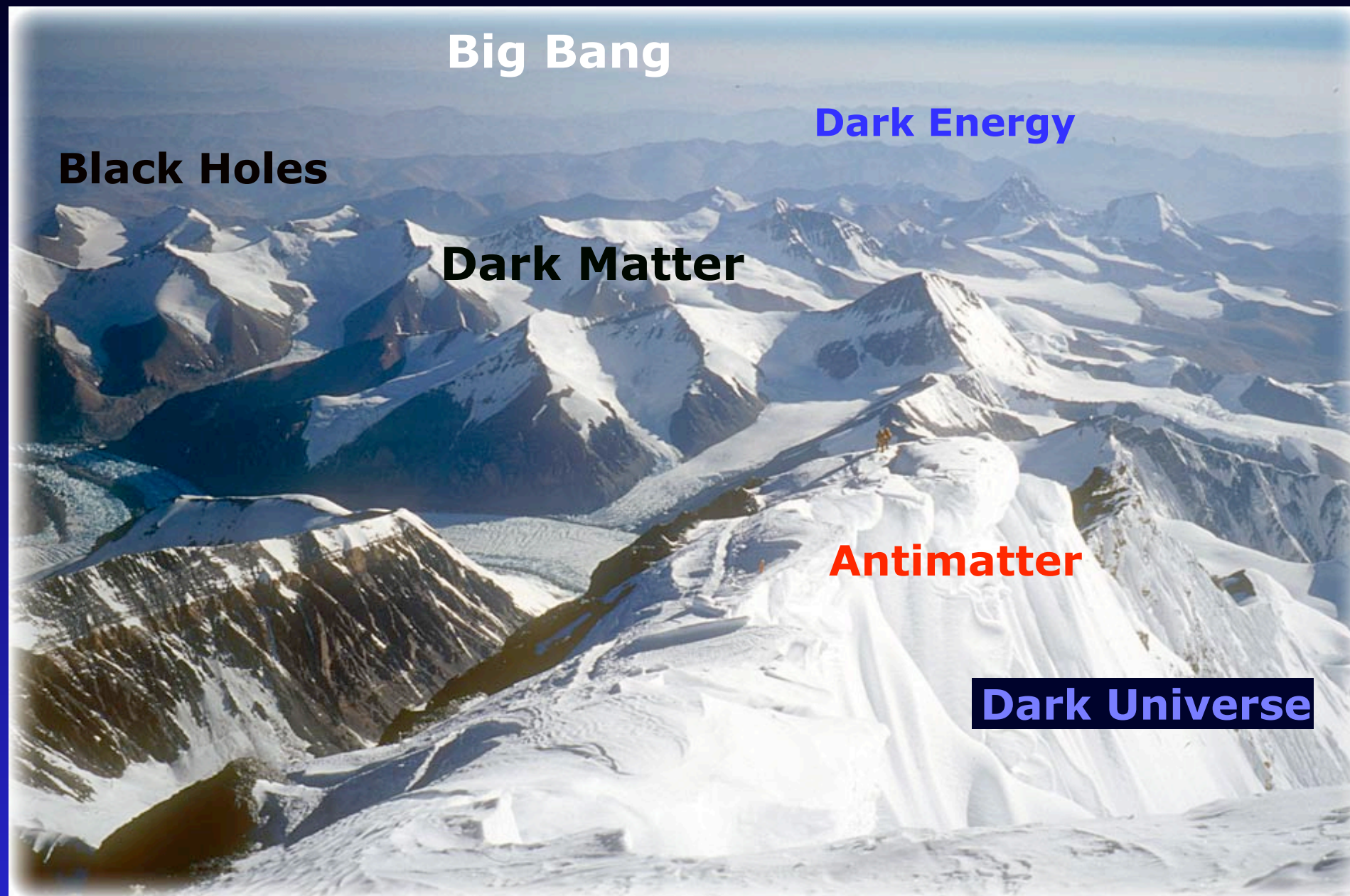
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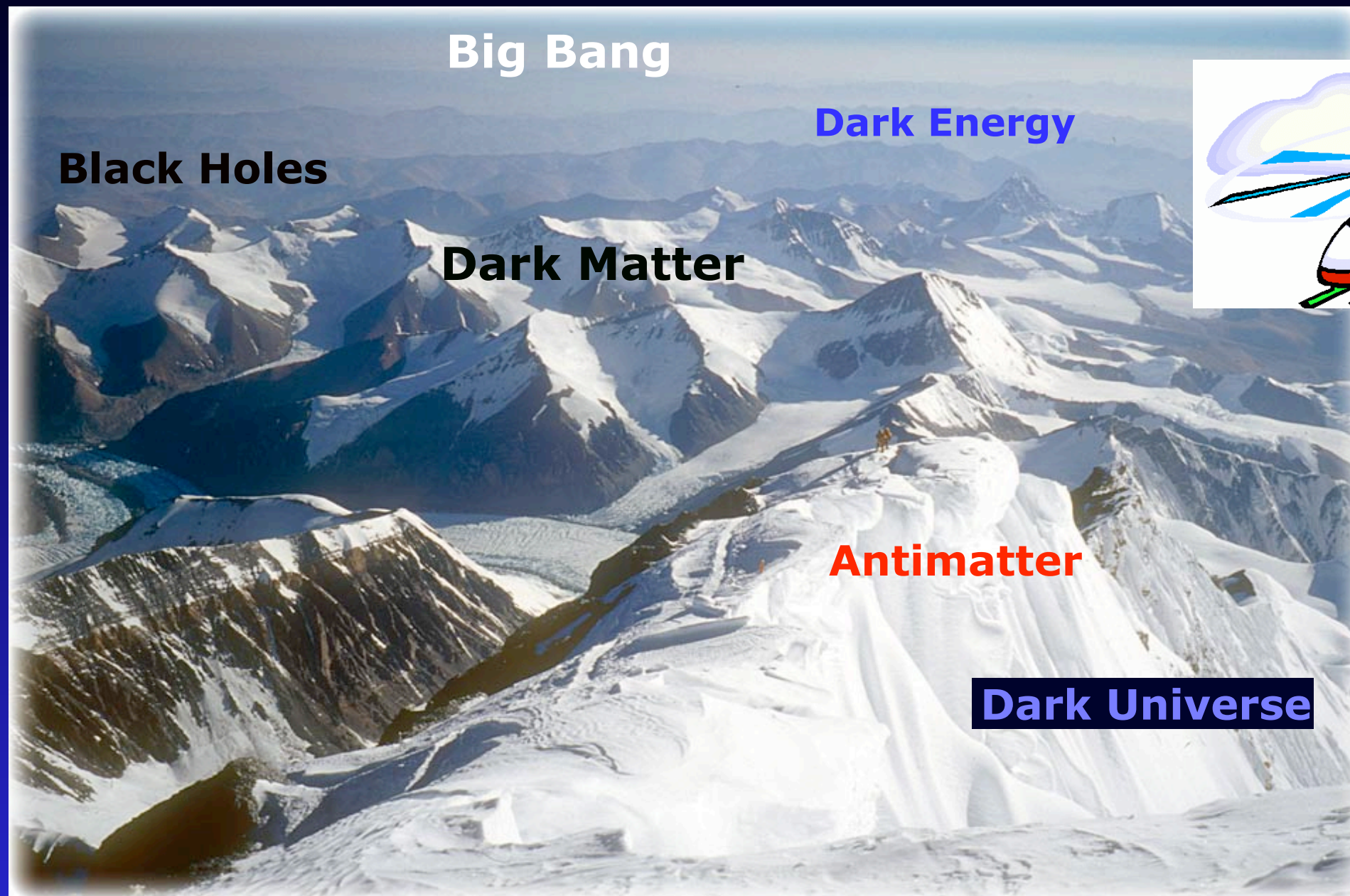
How school students view science



Take students on a sight-seeing tour ...



