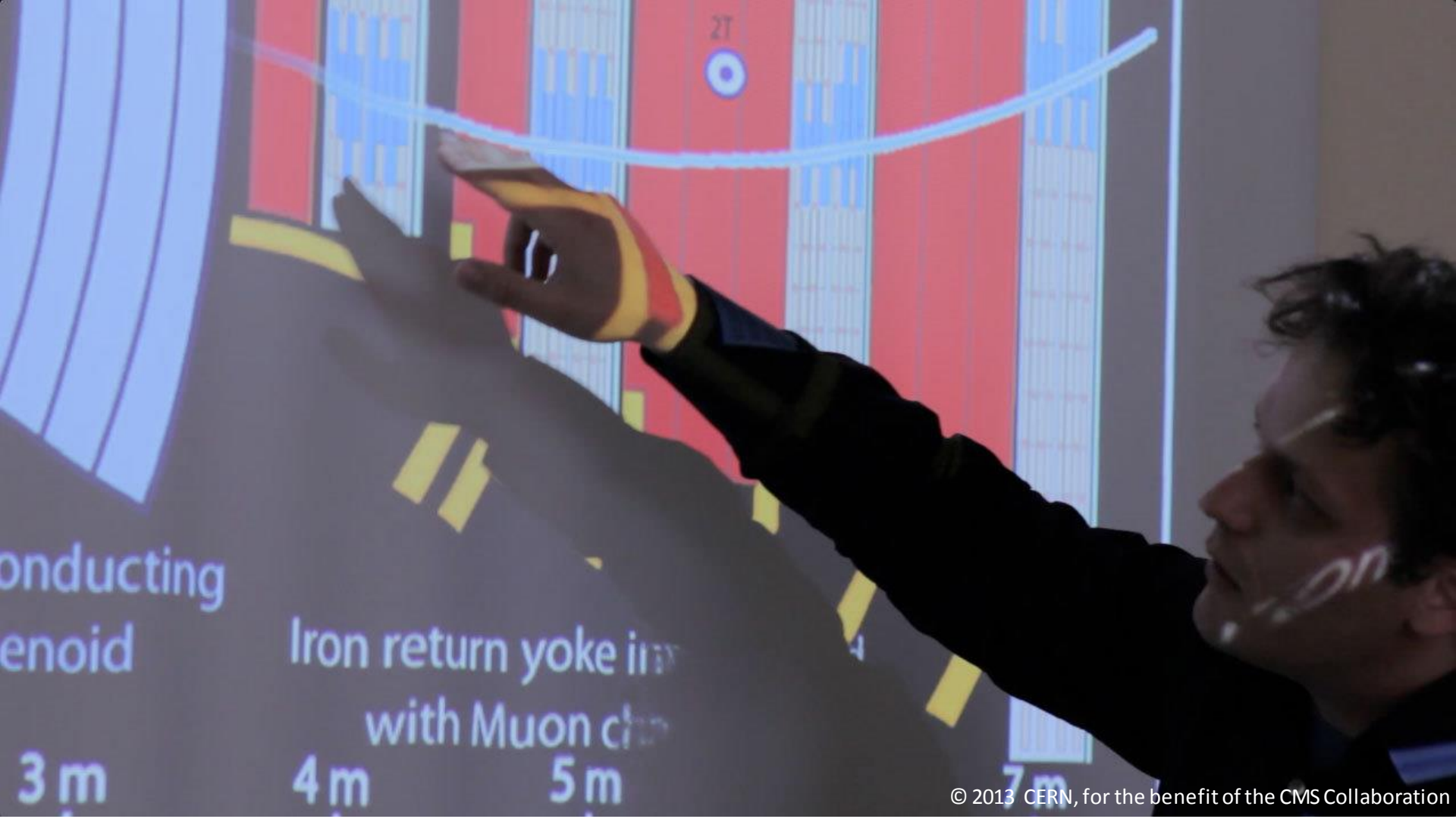
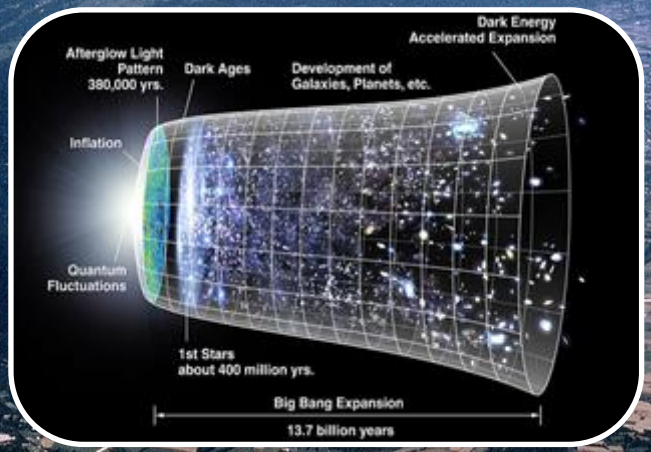




