BRINGING NOBEL PRIZE PHYSICS TO THE CLASSROOM

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Research and Development Department,
Ellinogermaniki Agogi,
Greece

FRONTIERS Visionary Workshop: Paris, 30-11- 2019

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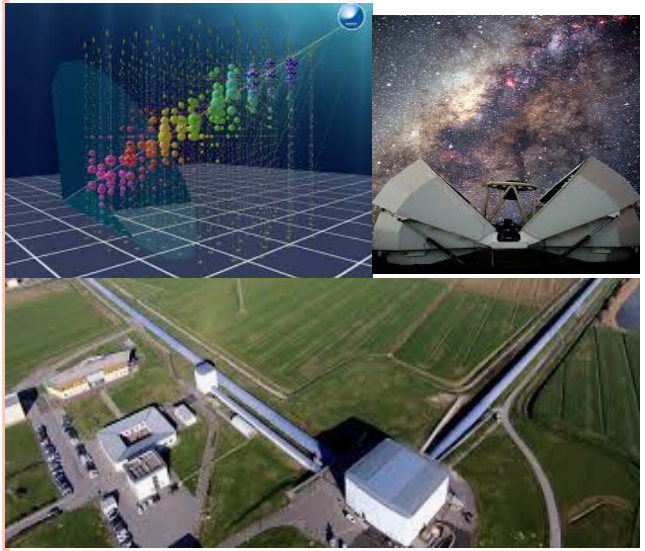

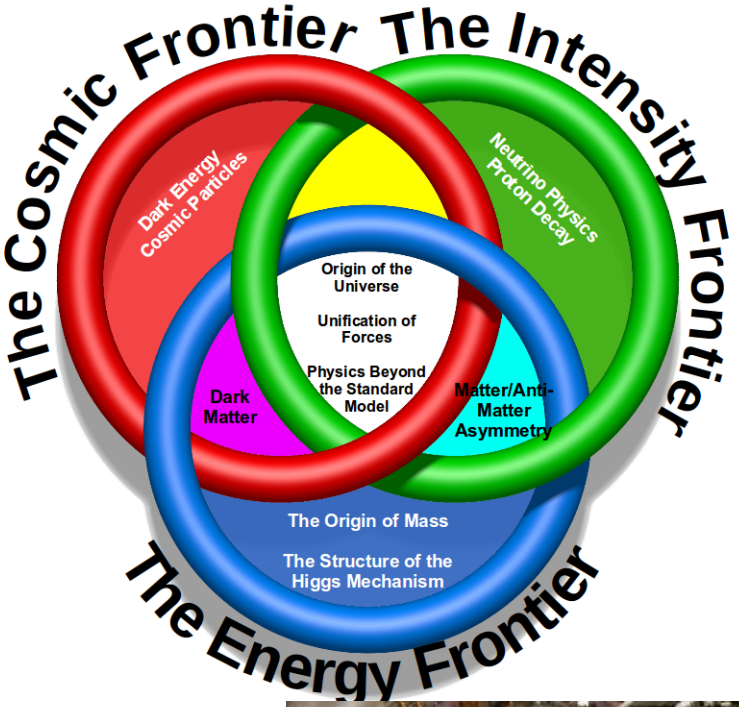

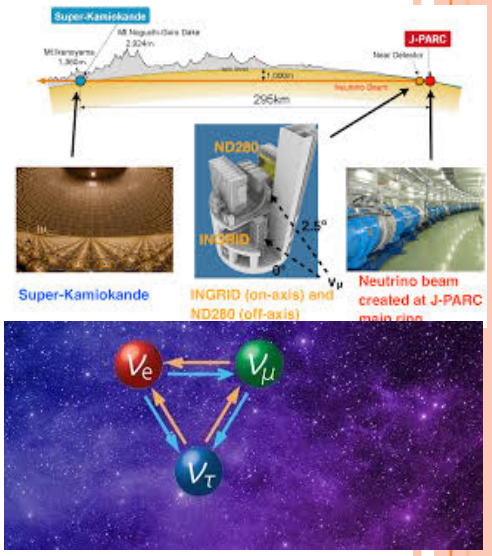

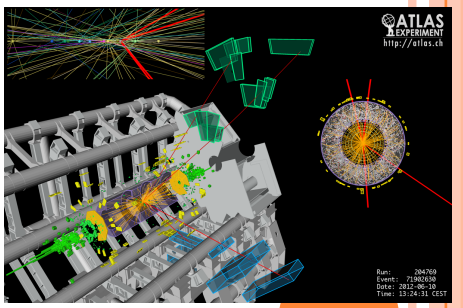

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Game Changing
Scientific Discoveries with great media coverage

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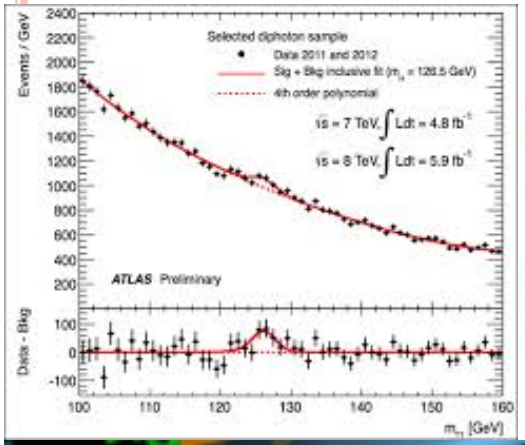
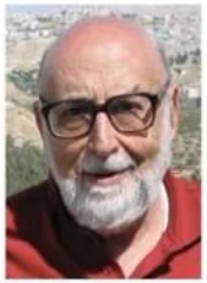


Physics 2013



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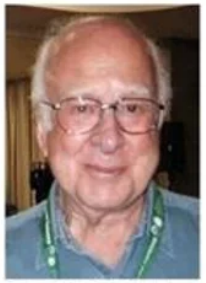

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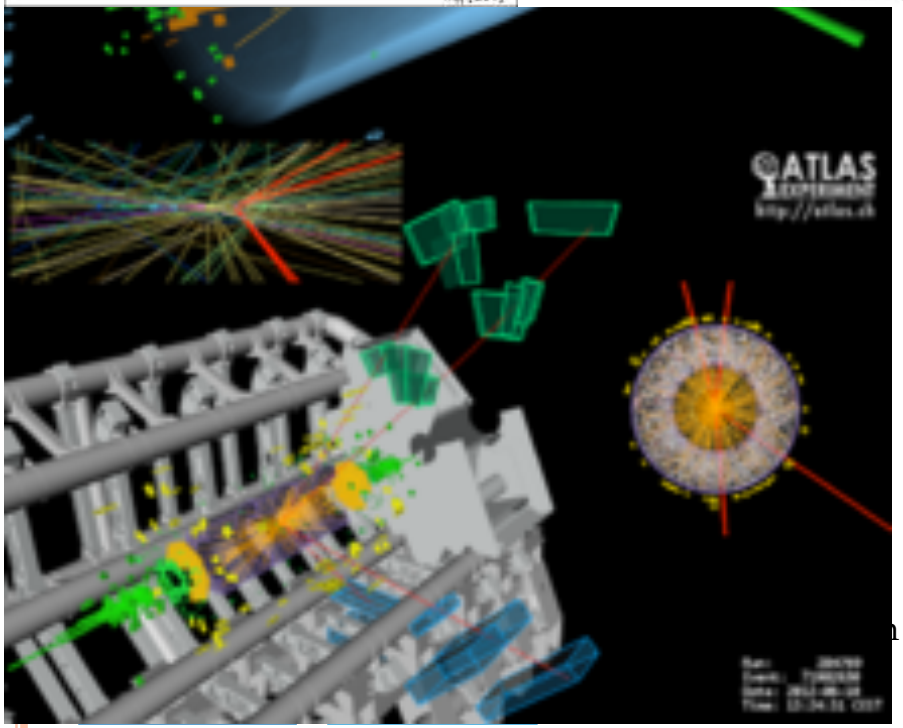

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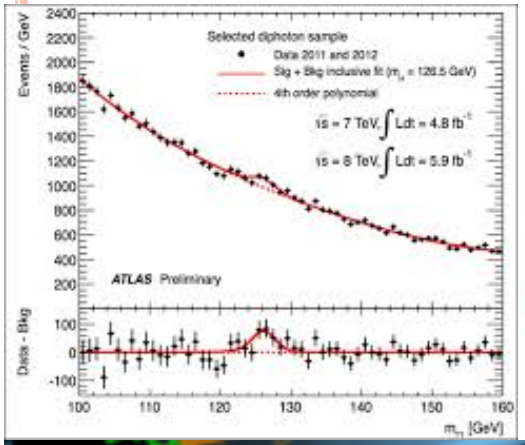

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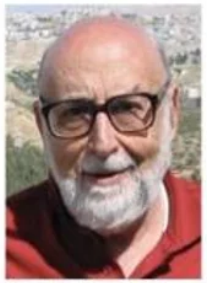

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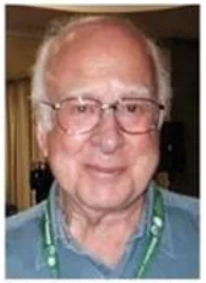

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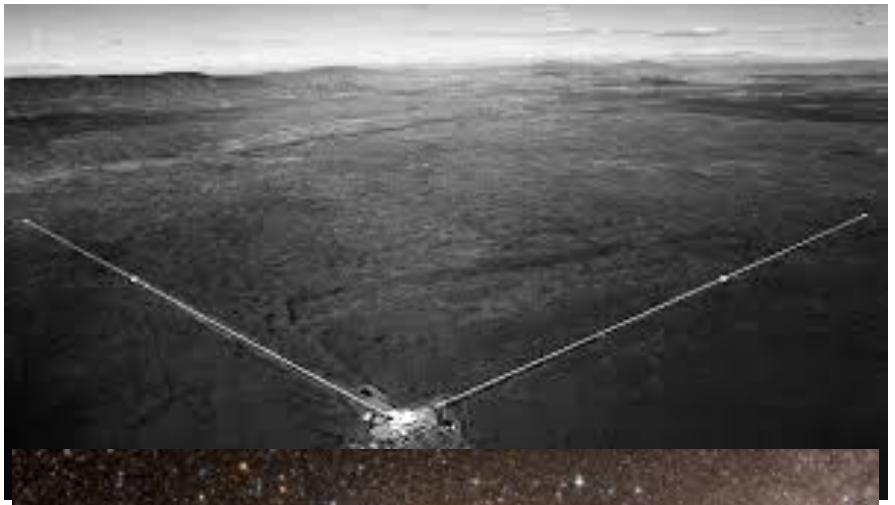