Take students on a sight-seeing tour ...



Take students on a sight-seeing tour ...

Big Bang

Dark Energy

Black Holes

Dark Matter

Antimatter

Dark Universe



180,000 copies per month



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SCIENCE & VIE
JUNIOR
DOSSIER HORS SERIE
L'expérience qui rend fou
Le chat mort et vivant!
La guerre de l'antimonde
Le monde étrange des
PARTICULES

180,000 copies per month

Use modern physics to inspire and motivate school teachers (and their students):

- 1) Contact with frontier science (self-confidence, develop/exchange ideas)*
- 2) Increase attractiveness of science lessons (**13-15 yrs**)*

5) CERN teacher programmes

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International “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

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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

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International weekend schools (3 days)

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In English

Content of CERN Teacher Schools

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Lectures:

Particle Physics

Cosmology

Accelerators (LHC)

Detectors

Applications (IT, Medicine)

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Guided tours:

LHC experiments

Antimatter factory (AD)

PS/LEIR

CLIC

Computing Centre - GRID

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Activities:

Interactive teacher lab

Educational Resources

Games, Quiz

Lesson reviews (Q+A)

2007: 20 CERN Teacher Schools

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

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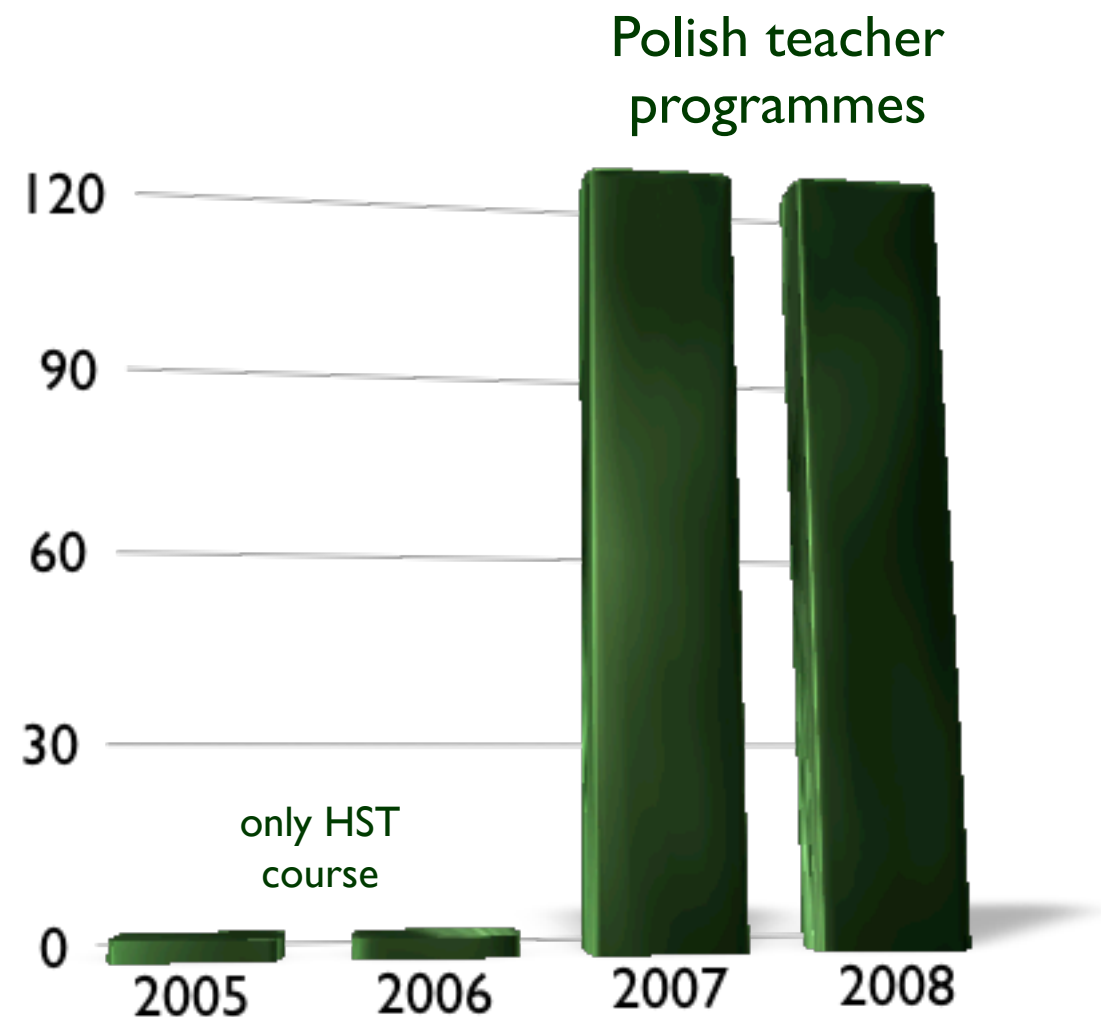
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Preview 2008: ~25 CERN Teacher Schools, ~1000 participants