# Bringing CERN to the School Classroom

Dr. Angelos Alexopoulos

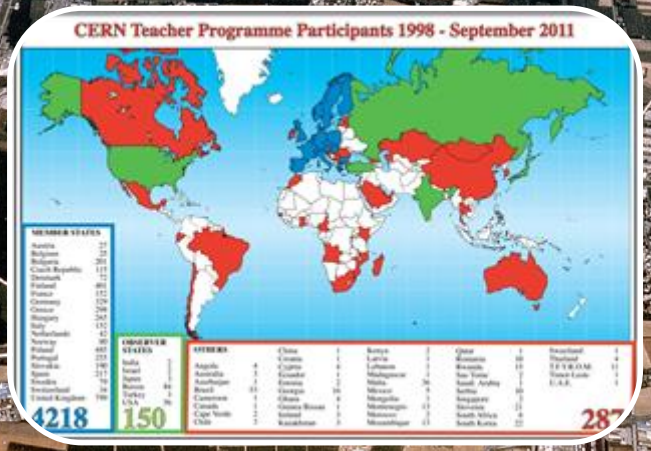
Norwegians Teachers Programme 2013



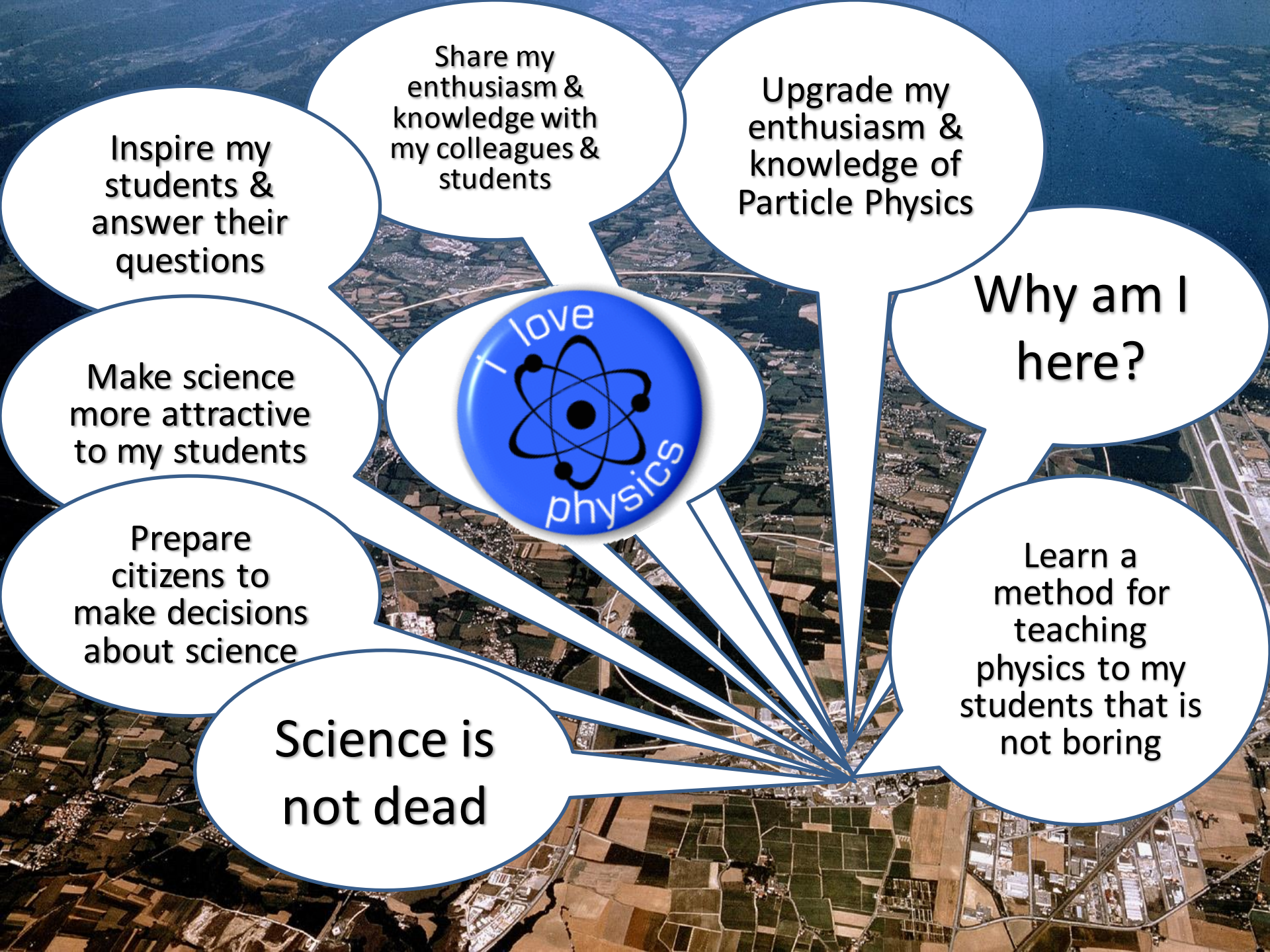

Research

Technology

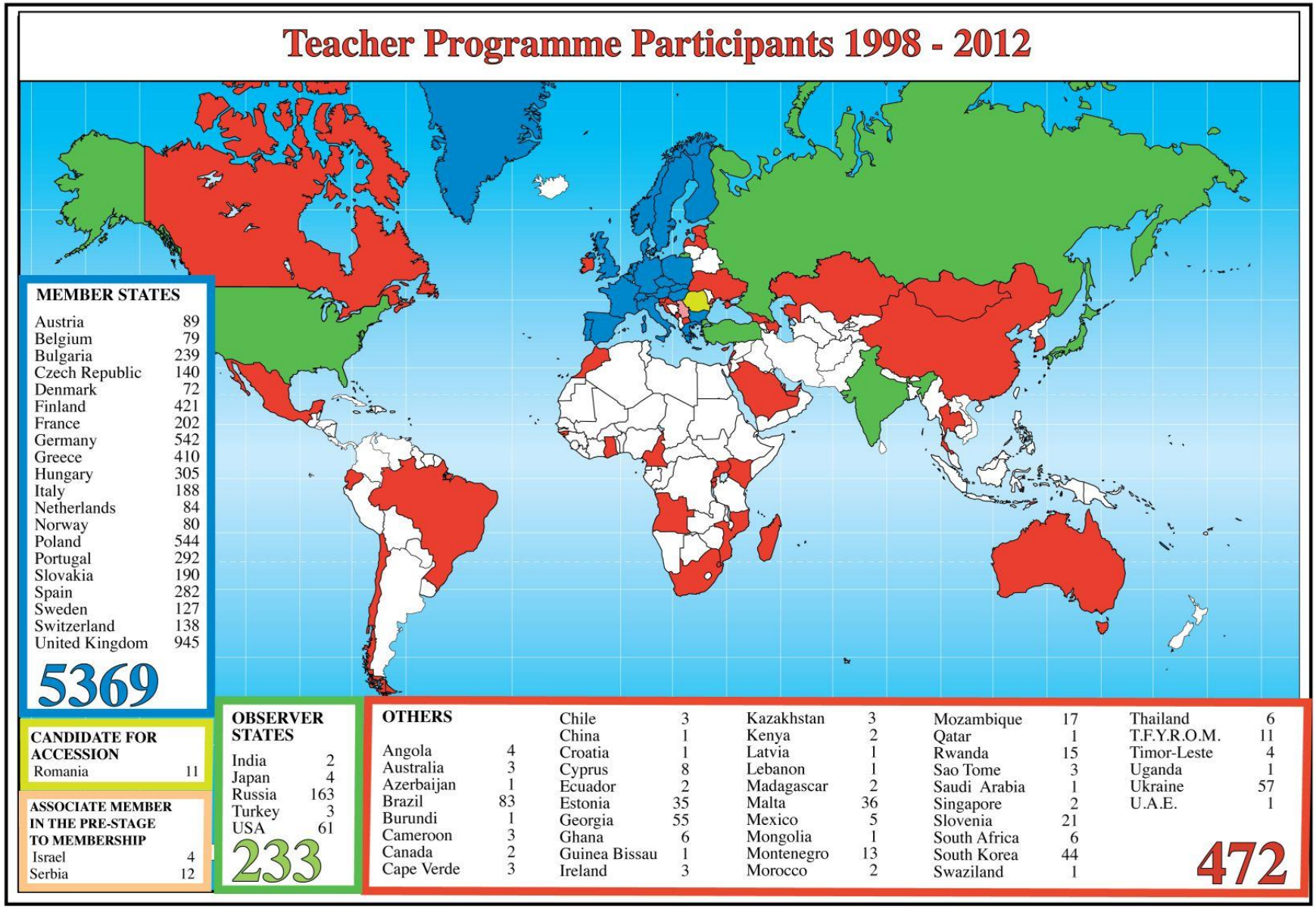
Collaboration




Education


Share my enthusiasm & knowledge with my colleagues & students
Upgrade my enthusiasm & knowledge of Particle Physics
Inspire my students & answer their questions
Why am I here?
I love physics
Make science more attractive to my students
Prepare citizens to make decisions about science
Learn a method for teaching physics to my students that is not boring
Science is not dead

# Teachers @ CERN

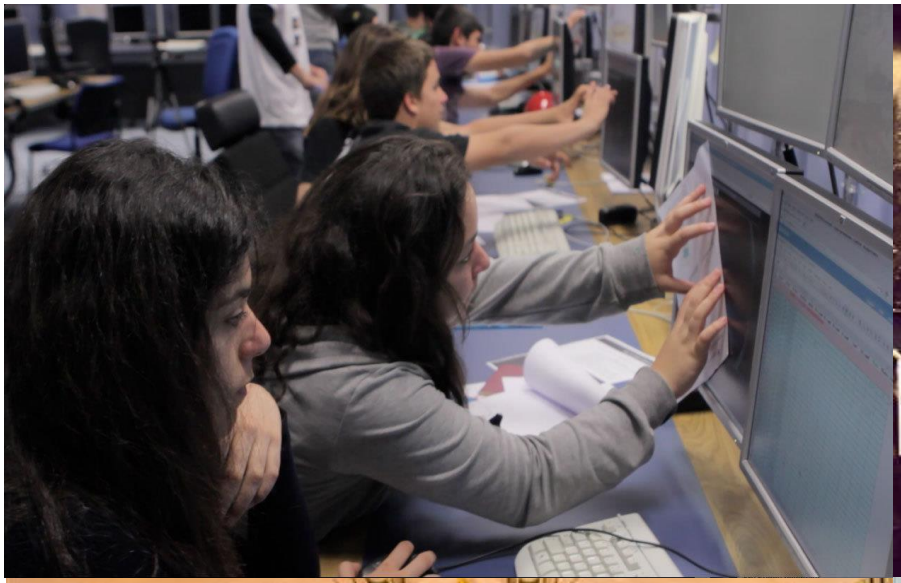


# CERN Teacher Programmes

## 2011 – 2012

- >60 3-day workshops
- 2150 participants from 76 countries
  - *86% from 20 member states (1747)*
  - *14% from 56 non-member states*