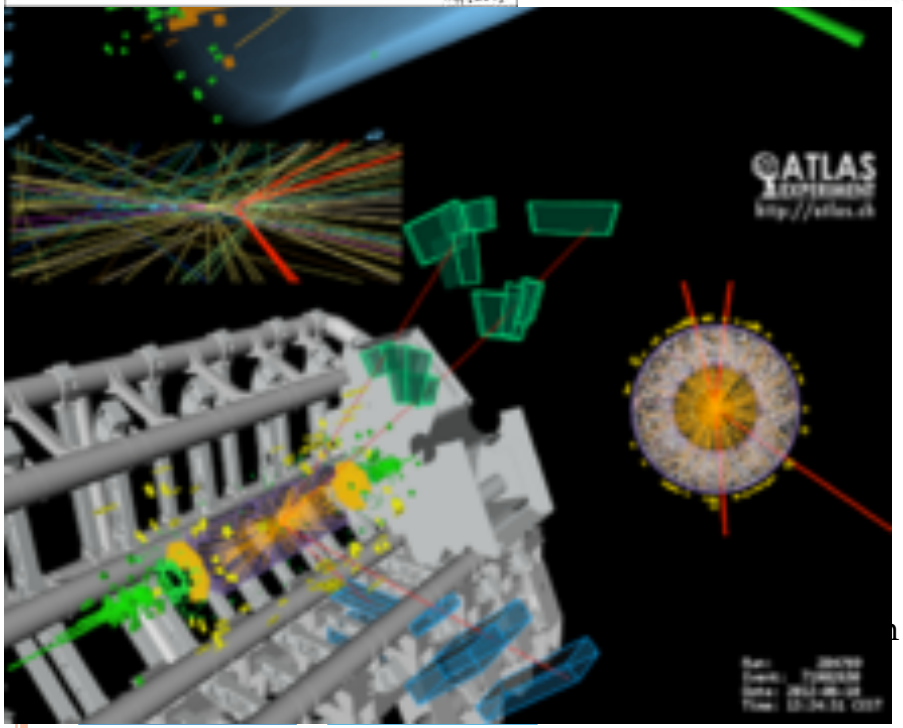

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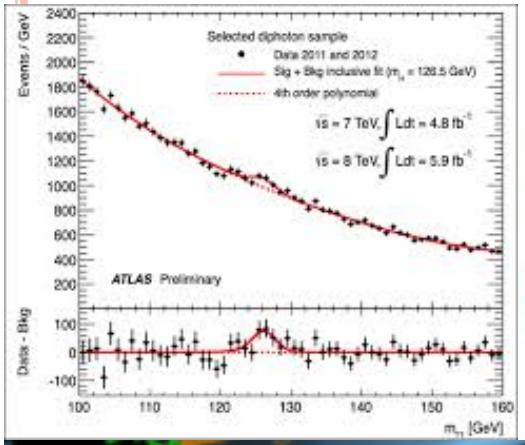

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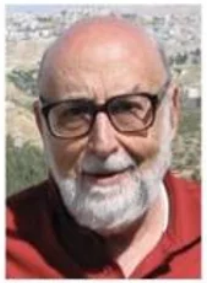

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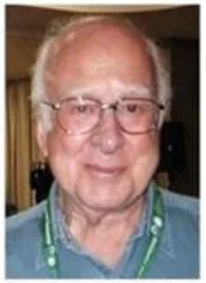

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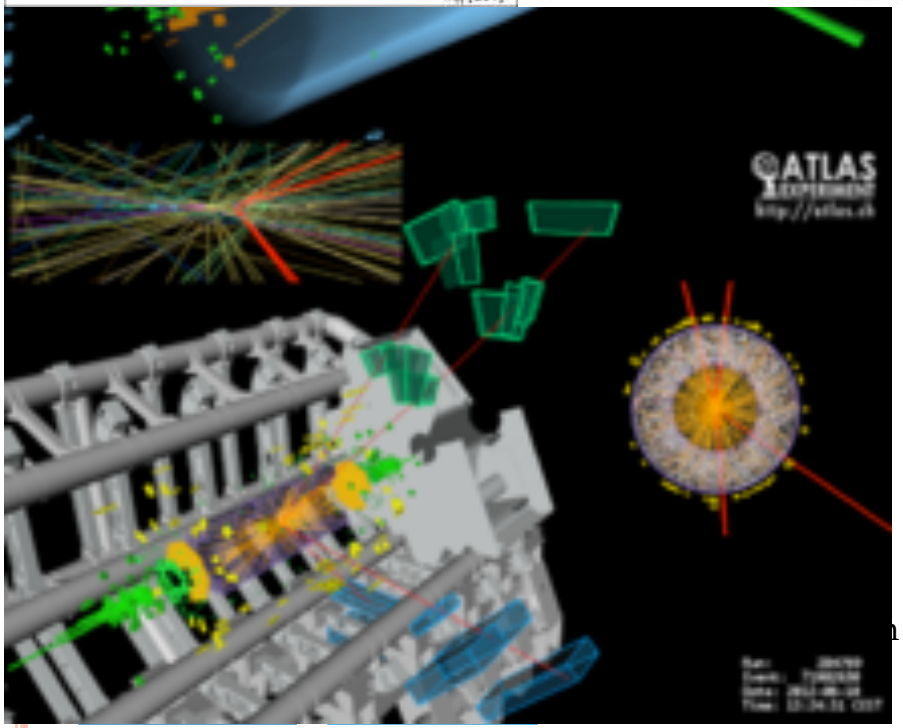

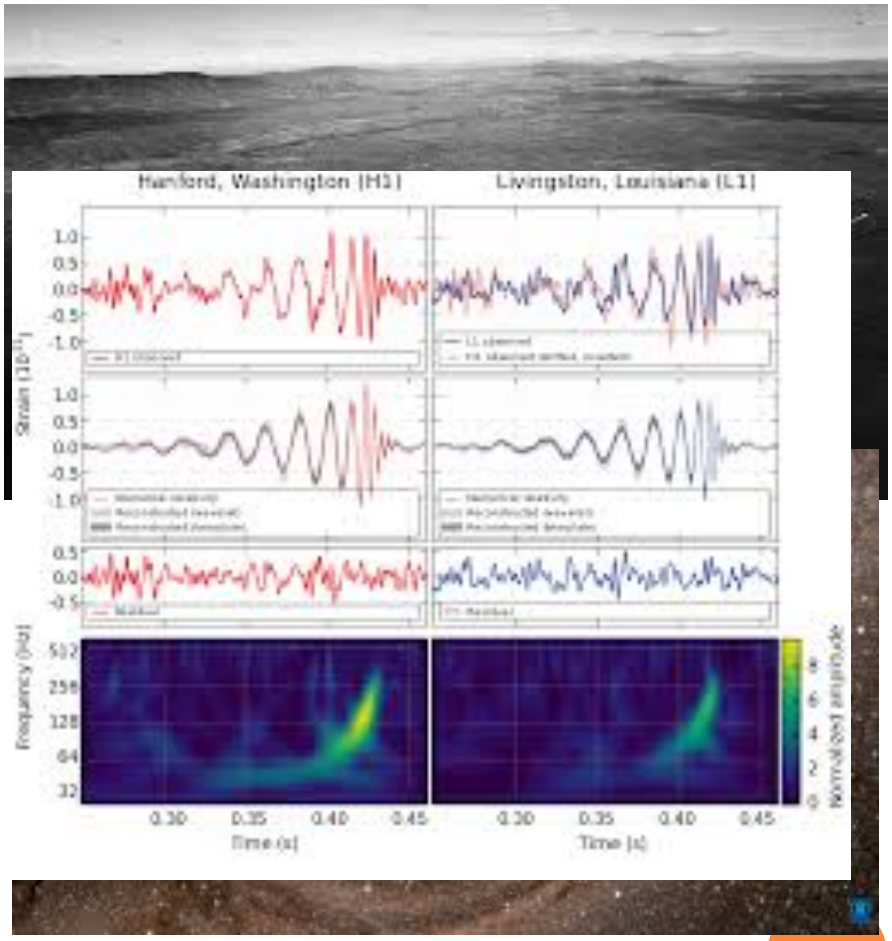

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And unprecedented impact in humankind

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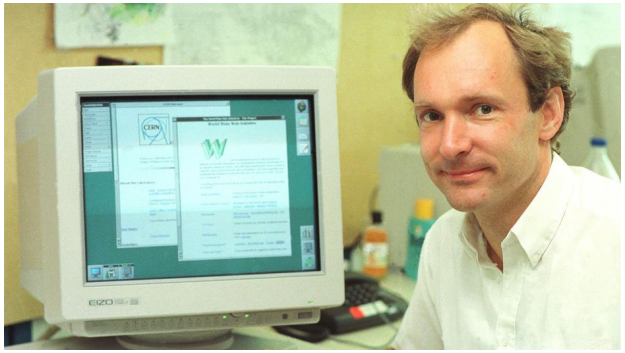

The World Wide Web

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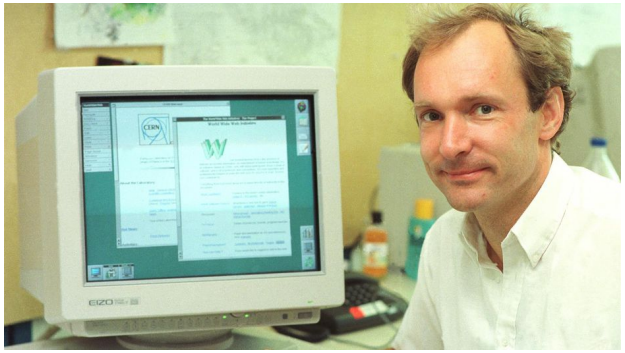
The Impacts of Large Research Infrastructures
on
Economic Innovation and on Society:

Case Studies at CERN

OECD



The World Wide Web

Proton therapy

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The Impacts of Large Research Infrastructures
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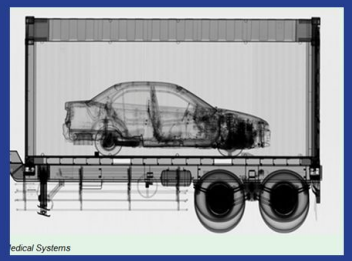
Accelerators for National Security



More than two billion tons of cargo pass through U.S. ports and waterways annually. Many ports now screen cargo for weapons or nuclear materials with gamma-ray scanners, based on radioactive isotopes such as cobalt-60 .However, high-energy X-rays generated by particle accelerators can make this process faster, cheaper, and safer

24 PASI, March 2013 - S. Holmes/R. Kephart Fermilab

The World Wide Web

Proton therapy

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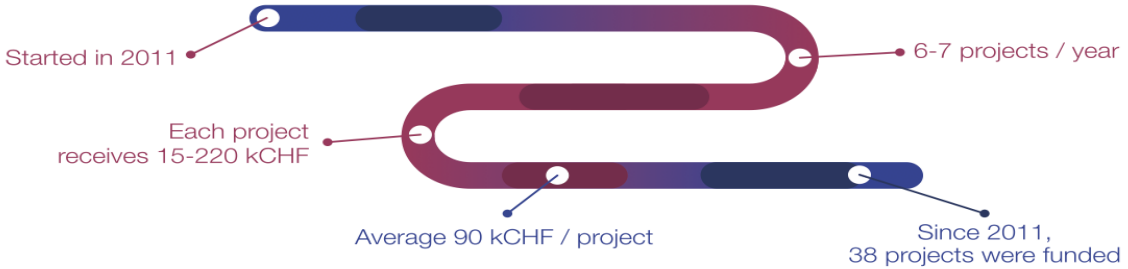