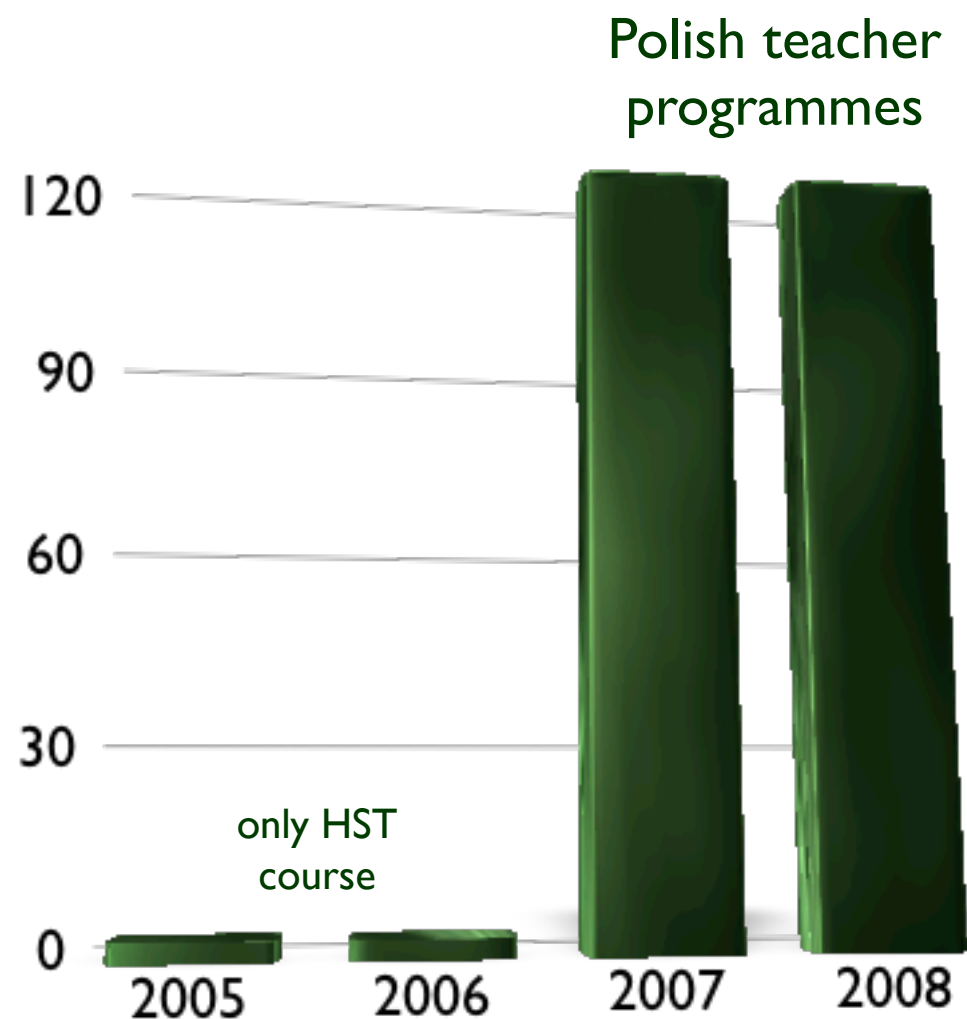
6) Polish Quantum Step

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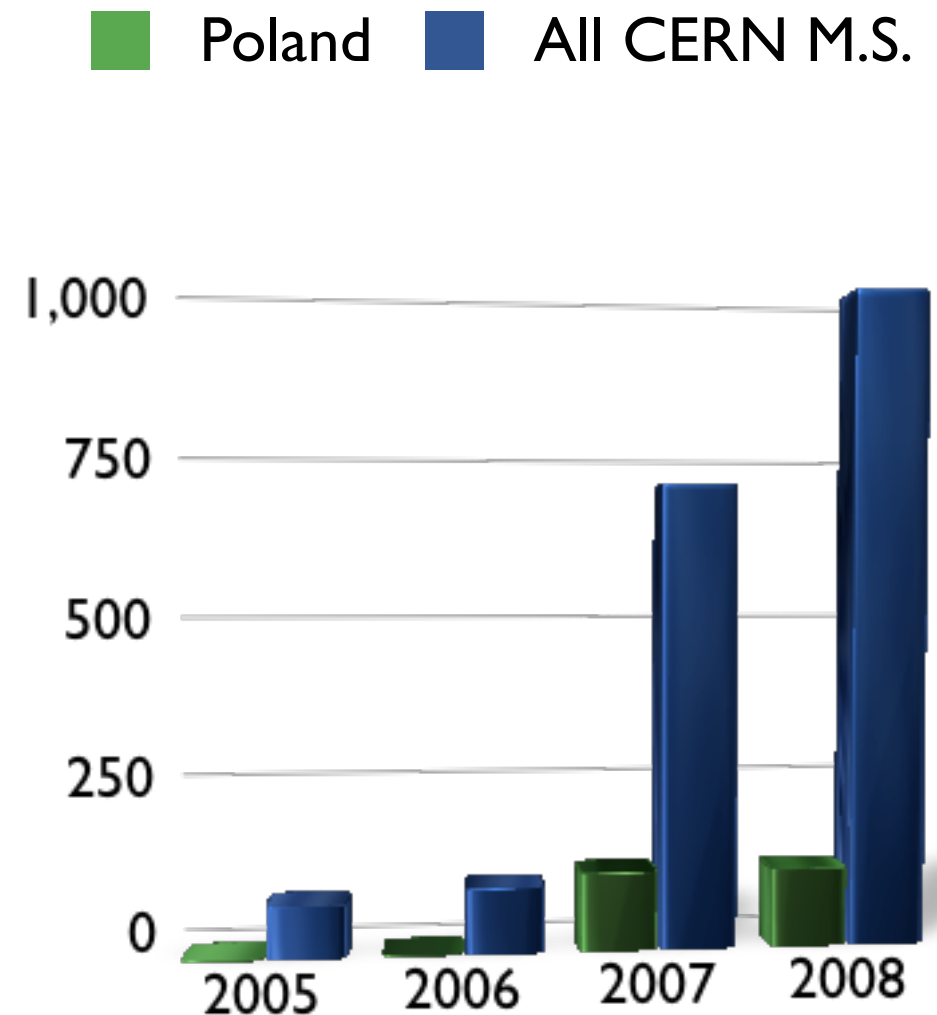