- Lectures, visits, hands-on activities, knowledge sharing and networking
- All materials and archived video recordings are publicly available
- All workshops incl. “Building a Cloud Chamber” and some “HYPATIA”
- Workshops are validated internally and externally

# Students @ CERN



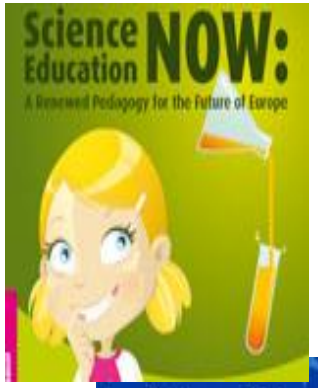


# The Challenge

What can I bring back to my school from CERN & how can I do it best?

# Science Education in Europe: Challenges & Opportunities

Rocard et al. 2007





Osborne & Dilon 2008

- Reverse declining student interest in Science
- Re-imagine the science classroom of tomorrow
- Realise the potential of eScience for engaging students in scientific inquiry

# Change of Mindsets & Mindsets of Change

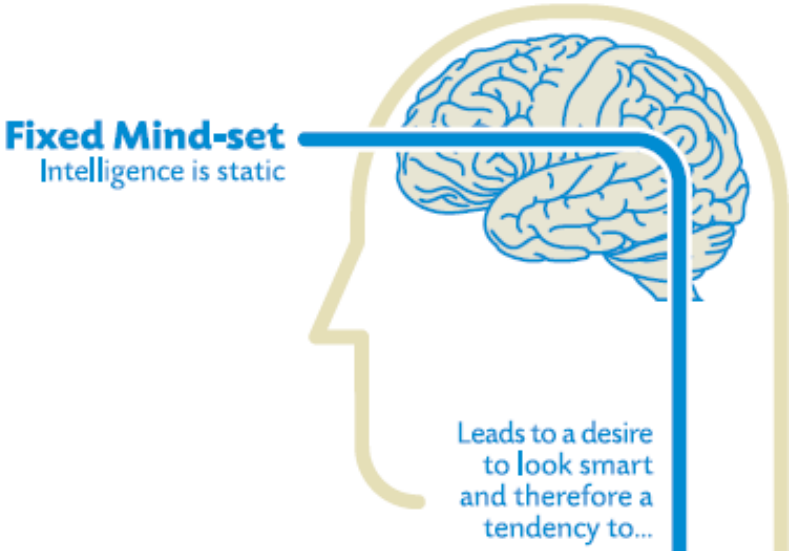

"Smart people don't learn…because they have too much invested in proving what they know and avoiding being seen as not knowing"