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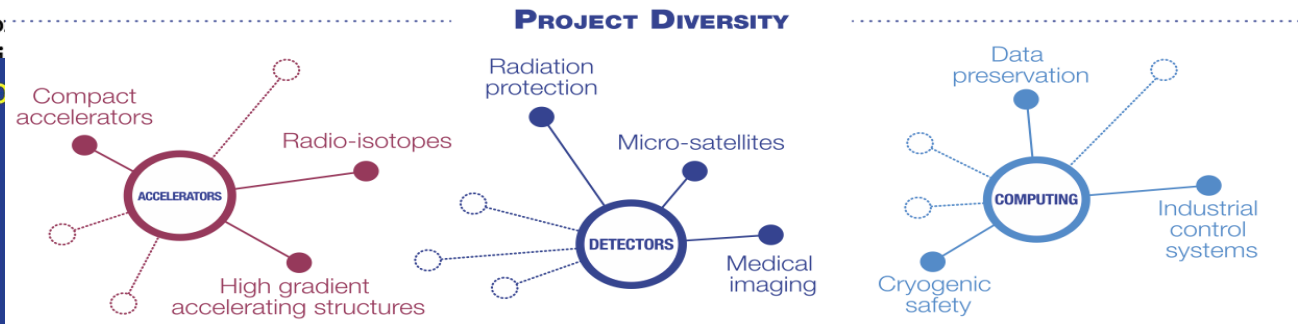
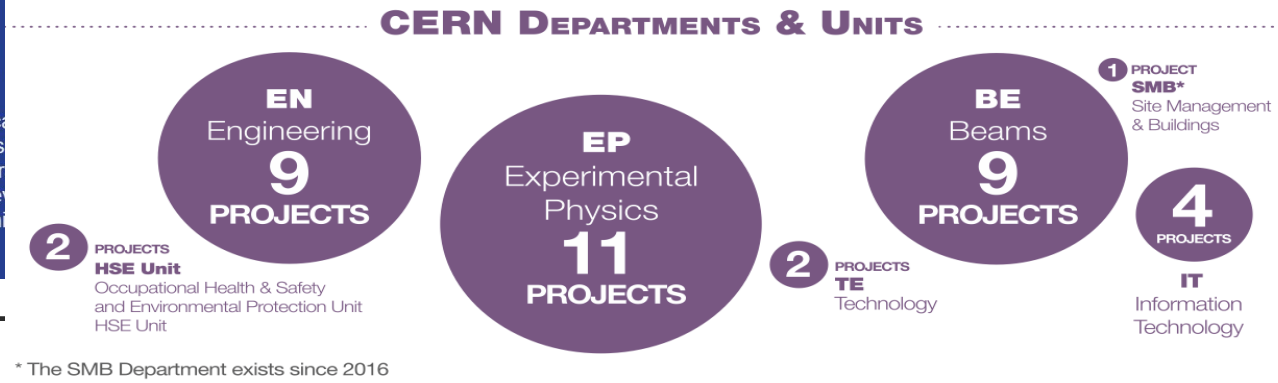


therapy



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And unprecedented impact in humankind

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YET.. IF YOU SEARCH CERN ON YOUTUBE

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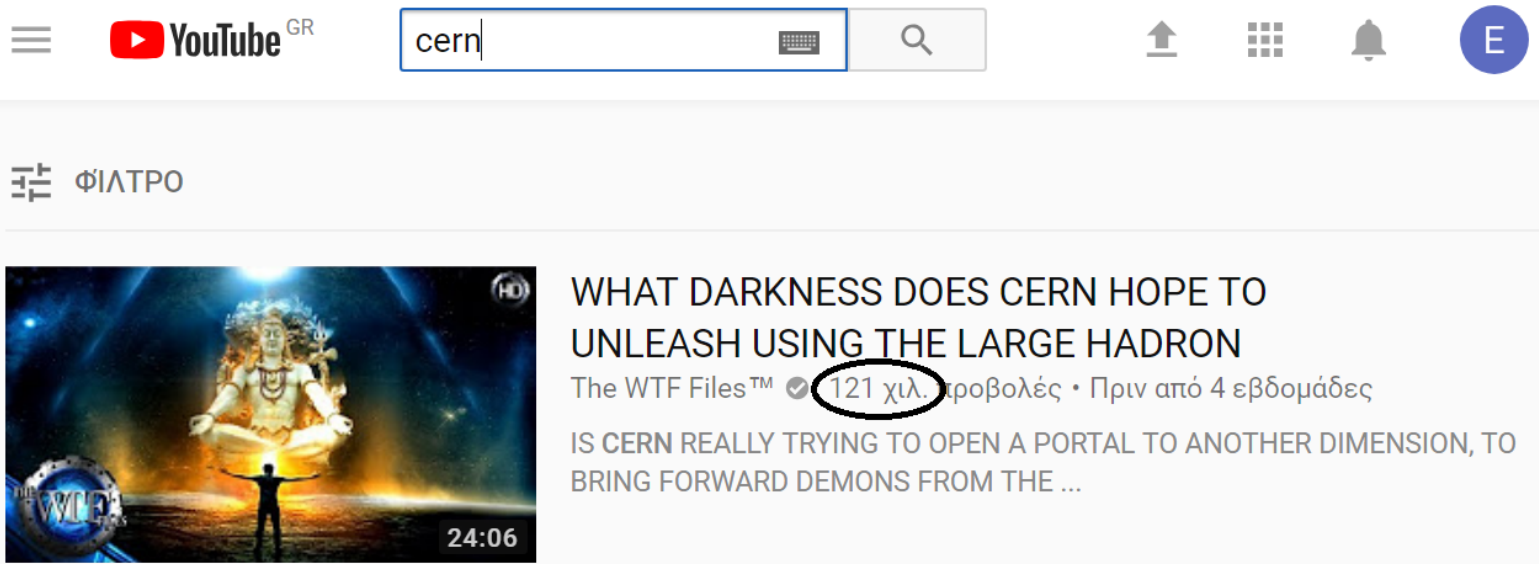

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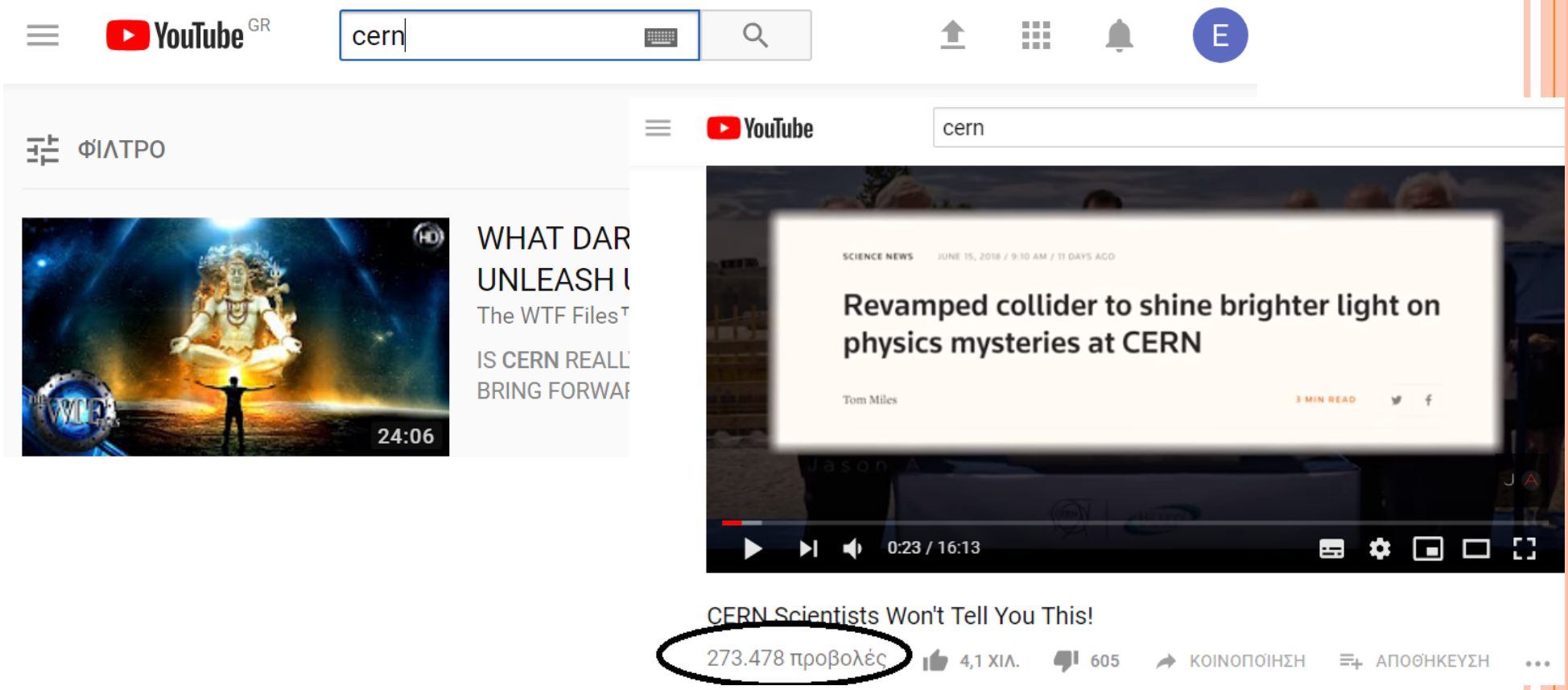

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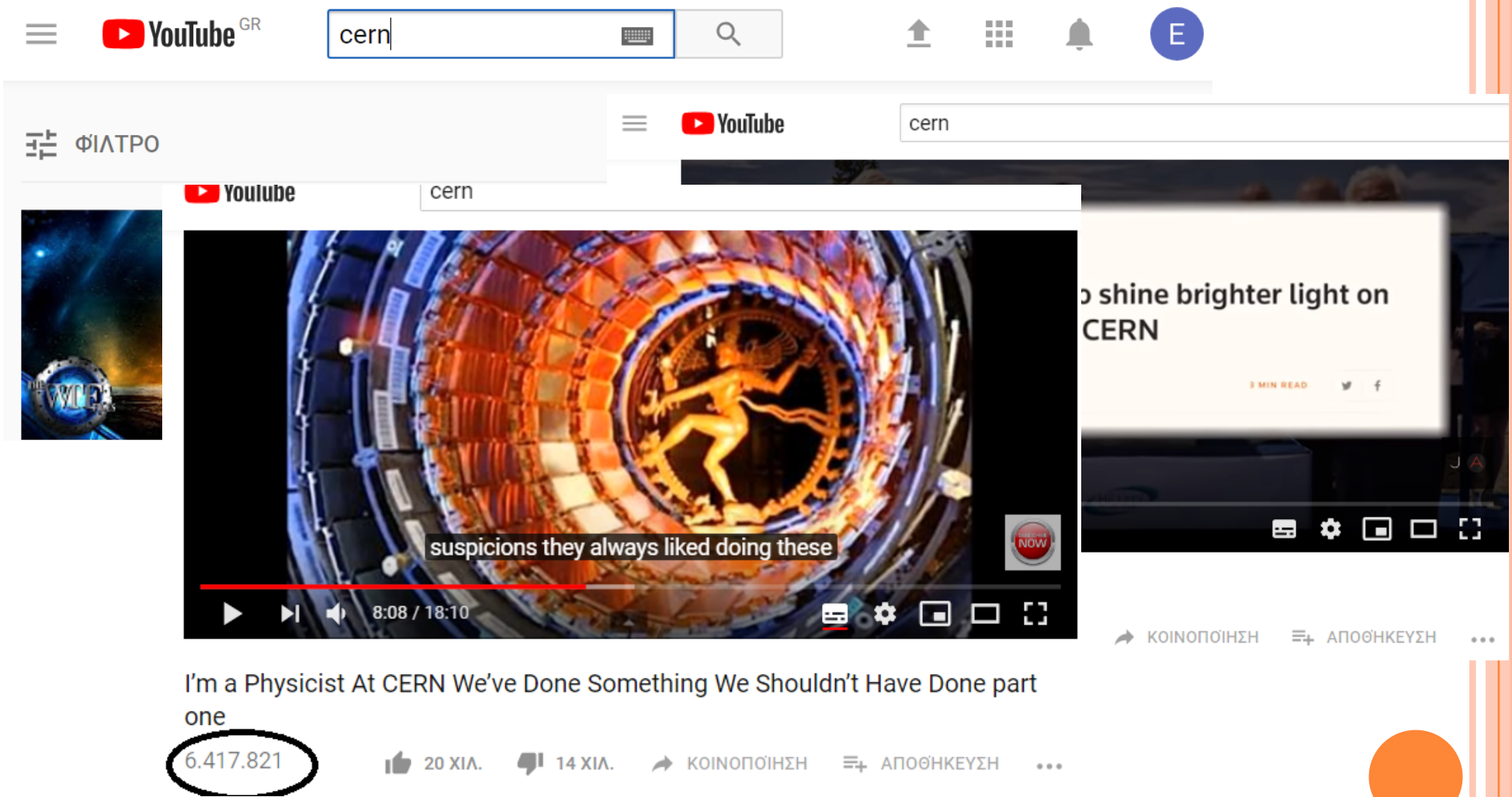

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Or ..Flat Earth

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IT ALL STARTS FROM EDUCATION..