From 3 to 120 per year

6) Polish Quantum Step



From 3 to 120 per year



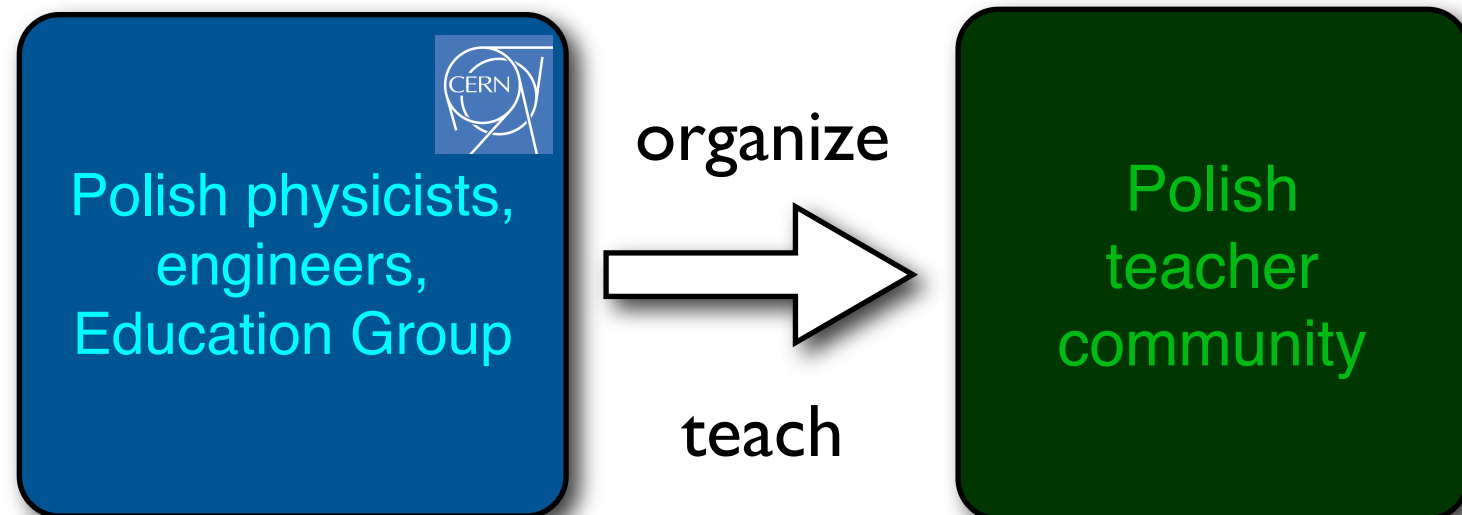
More than 12% of all participants

Partners



Polish
teacher
community

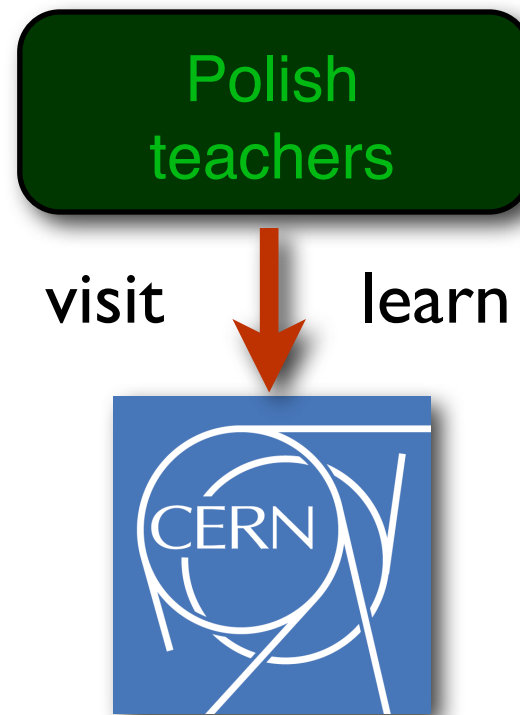
Partners



Partners



Follow-up

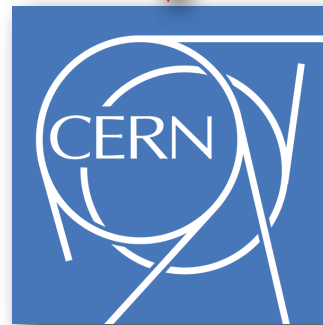


Follow-up

Polish