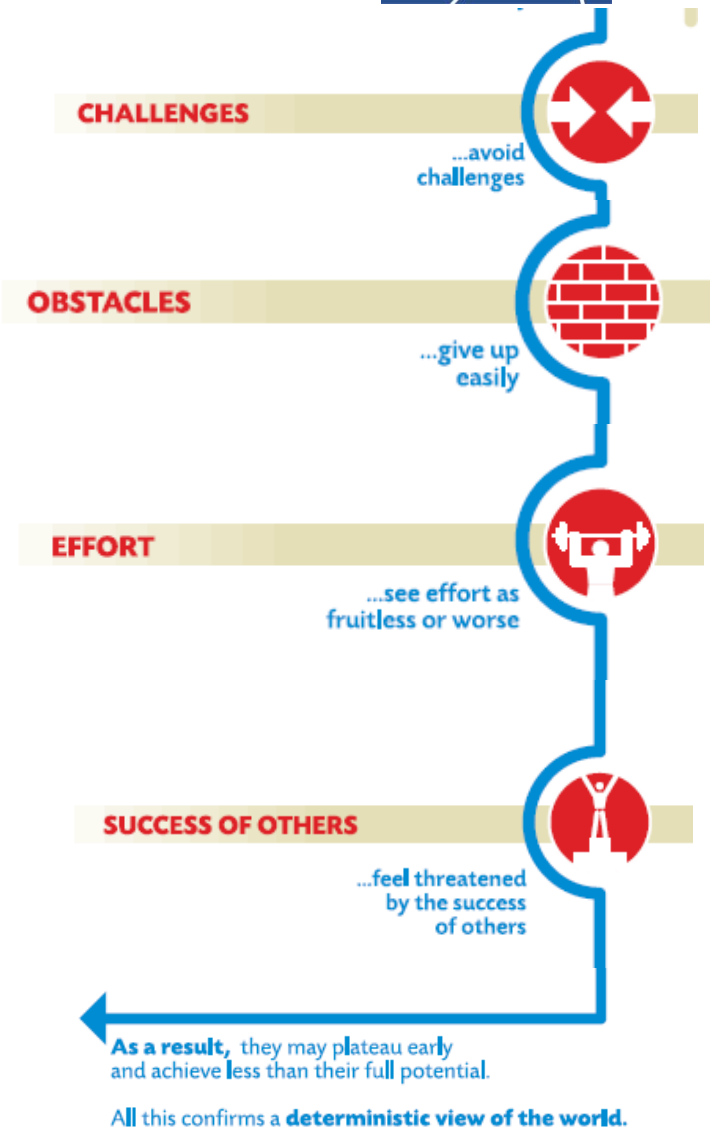
Chris Argyris
[Business theorist]

"I didn't really want to be the coach who wins but the coach who educates. I want to keep preparing them for the future"

Vincente del Bosque
[Spain's football team coach]


# The "Fixed" Mindset (Dweck, 2008)

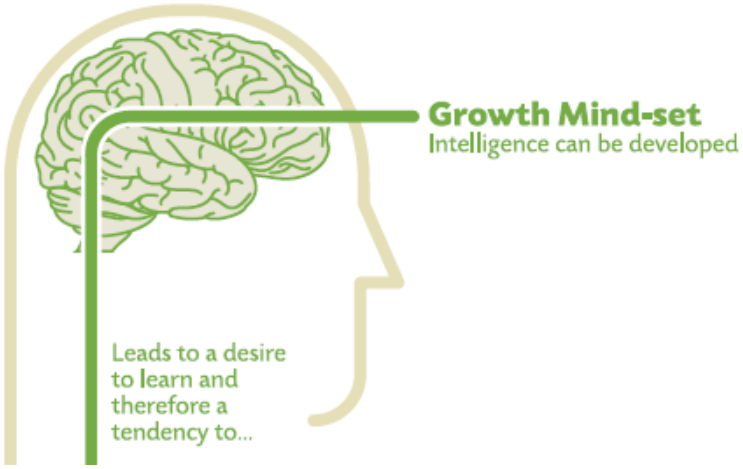


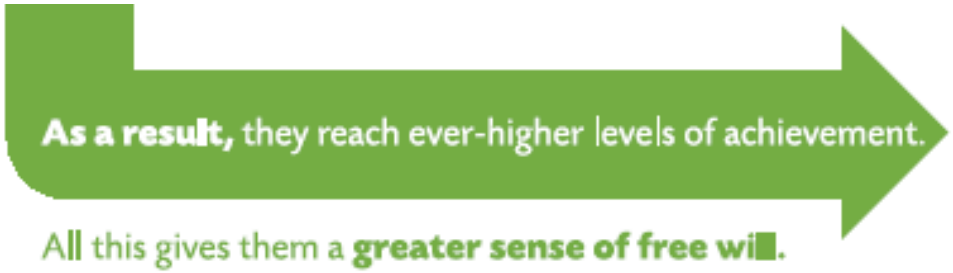



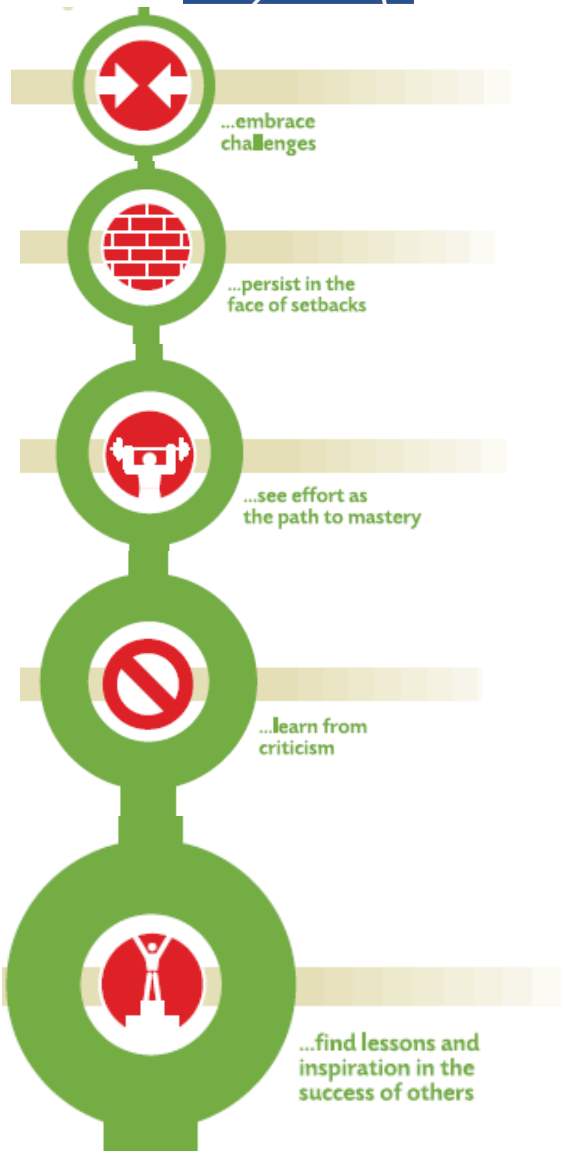

A Fixed Mindset saying:
"I don't do physics (or maths or…science)"