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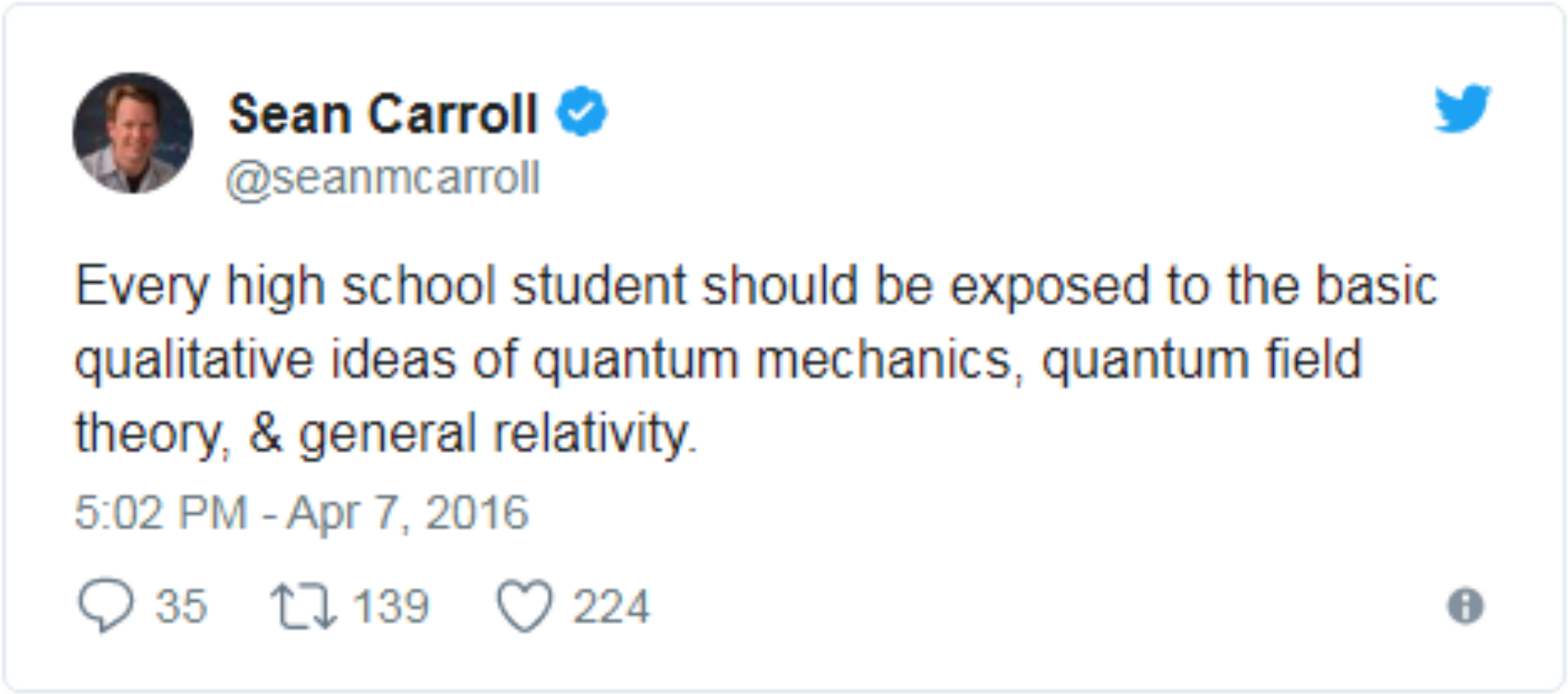

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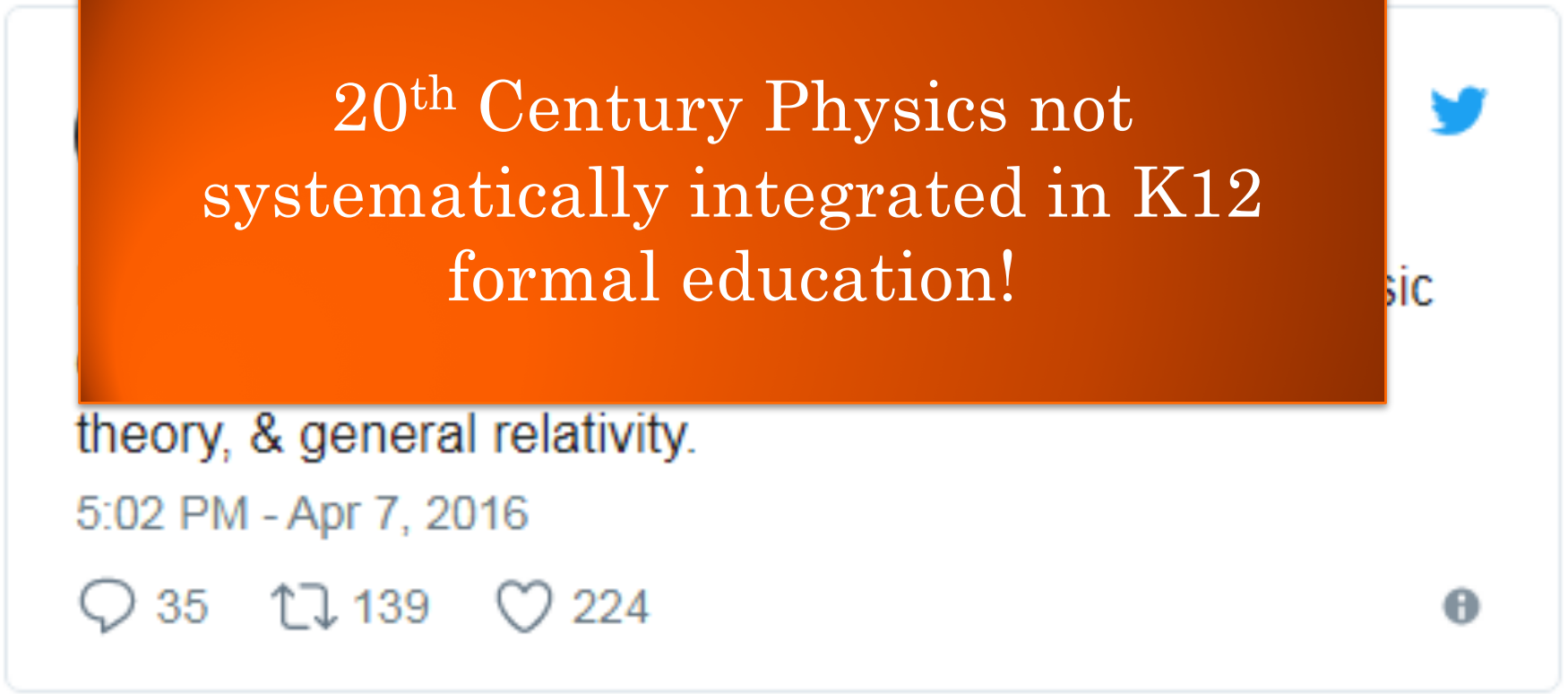

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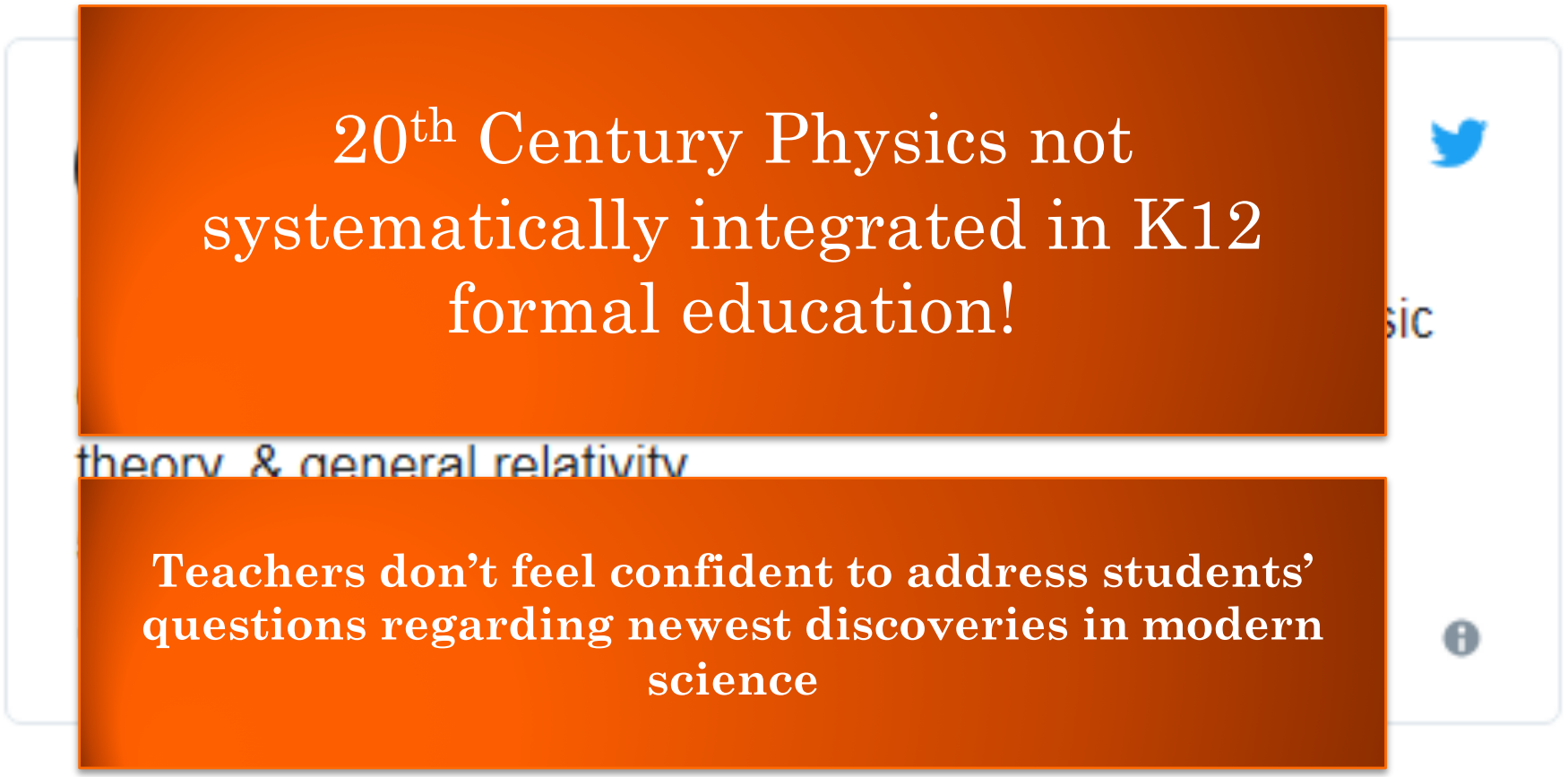