teachers

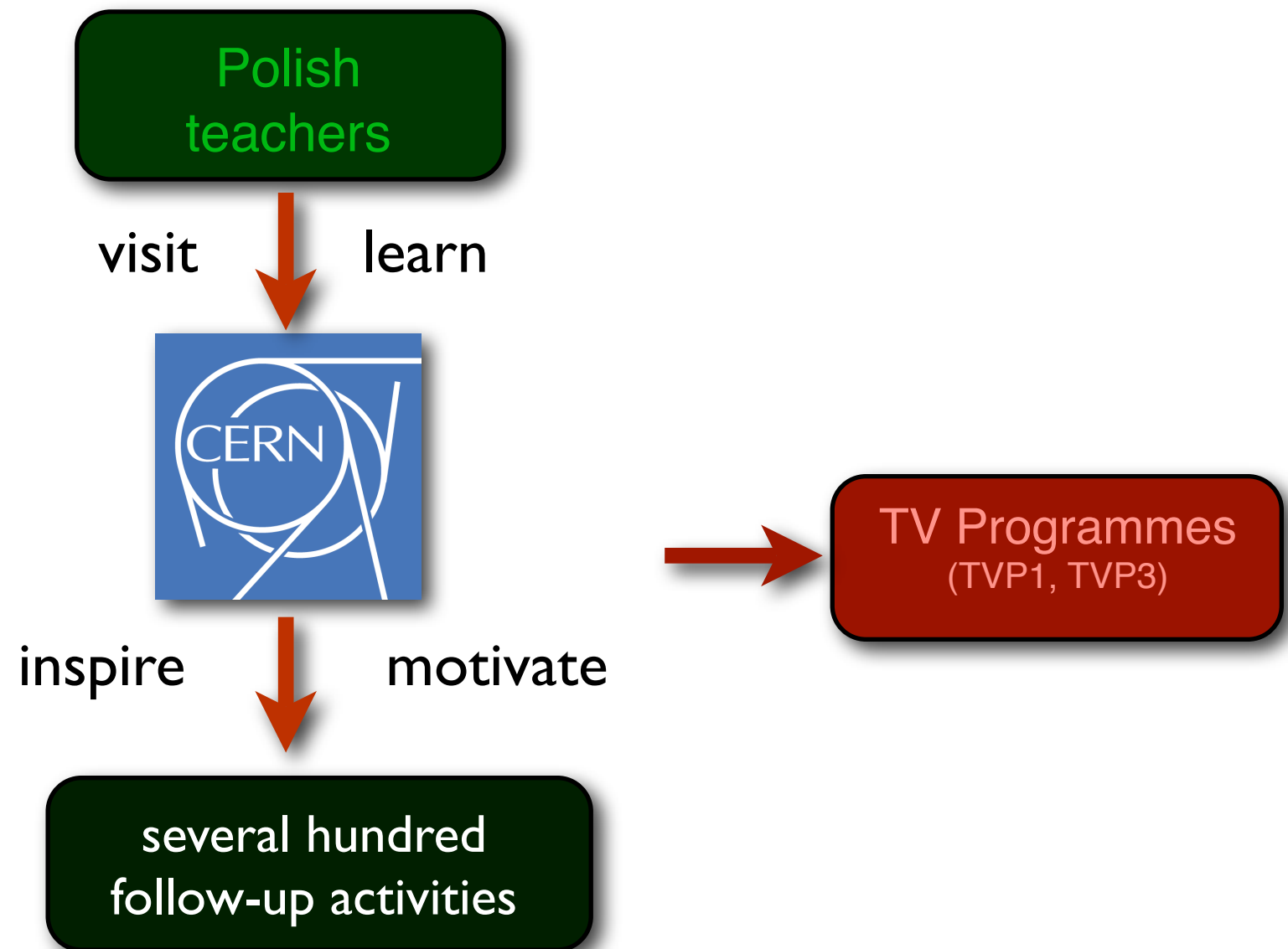
visit

learn

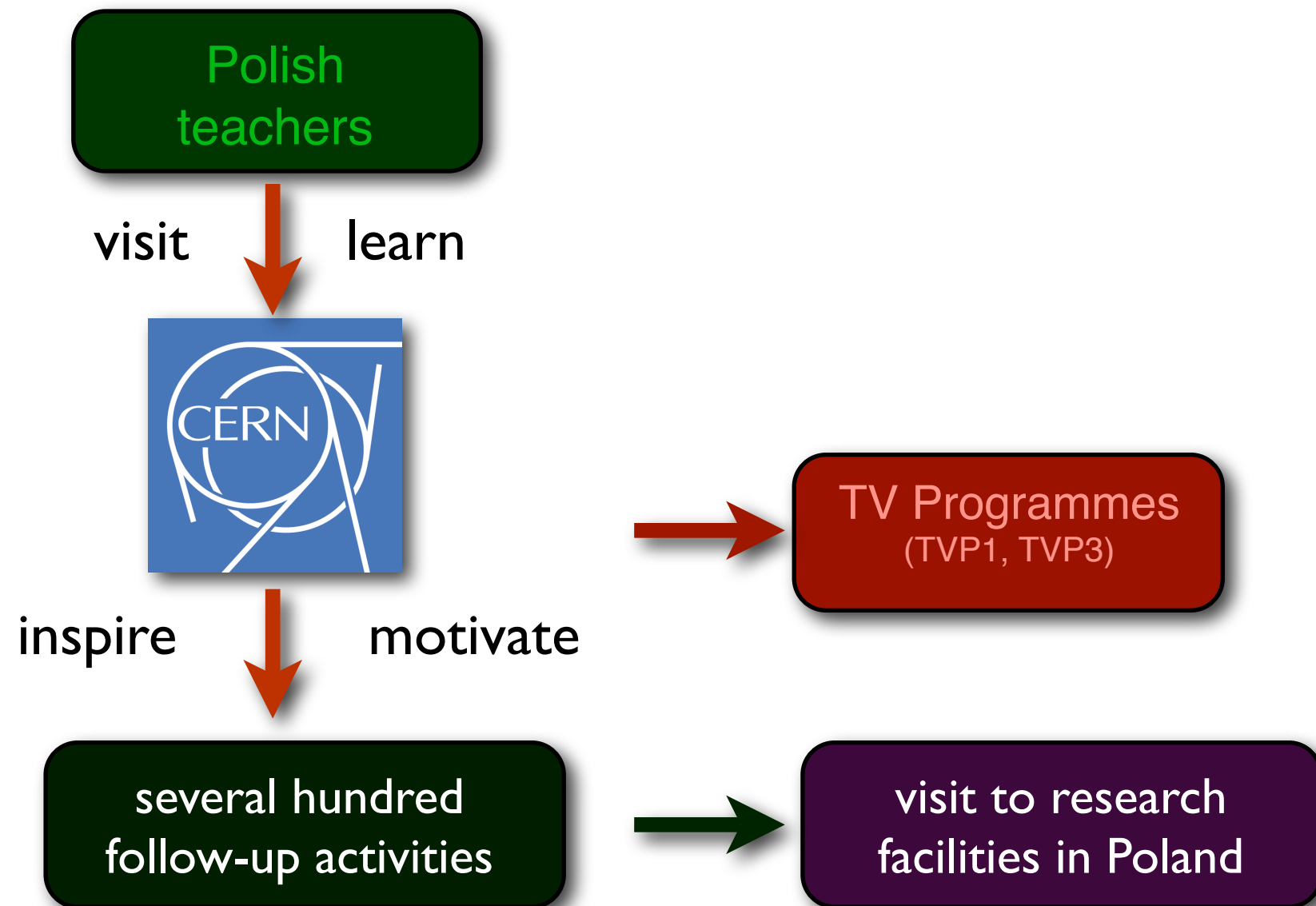


TV Programmes
(TVP1, TVP3)

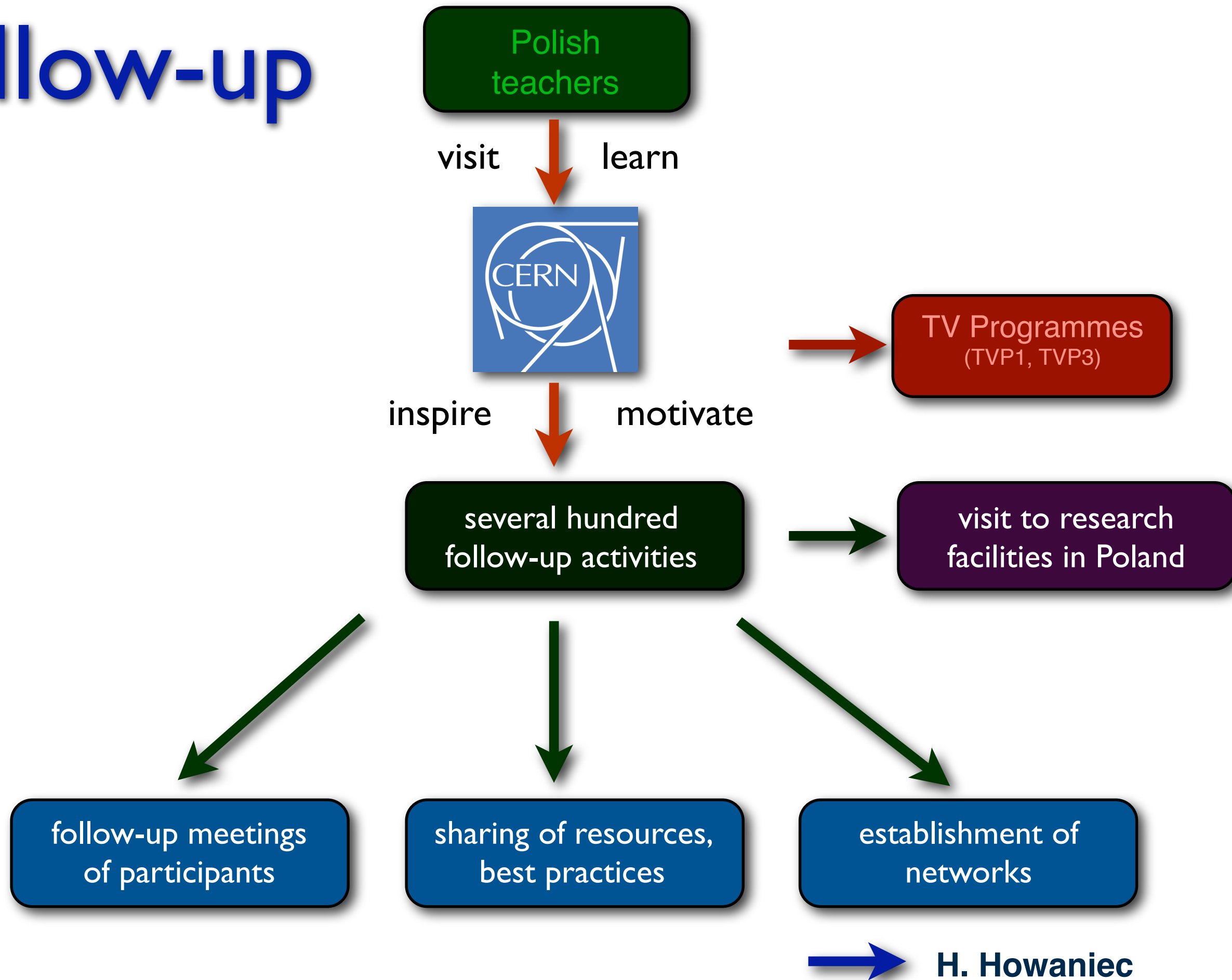
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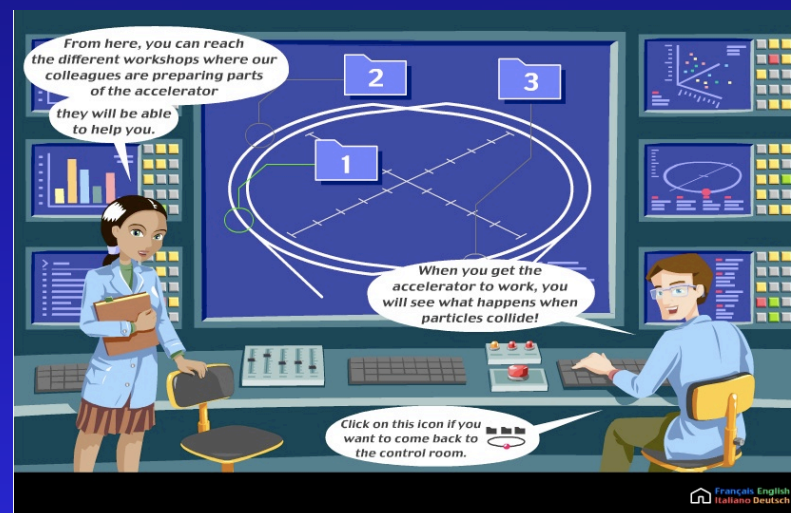
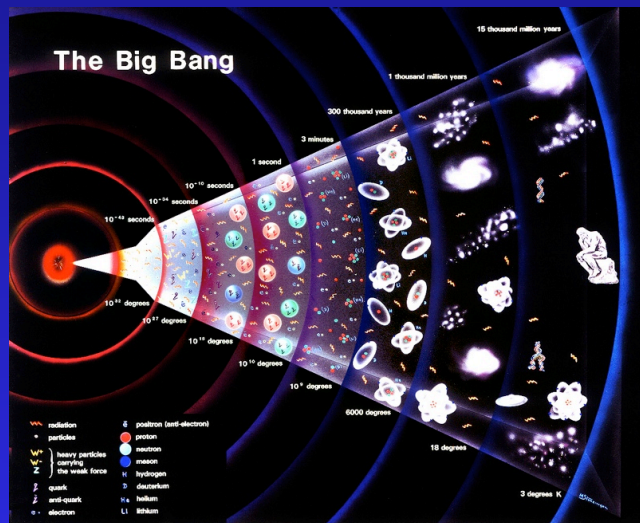
Teaching resources