Holmes, N. (n.d) Mindset graphic
http://www.stanfordalumni.org/news/magazine/2007/marapr/images/features/dweck/dweck_mindset.pdf
Richard, M. G. (n.d.) "Fixed mindset vs. growth mindset: which one are you?" http://michaelgr.com/2007/04/15/fixed-mindset-vs-growth-mindset-which-one-are-you/

# The "Growth" Mindset (Dweck, 2008)




Holmes, N. (n.d) Mindset graphic http://www.stanfordalumni.org/news/magazine/2007/marapr/images/features/dweck/dweck_mindset.pdf accessed [02/01/12]
Richard, M. G. (n.d.) "Fixed mindset vs. growth mindset: which one are you?" http://michaelgr.com/2007/04/15/fixed-mindset-vs-growth-mindset-which-one-are-you/ accessed [02/01/12]

# Learning Objectives of Science Education

→ Students need to:

- learn the principles and concepts of science
- acquire the reasoning and procedural skills of scientists
- understand the nature of science as a particular form of human effort

# Inquiry-based Science Education (IBSE)

→ The learning activities in which students develop:

- knowledge and skills (i.e. abilities) to do scientific inquiry
- an understanding of how scientists study the natural world

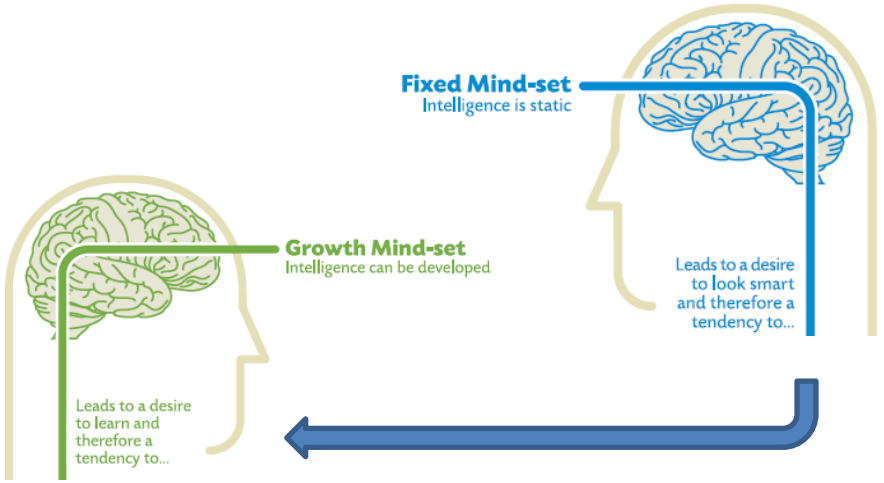
Inquiry can be defined as *"the intentional process of diagnosing problems, critiquing experiments, and distinguishing alternatives, planning investigations, researching conjectures, searching for information, constructing models, debating with peers, and forming coherent arguments"*

(Linn, Davis & Bell, 2004: 4)

# Why Inquiry-based Learning?


→ Engagement
- Students work together
- Students choose which areas to explore and which questions to answer
- Students are active in the learning process

→ Focus
- Towards the student
- Towards the subject
- Towards the learning process




→ But
- Requires preparation
- Requires confidence to allow students to explore

# Five Features of Inquiry Learning & Teaching

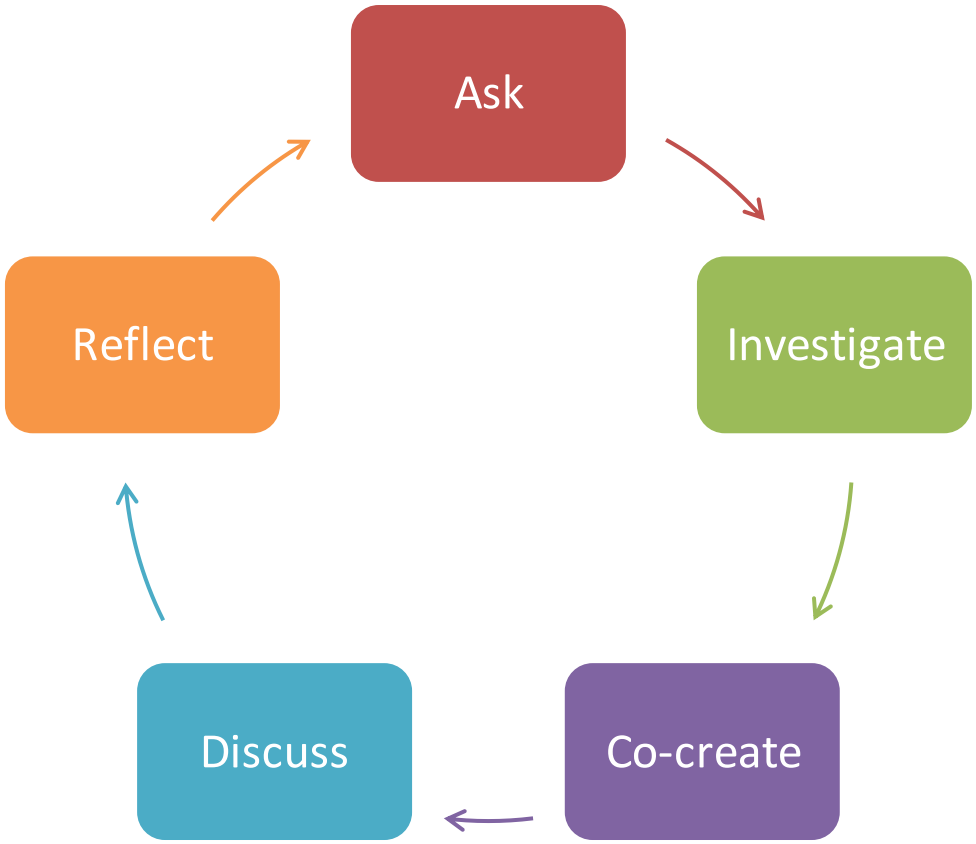
i. Students engage with a scientific question, event or phenomenon.

ii. Students explore ideas through hands-on observations and create explanations of what they observe.

iii. Students gather evidence from observations and clarify concepts and explanations.

iv. Students extend their understanding and identify applications of their findings to other situations.

v. Students reflect on what they have learned and how they have learned it.