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Many education and outreach initiatives, especially in HEP and Astronomy

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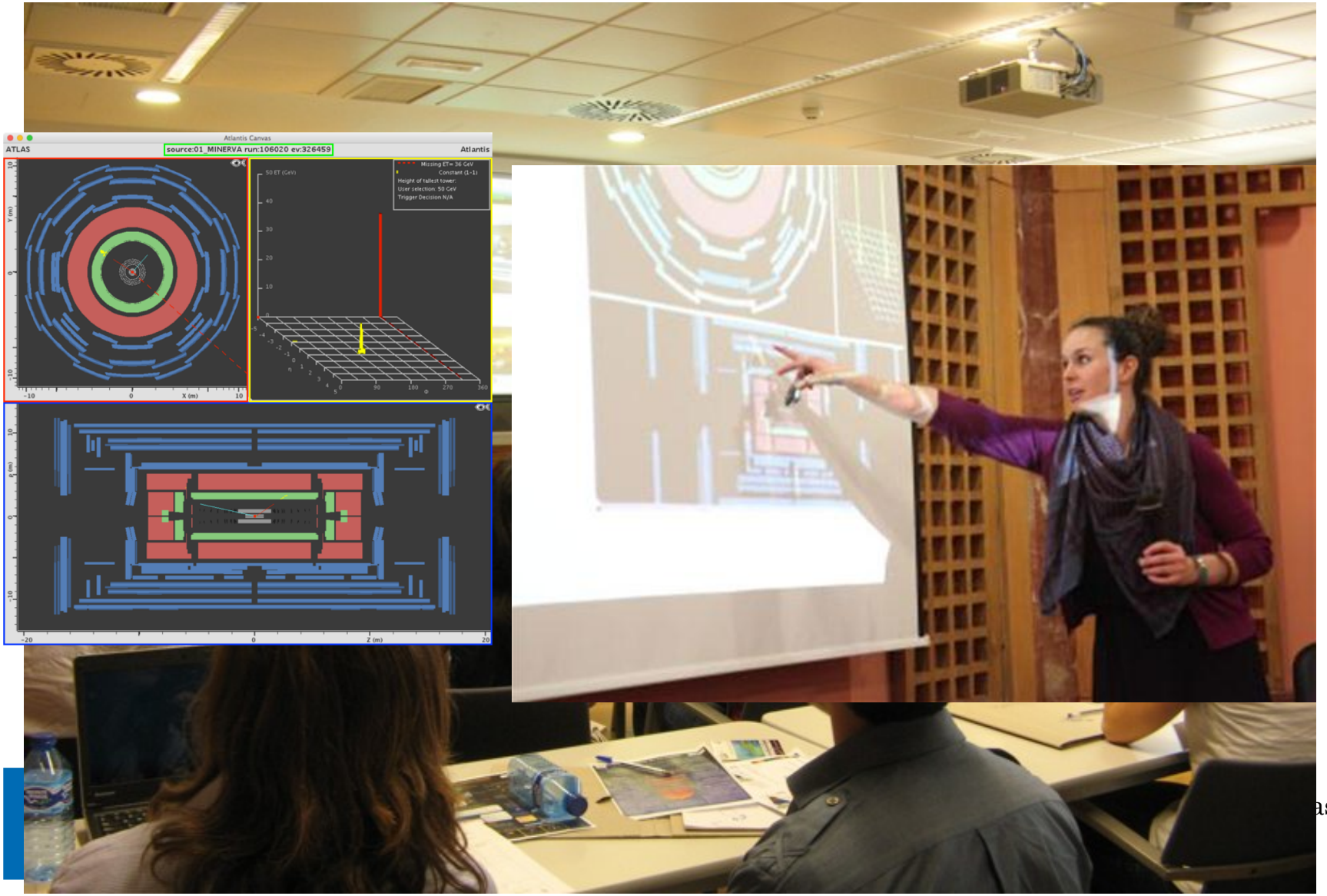

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WITH DOCUMENTED IMPACT

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With documented impact

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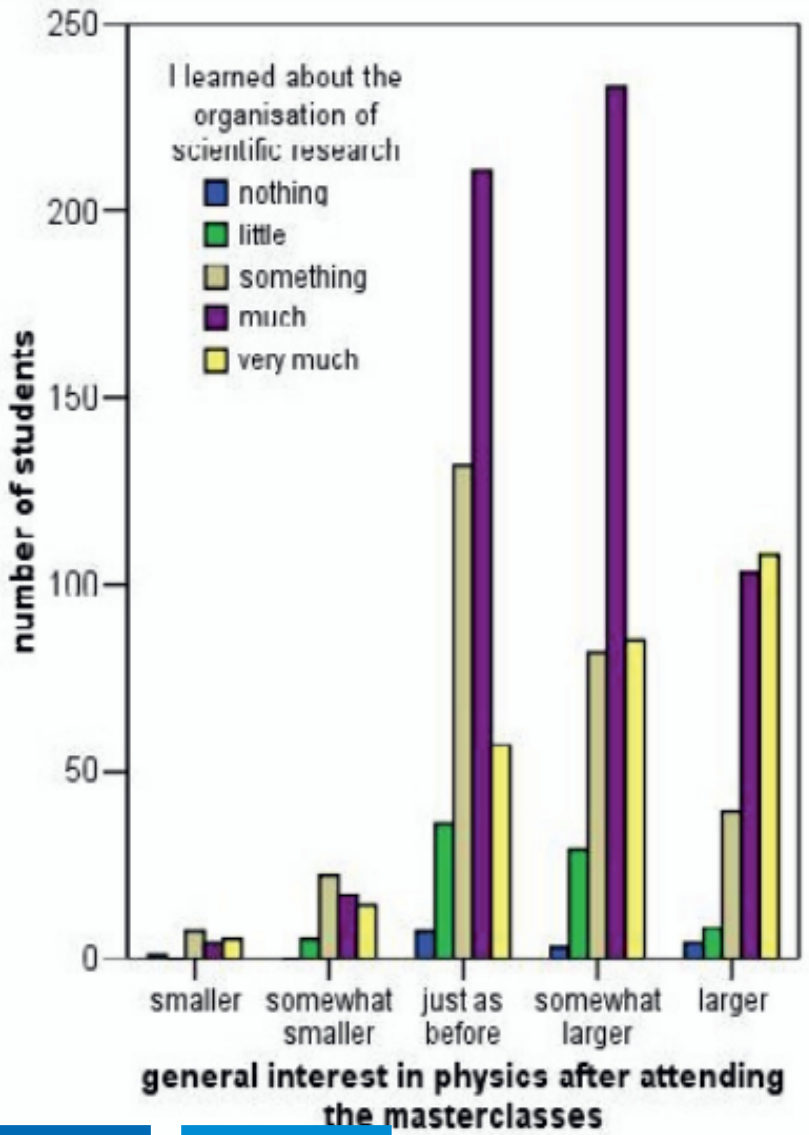
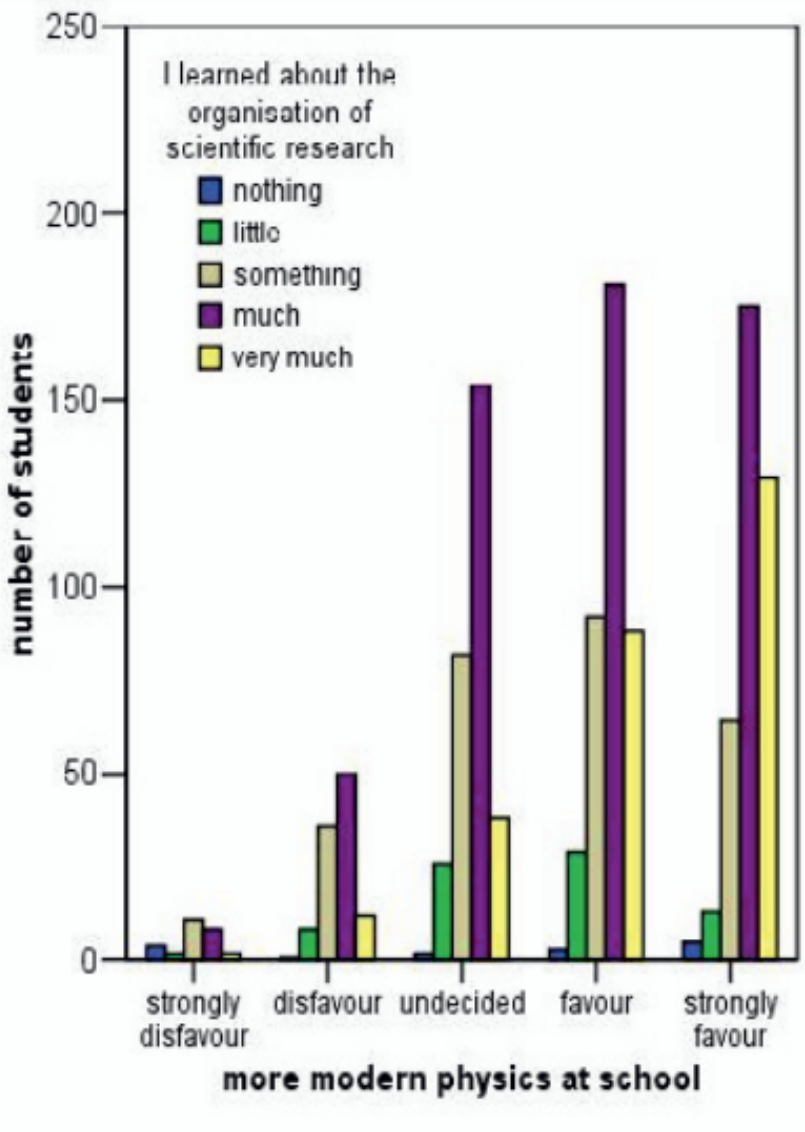
http://inspirehep.net/record/1294255/files/epjconf_icnfp2013_00017.pdf