All teacher courses and materials are **recorded and archived**

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

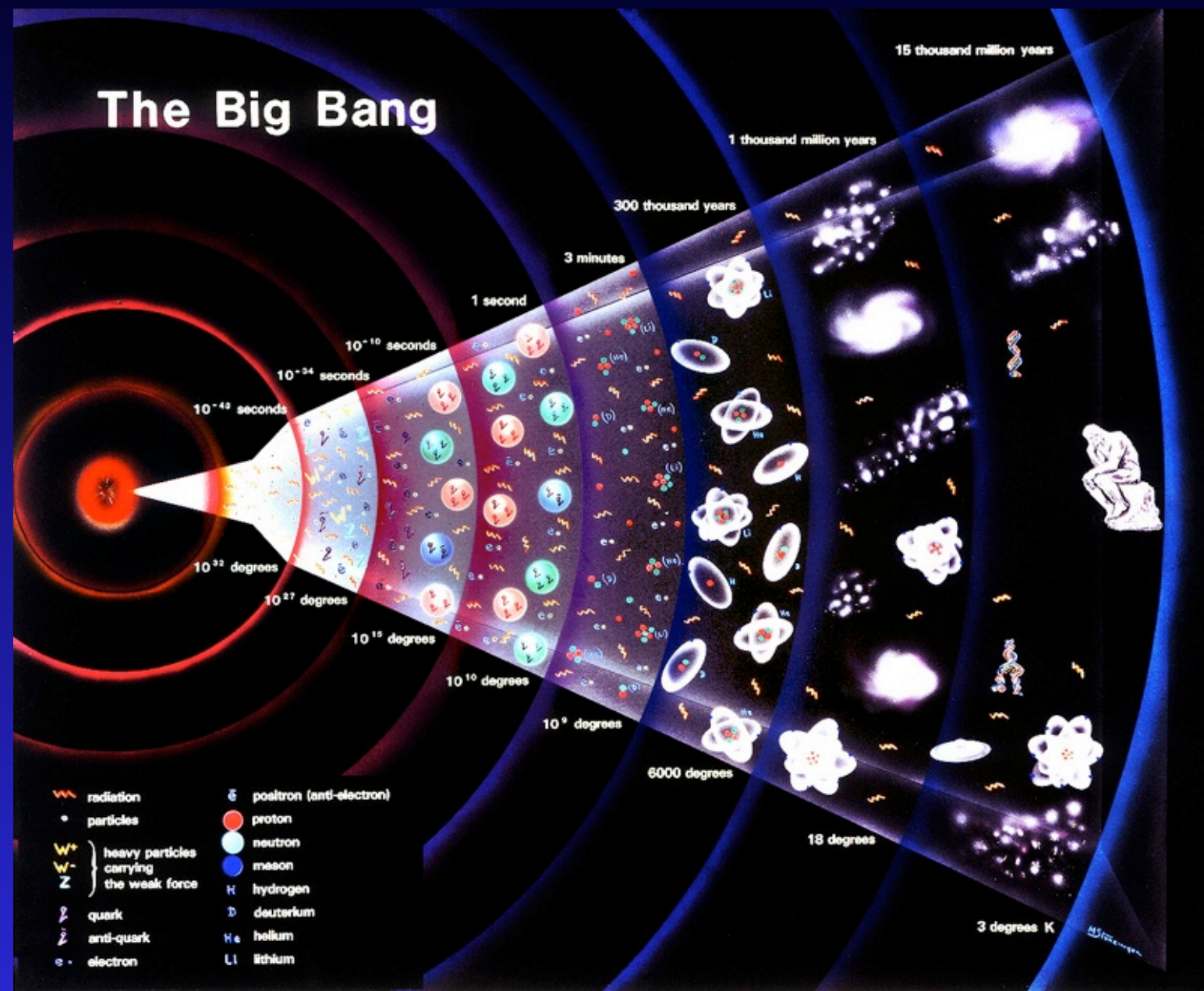
Video-Conferences between school classes and CERN scientists