# References


Dweck, C. (2008) “Mindset: The New Psychology for Success”, Ballantine Books, Random House, New York.

Holmes, N. (n.d.) Mindset graphic http://www.stanfordalumni.org/news/magazine/2007/marapr/images/features/dweck/dweck_mindset.pdf

Linn, M.C., Davis, E.A., and Bell, P. (2004) “Internet Environments for Science Education” Lawrence Erlbaum Associates, Mahwah, New Jersey.

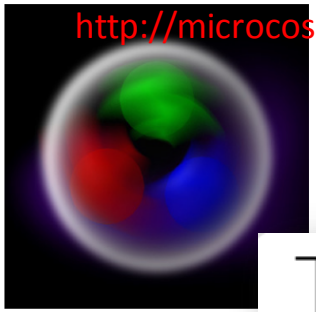
Richard, M. G. (n.d.) “Fixed mindset vs. growth mindset: which one are you?” http://michaelgr.com/2007/04/15/fixed-mindset-vs-growth-mindset-which-one-are-you/

# Where to find interesting stuff?


Zehnerpotenzen zum ANFANG

$10^{-15}$ meter = 0.000 000 000 000 001 meter

http://microcosm.web.cern.ch/microcosm/P10/german/welcome.html



Protonen und Neutronen im Kern bestehen aus jeweils drei Quarks. Im CERN werden die Wechselwirkungen der Quarks untersucht, um zu ergründen, wie bei der Geburt des Universums die elementaren Teilchen entstanden sind.

Powers of Ten™ (1977)

EamesOffice | Subscribe | 4 videos


Like | Add to | Share | 1,469,710

Uploaded by EamesOffice on 26 Aug 2010

Powers of Ten takes us on an adventure in magnitudes. Starting at a picnic by the lakeside in Chicago, this famous film transports us to the outer edges of the universe. Every ten seconds we view the starting point from ten times farther out until our own galaxy is visible only a s a speck of light among

9,423 likes, 81 dislikes

As Seen On: adafruit industries blog

The Scale of the Universe 2

Use the scroll bar to zoom in and out.

Click on objects to learn more.

By Cary Huang
Technical support by Michael Huang
Copyright © 2012 Cary and Michael Huang (http://htwins.net)
Music - "Frozen Star" by Kevin MacLeod (http://incompetech.com)

Start


# From Telescopes to Accelerators

15 partners

9 countries

BERKELEY LAB
Lawrence Berkeley National Laboratory

CERN

TECHNISCHE UNIVERSITÄT DRESDEN

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IoA
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NUCLIO
NÚCLEO INTERACTIVO DE ASTRONOMIA

SCIENCE VIEW

UNIVERSITY OF BIRMINGHAM

bm:uk Bundesministerium für Unterricht, Kunst und Kultur

ΕΛΛΗΝΟΓΕΡΜΑΝΙΚΗ ΑΓΩΓΗ

SEVENTH FRAMEWORK PROGRAMME

e-infrastructure

# e-Infrastructures

www.discoverthecosmos.eu





## Particle Physics

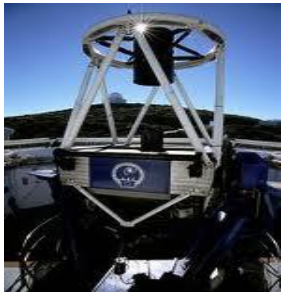
LHC

ATLAS

CMS

## Astronomy

Gaia



The Liverpool Telescope

The Faulkes Telescope

# e-Science Applications

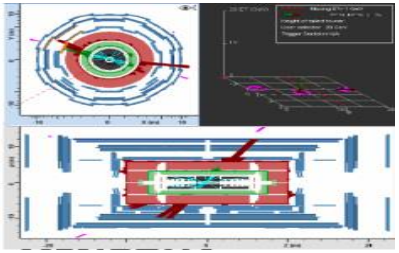




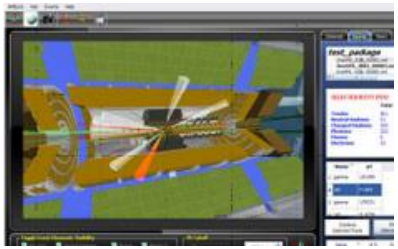
www.discoverthecosmos.eu

## Particle Physics

HYPATIA



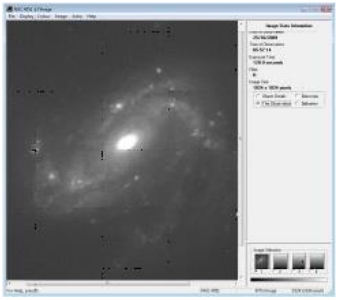
MINERVA



AMELIA

## Astronomy

SalsaJ



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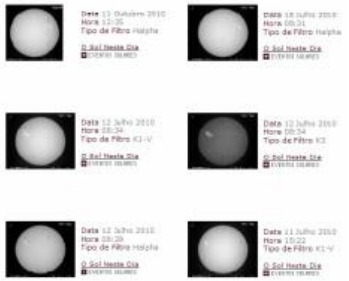
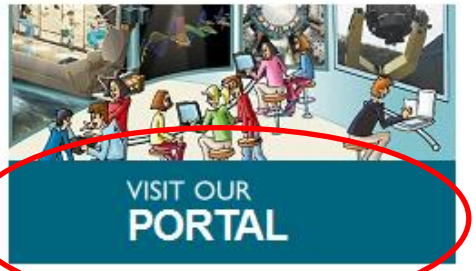