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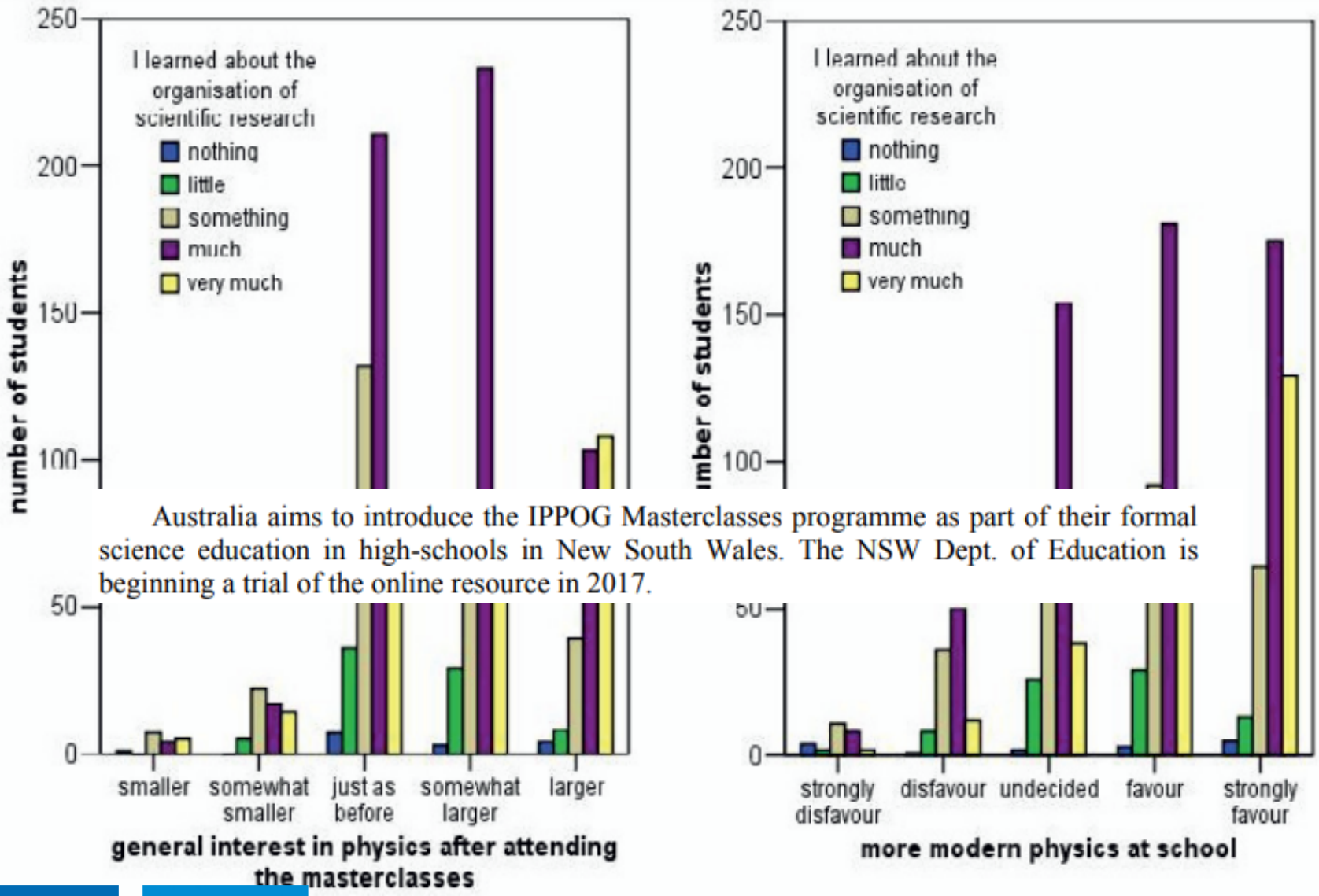

Australia aims to introduce the IPPOG Masterclasses programme as part of their formal science education in high-schools in New South Wales. The NSW Dept. of Education is beginning a trial of the online resource in 2017.

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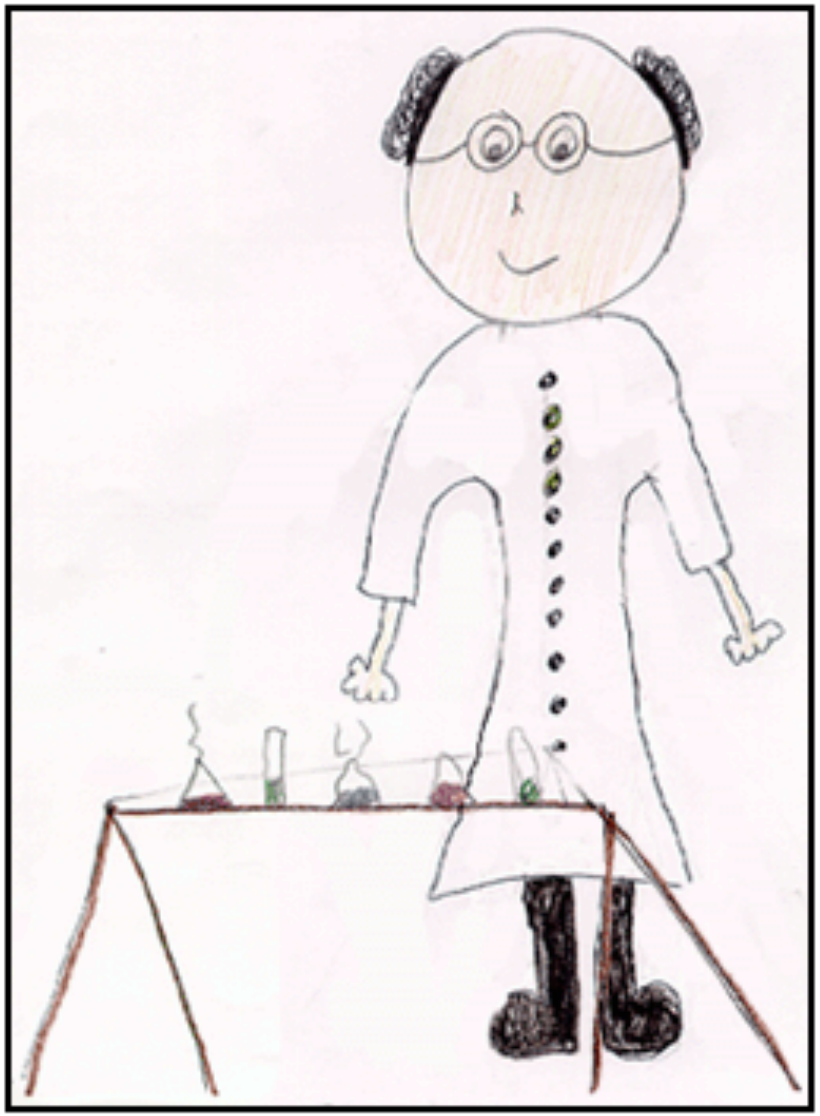
AND THE POTENTIAL TO CHANGE STUDENTS' VISION OF SCIENCE AND SCIENTISTS..

WHAT DOES A SCIENTIST LOOK LIKE?

Student answers after a visit at Fermi National Laboratory (Fermilab) in USA

BEFORE



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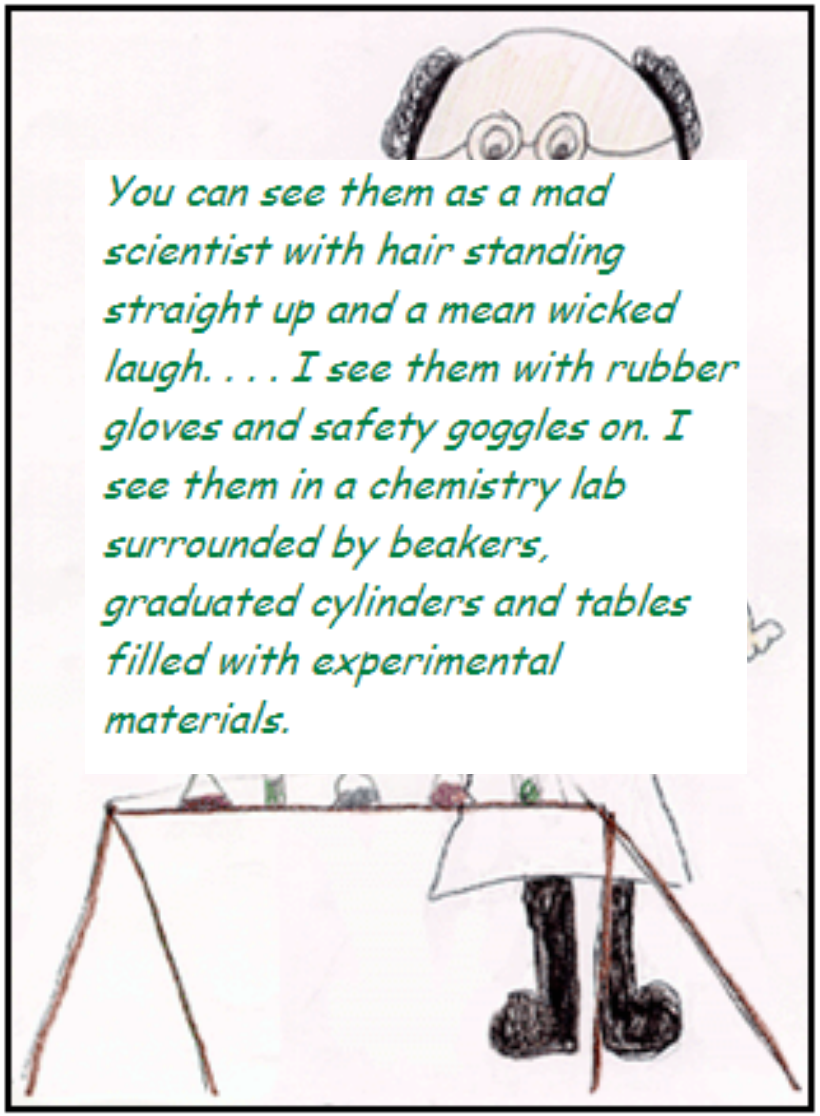