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

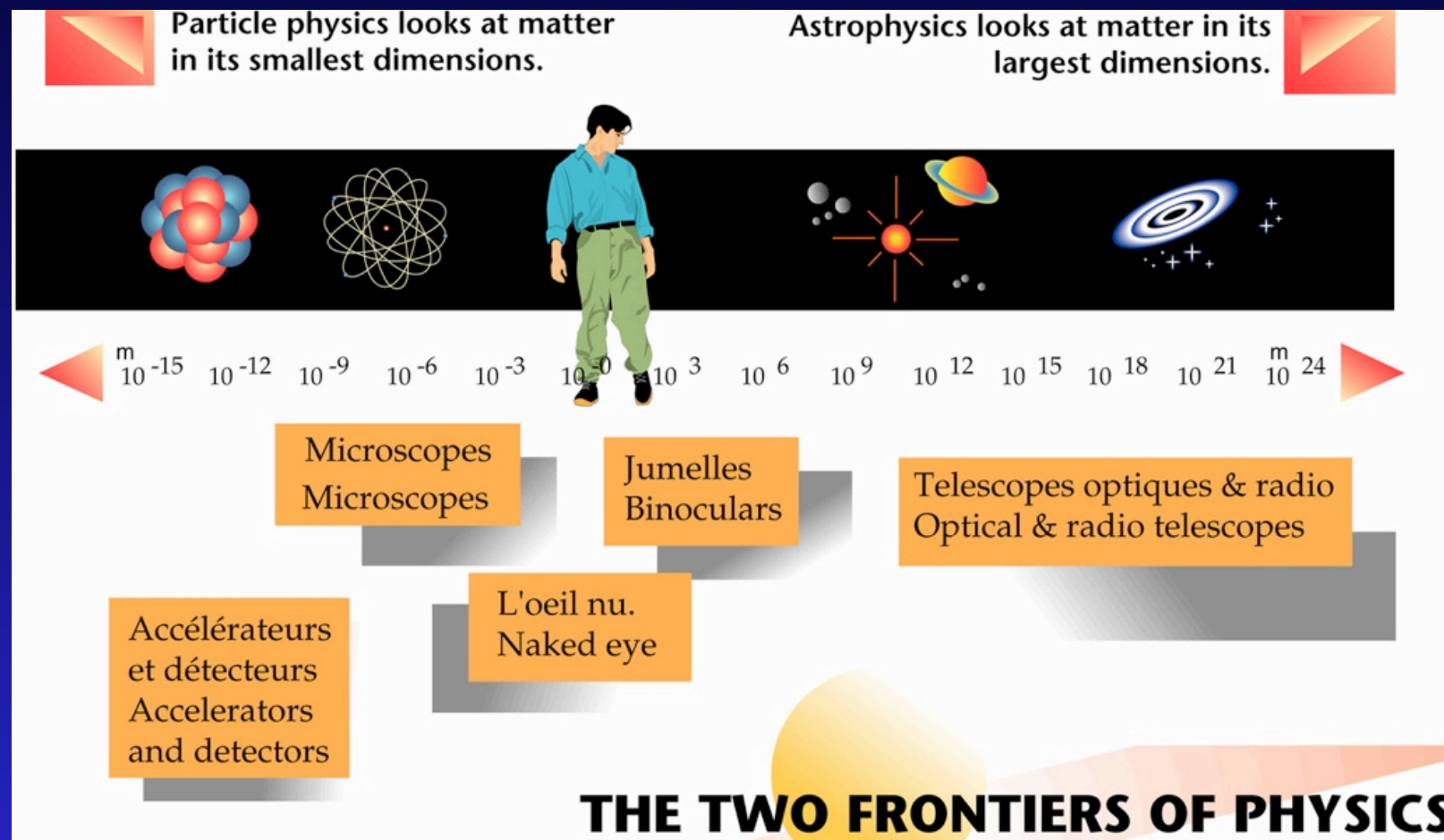


Graphics

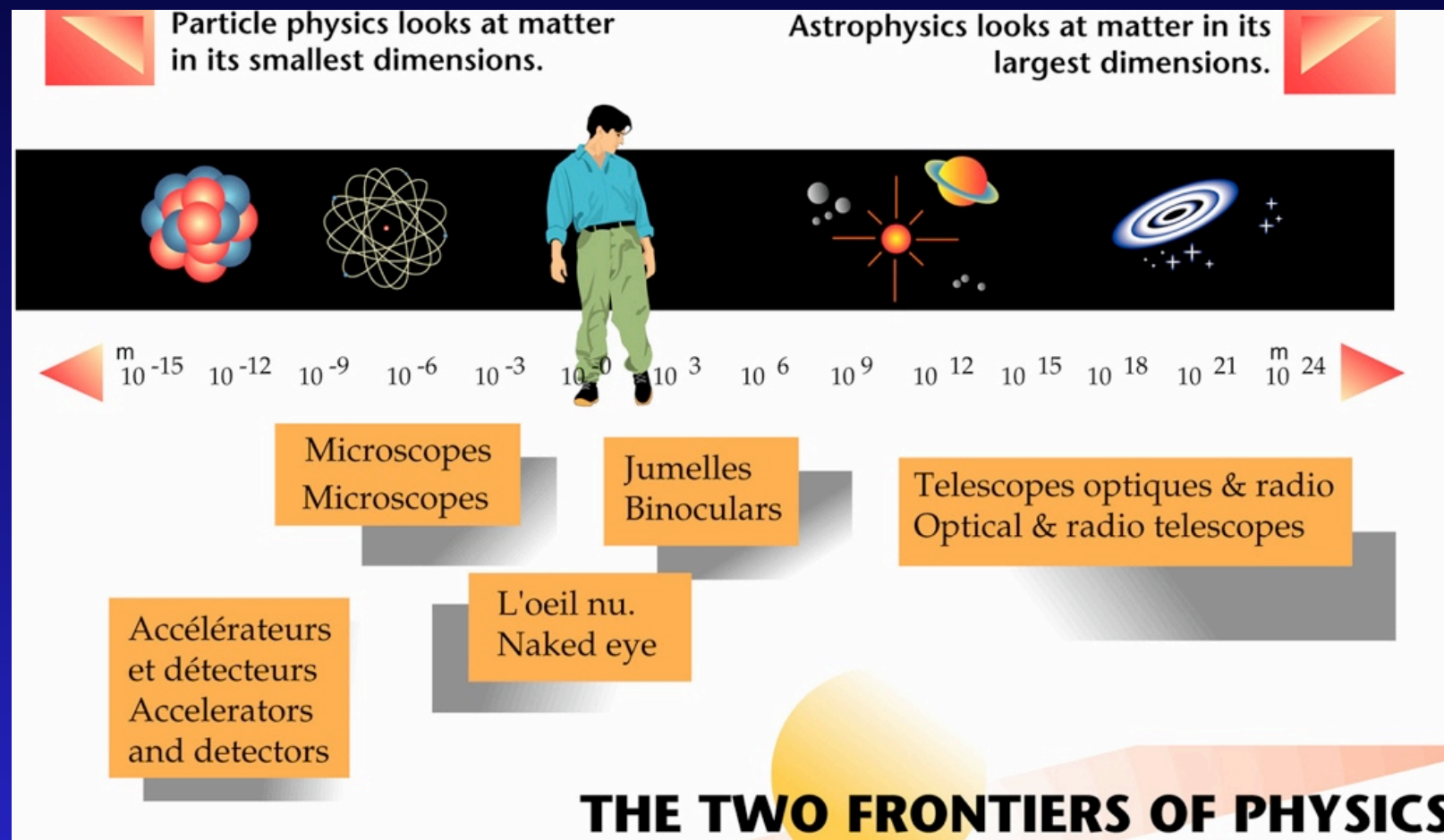
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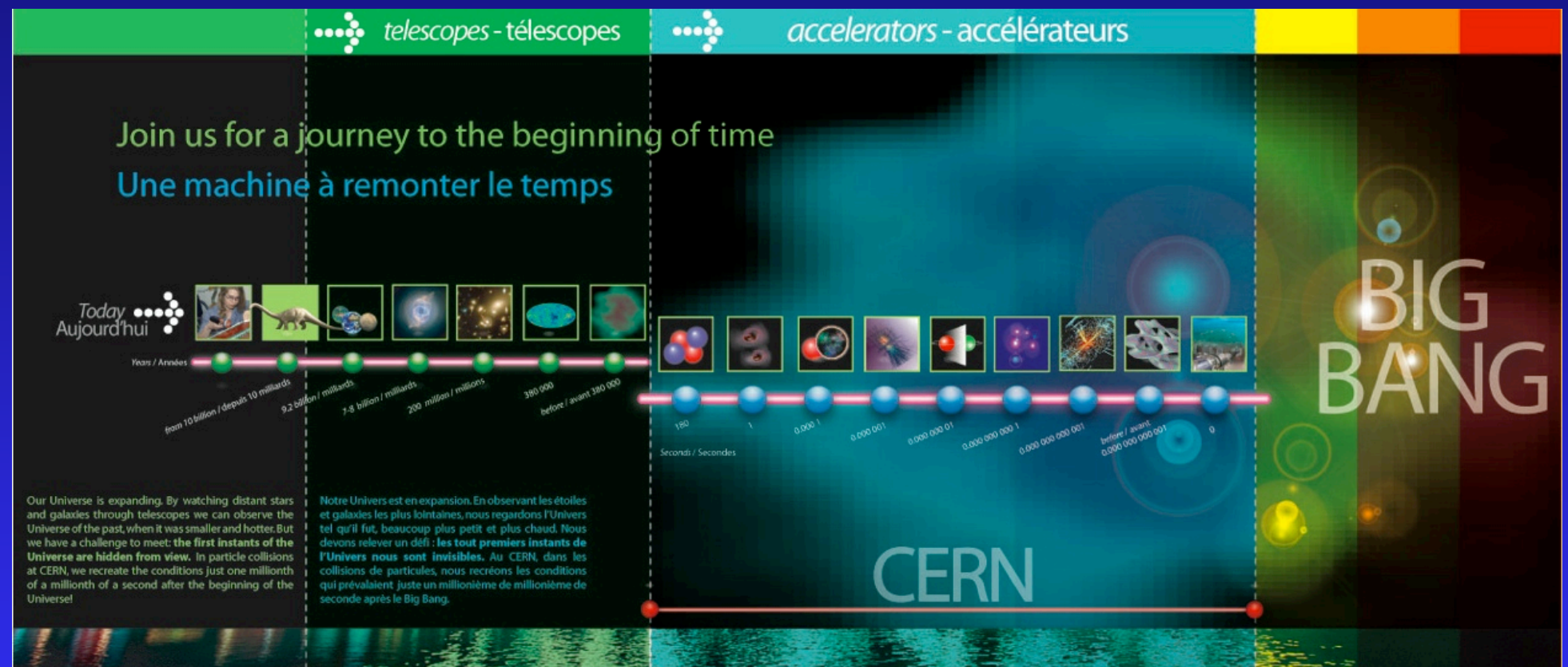
press.web.cern.ch/press/PhotoDatabase/welcome.html

Posters: Evolution of the Universe



17 posters

Key concepts of
the evolution of matter



Evolution of the Universe (2)



Evolution of the Universe (3)

accelerators - accélérateurs

Seeing in the dark L'âge obscur

Looking out into space telescopes can take us back to 380,000 years but not before. Before then, the matter existed mostly in the form of protons, helium nuclei, and electrons. It was too hot for atoms to be stable. Light was continuously 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.

(En) Messager(s) nous, parvenant(s) d'éloignement(s) jusqu'à 380 000 ans, avant que, soudainement, la matière existait sous forme de protons, noyaux d'hélium et d'électrons. Il faisait trop chaud pour que les atomes soient stables. La lumière était continuellement absorbée et ré-émise par les particules agitées. L'Univers était opaque. Pour recréer les conditions plus lointaines dans le temps, les scientifiques recréent les conditions d'alors dans des laboratoires comme le CERN et les autres accélérateurs.

CERN

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, 2 compte 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 sans être arrêtés par la matière.

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 énigmatiques, le CERN envoie un faisceau de neutrinos à travers la terre sur 732 km vers le Laboratoire du Gran Sasso en Italie.

CERN

Pushing back the frontiers Repousser les limites