Sun for All

# Discover the COSMOS Portal

www.discoverthecosmos.eu








http://portal.discoverthecosmos.eu/

SEVENTH FRAMEWORK PROGRAMME

e-infrastructure

# We need engaging science instruction

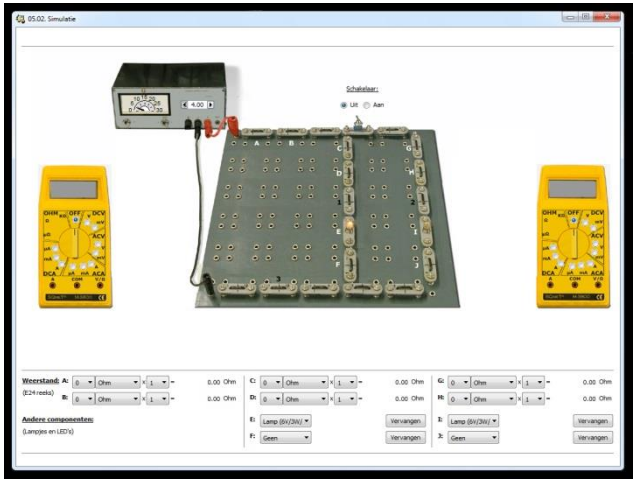
# Attractive science instruction

- Constructive (inquiry) learning
  - Computer simulations/games
  - Virtual laboratories
  - Modeling (design) environments
- Collaborative learning
  - Shared objects
  - Chats, video conferencing
- Situated learning
  - Remote/virtual laboratories
  - Simulators (e.g., medicine)

# Is there a “best of both worlds”?

- Students learning in a sequence (parallel or sequential) of simulation and real laboratory outperform the simulation and/or laboratory
  - Zacharia & Anderson, 2003
  - Zacharia, 2007
  - Jaakkola & Nurmi,  2008
  - Zacharia, Olympiou, & Papaevripidou, 2008
  - Jaakkola, Nurmi, & Veermans, 2011
  - Zacharia & de Jong, submitted

# Example study



- Participants:
  - Vocational education
  - *n* = 43
  - intermediate level vocational engineering training
  - boys; age 16-22 year (*M* = 19,17; *SD* = 1,39)
  - High prevalence of dyslexia (34,9%)

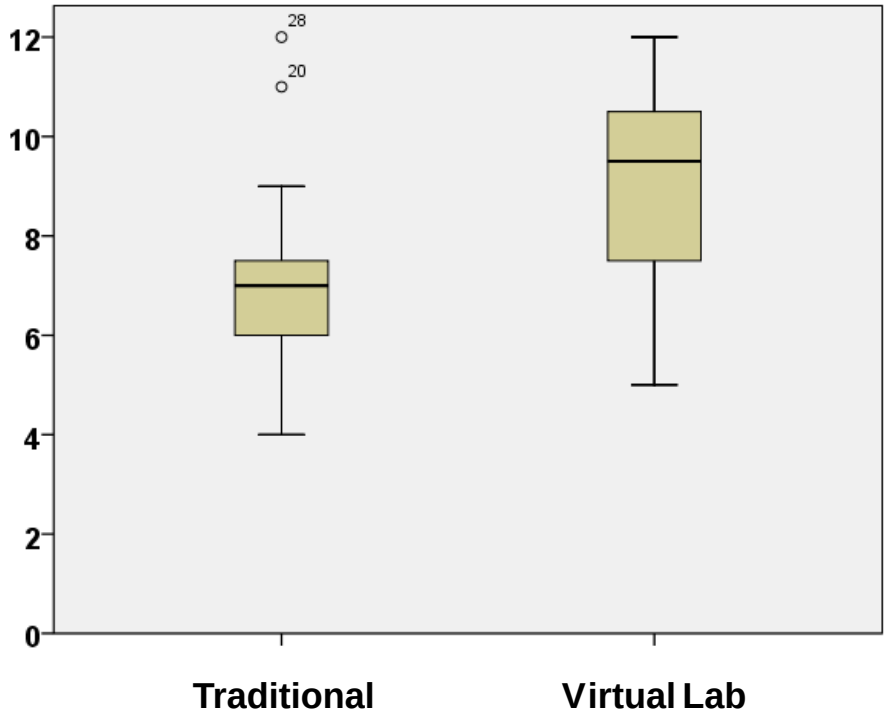
# Method

| | | | |
|---|---|---|---|
| **Simulation =** | **Traditional instruction** | **+** | **Virtual lab-based inquiry learning** |
| **Traditional =** | **Traditional instruction** | **+** | **Extra (traditional) instruction** |

# Results

- Post-test:
  - Total score

($p < .01$; Cohen's $d = 0{,}98$)



# What Go-Lab offers



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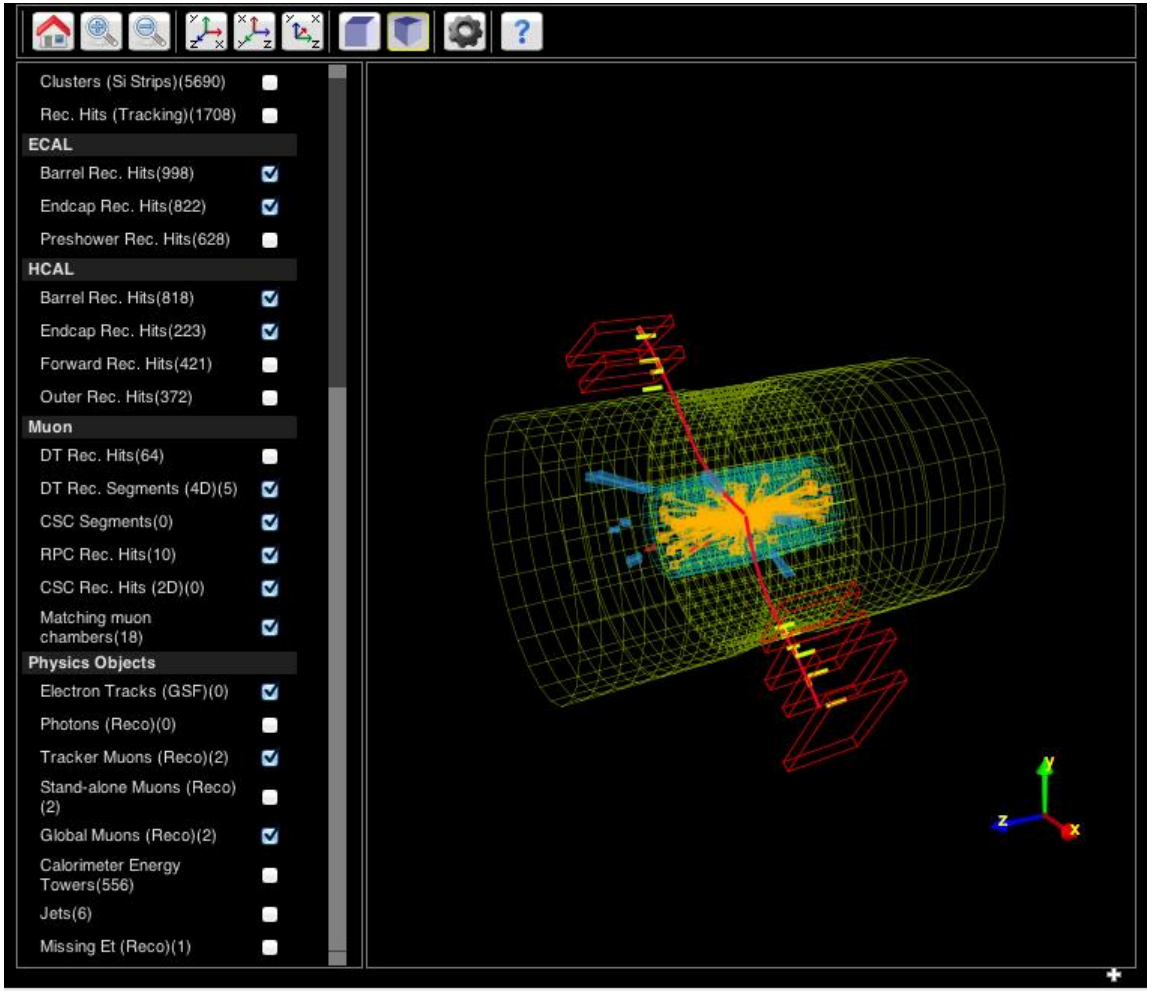
  for their students