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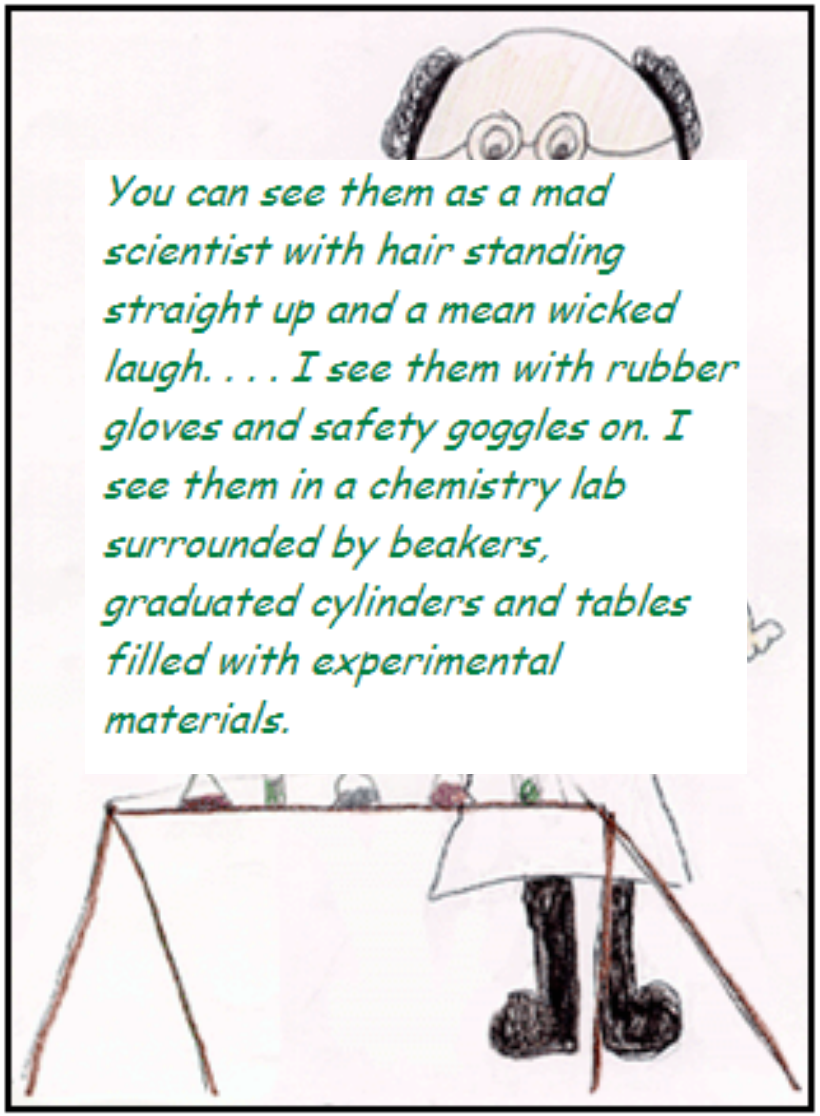

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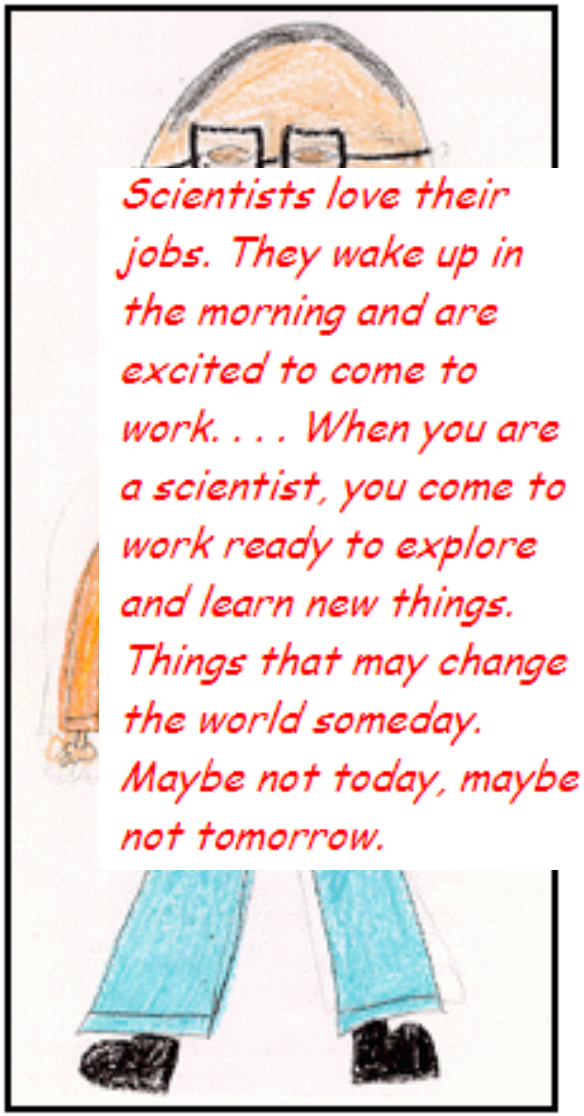
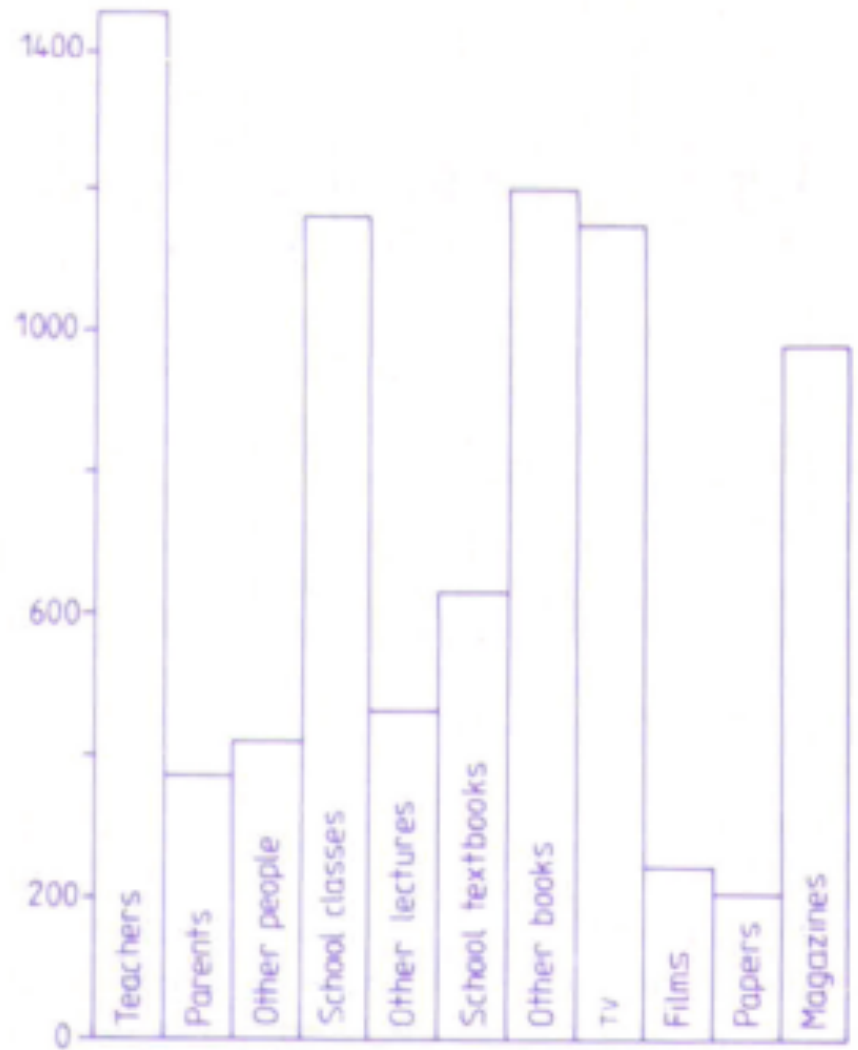


As well as potential to attract students to science careers



- Research on more than 2000 college students in Physics in UK.

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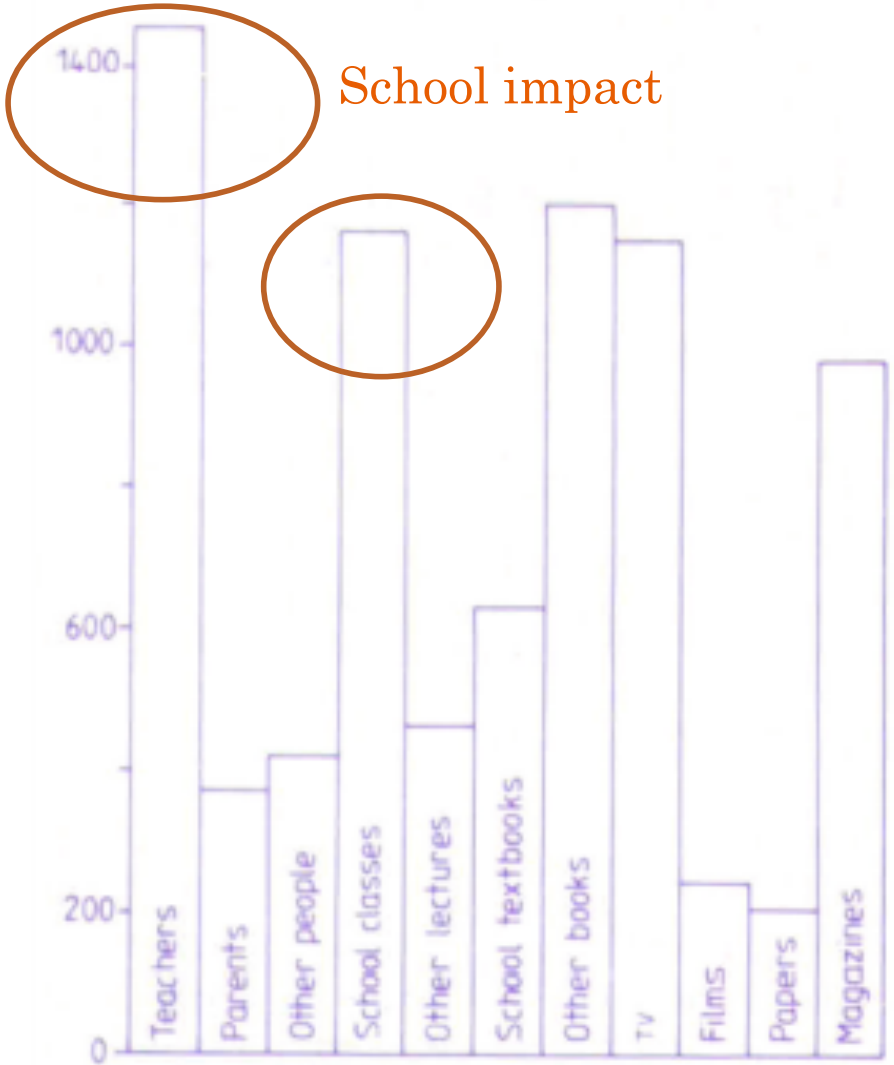