The ATLAS detector measures 46 m long and 22 m high, with a mass of 3,900 tons. It is being built by 160 physicists and engineers from 160 institutions in 34 countries (as of end 2005).

Le détecteur ATLAS mesure 46 m de long et 22 m de haut, et pèse 3 900 tonnes. Il a été conçu par 160 physiciens et ingénieurs de 160 institutions et 34 pays d'ici fin 2005.

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?

Ces ordinateurs simulent les traces émergentes des grosses collisions de protons au LHC. Elles nous aident à comprendre ce qui se passe. Ces simulations informatiques d'une collision entre protons nous aident à comprendre ce qui se passe. Elles nous aident à comprendre ce qui se passe.

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.

A un milliardième de seconde, nous atteignons les limites du savoir actuel. Il y a encore bien des choses que nous ne comprenons pas. La gravité agit sur la masse, mais on ne sait pas pourquoi les particules ont une masse. La matière visible ne représente 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 milliardième de seconde après le Big Bang.

Topical websites (e.g. Antimatter)



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

Games



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)

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



Science In School journal



Since March 2006 - now at Issue 8
4 issues/year, 88 pages; English (print)
30,000 copies; distributed in 38 countries

Science In School: Interest is growing very fast ...



More than 5000 registrations for e-mail alerts

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No emphasis on mathematical/deductive approach

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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

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