# What Go-Lab offers




**Lab Type**

Virtual Lab (14)
Remote Lab (7)
Database (6)

**Filter by subject:**

Astronomy (9)
Particle Physics (5)
Physics (4)
Biology (2)
Electronics (2)
Environmental Science (2)
Geography (2)
Mathematics (2)
Multiple (2)
Astrophysics (1)
Electromagnetism (1)
Engineering (1)
Environmental Sciences (1)

# What's up @ CERN?

CERN OPENDAYS

Our Universe is Yours

*Notre Univers est le vôtre*

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**CERN opens its doors September 28th - 29th**


ATLAS LIVE

**ATLAS Virtual Visits**

Sofia Science Festival, Bulgaria

Share on

Sofia

10 May - 11:00 CET

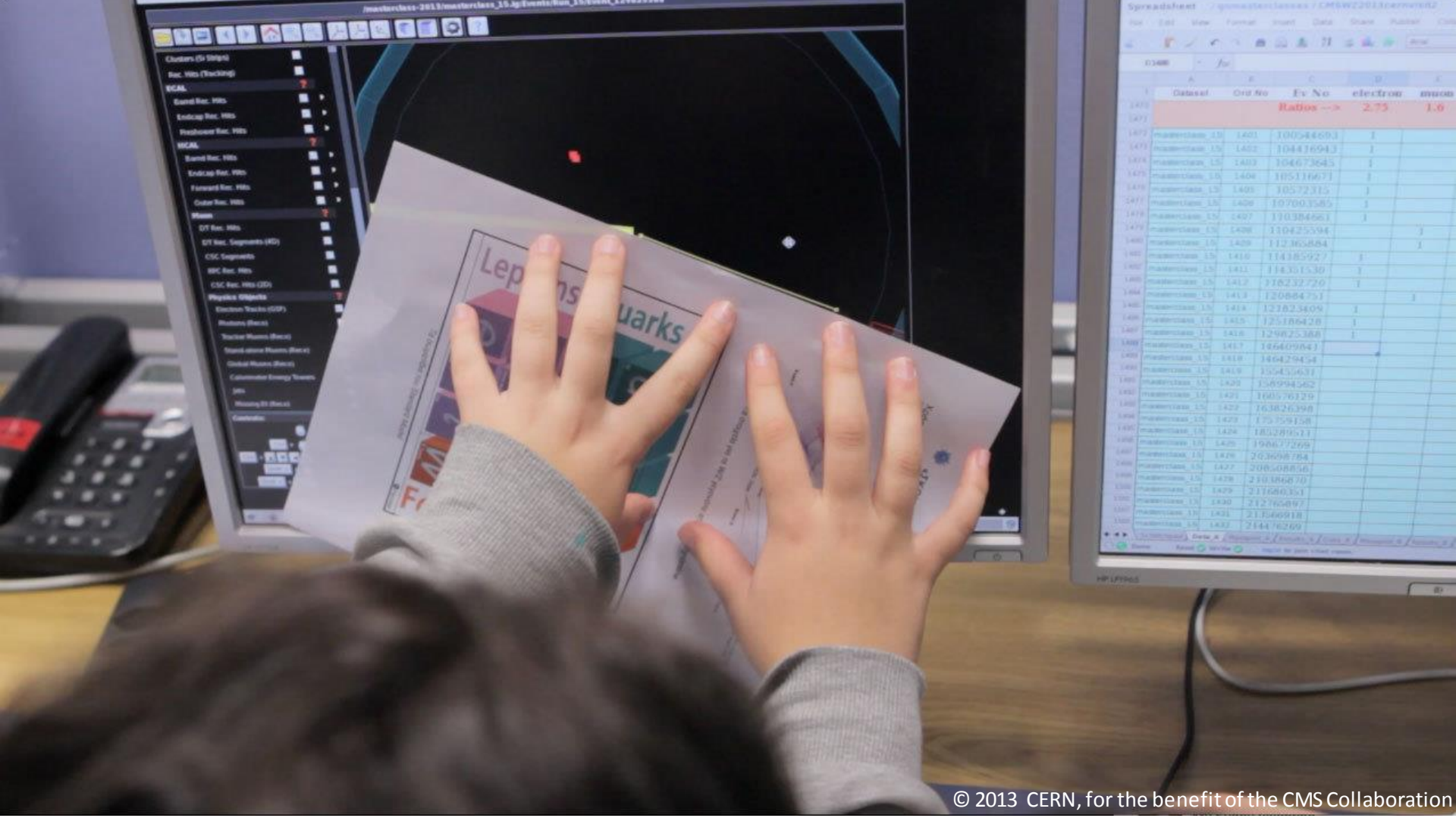
Have you ever imagined that you could have access to CERN, one of the word's largest and most respected centres for scientific research? Have you ever imagined that you could have access to science educational material with just one click? The Discover the COSMOS project goes to this year's Sofia Science Festival and


Angelos Alexopoulos and George Salukvadze in the ATLAS Control Room and participants of the workshop in Sofia.

**Hangouts with CERN**

by CERN

Play all





Thank you!

angelos.alexopoulos@cern.ch