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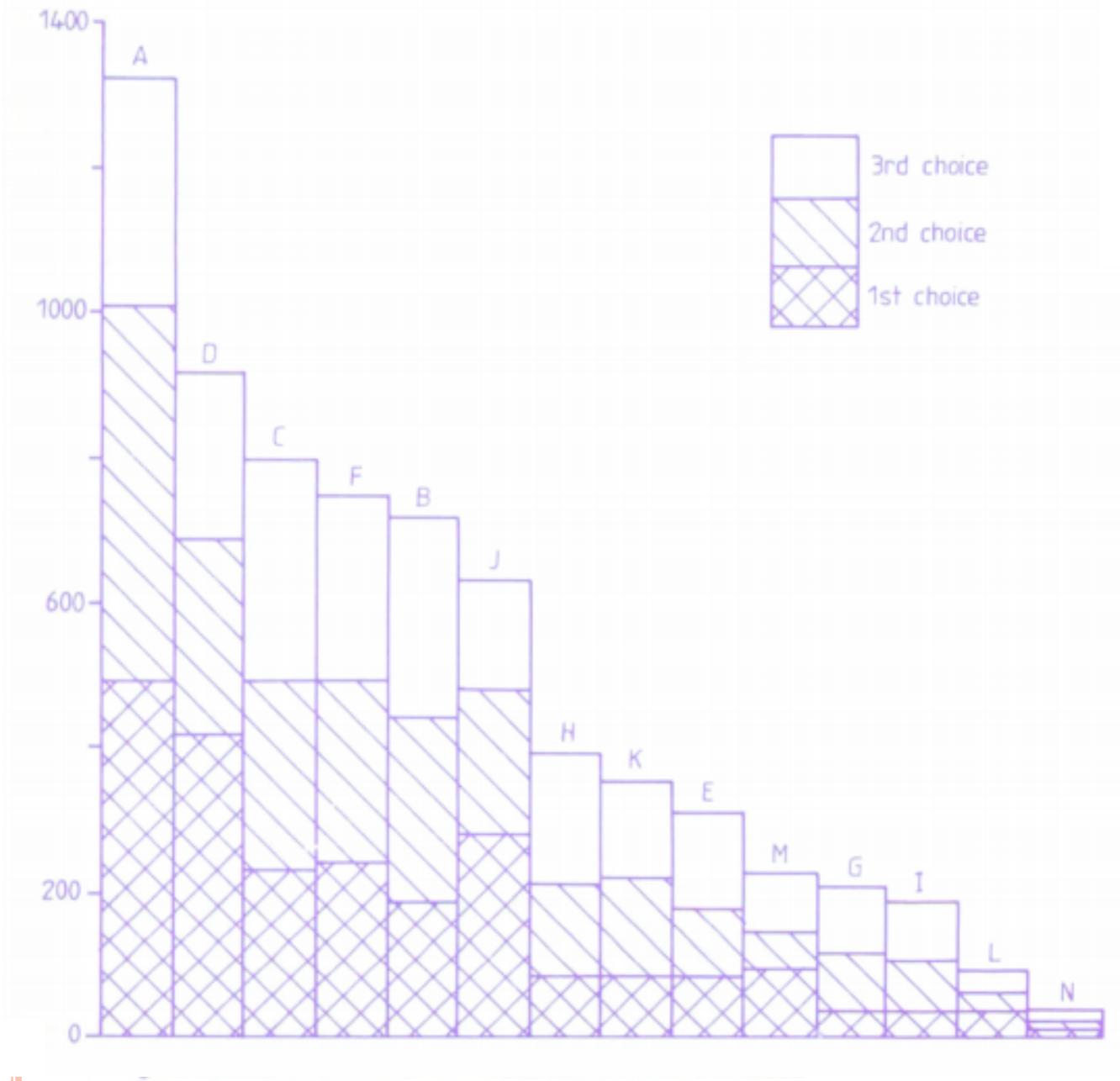
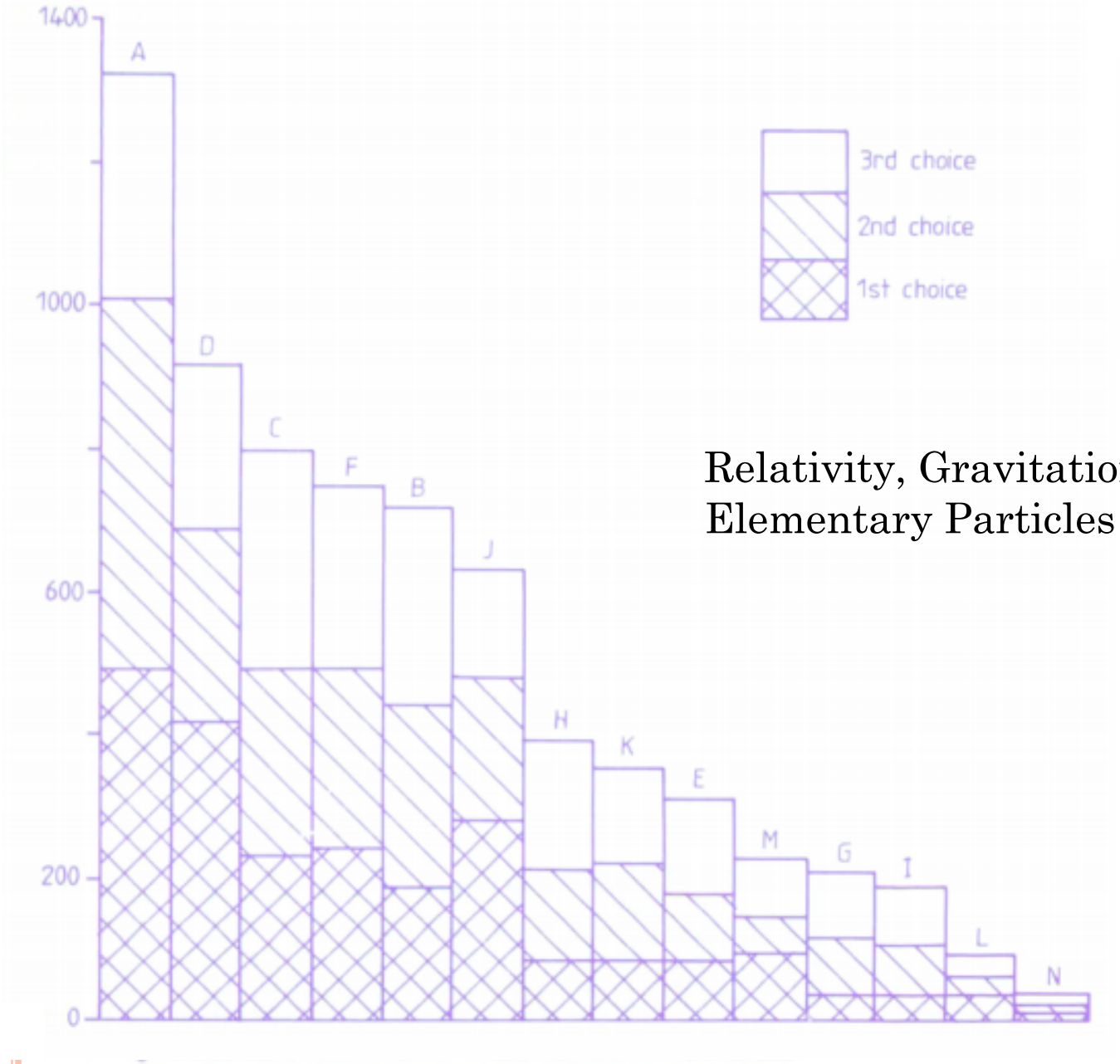


A Relativity and gravitation
B Quantum theory, other theoretical physics
C Elementary particles
D Astronomy, astrophysics, cosmology, space research
F The nucleus, nuclear energy
H Optics
I Atoms, molecules, chemical physics
J Electronics
K Computing



Relativity, Gravitation, Astrophysics and Elementary Particles in students' top 5 list.

SOME TEACHER FEEDBACK

Feedback from teachers in Brazil who participated in HEP Masterclasses

*"**Materials for studying and teaching**. The High School books **do not cover these topics**" (T14)*

*"There are **too many topics** to address and the **time is very short.**" (T4)*

*"**Lack of time** to cover an extensive curriculum. [...]" (T18)*

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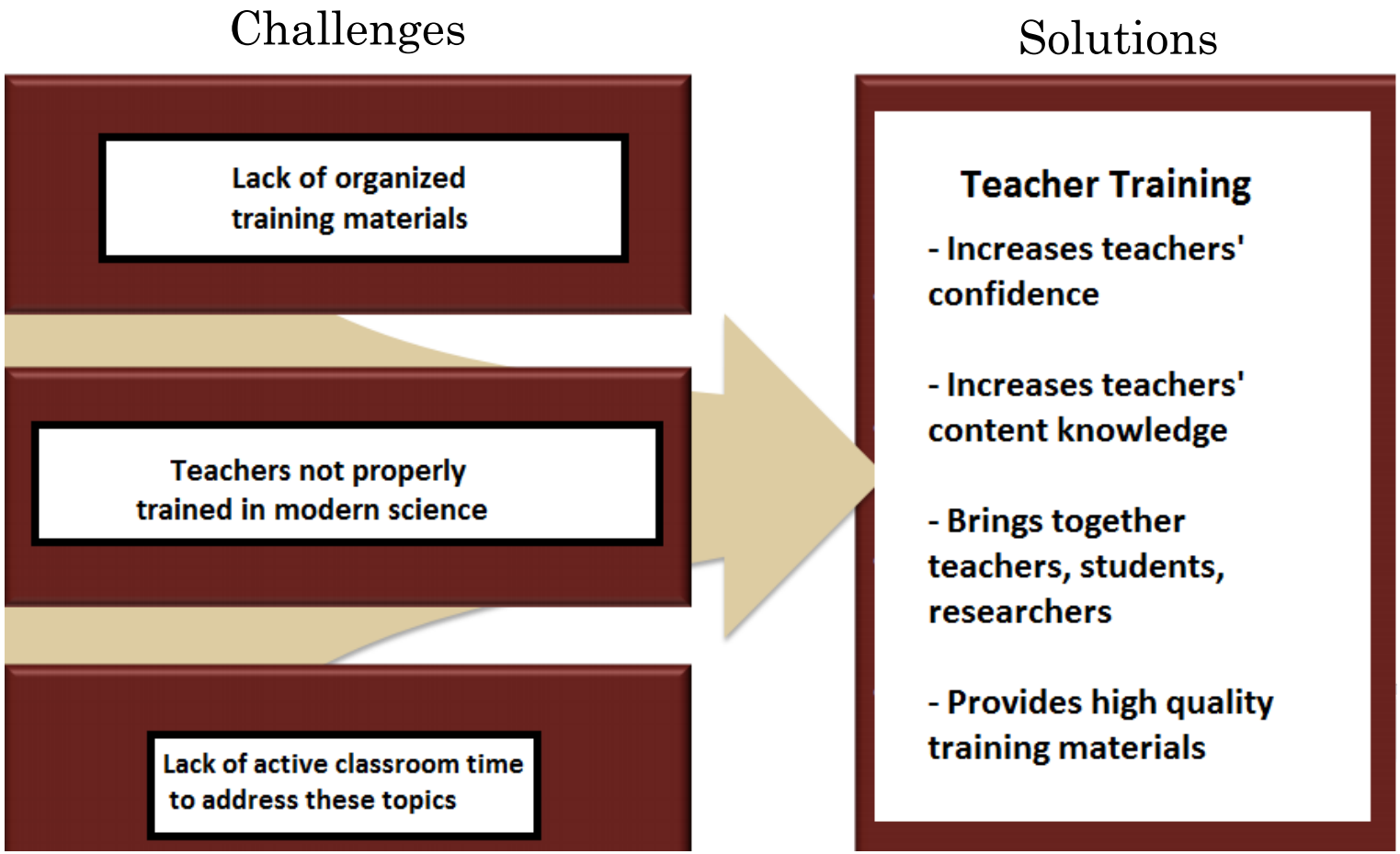
SOME TEACHER FEEDBACK

*"... (I) **had no idea of so many possibilities** to address the content that will be worked with the students" (T1)*

*"**I learned a lot**; besides learning about particle physics, I also **discovered new methods** and instructional experiences from other teachers. Students get excited"* (T17)

*"[the workshop] **approaches the teacher to the reality of current researches**, providing the **elements to contextualize** [particle physics]"* (T9)

The value of teacher training in Frontier Science



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Challenges and problems

- Lack of organized educational content introducing modern Physics in the classroom in a consistent fashion.
- Lack of teacher training in modern Physics topics.
- Lack of a pedagogical framework and methodology to introduce these topics in the classroom.
- Lack of feedback and systematic communication between educators – researchers as well as between educators with the same passion for introducing Modern Physics in their school.
- Lack of time and curriculum pressure for timely completion of the prescribed syllabus and preparation for exams.
- Lack of support from the state.

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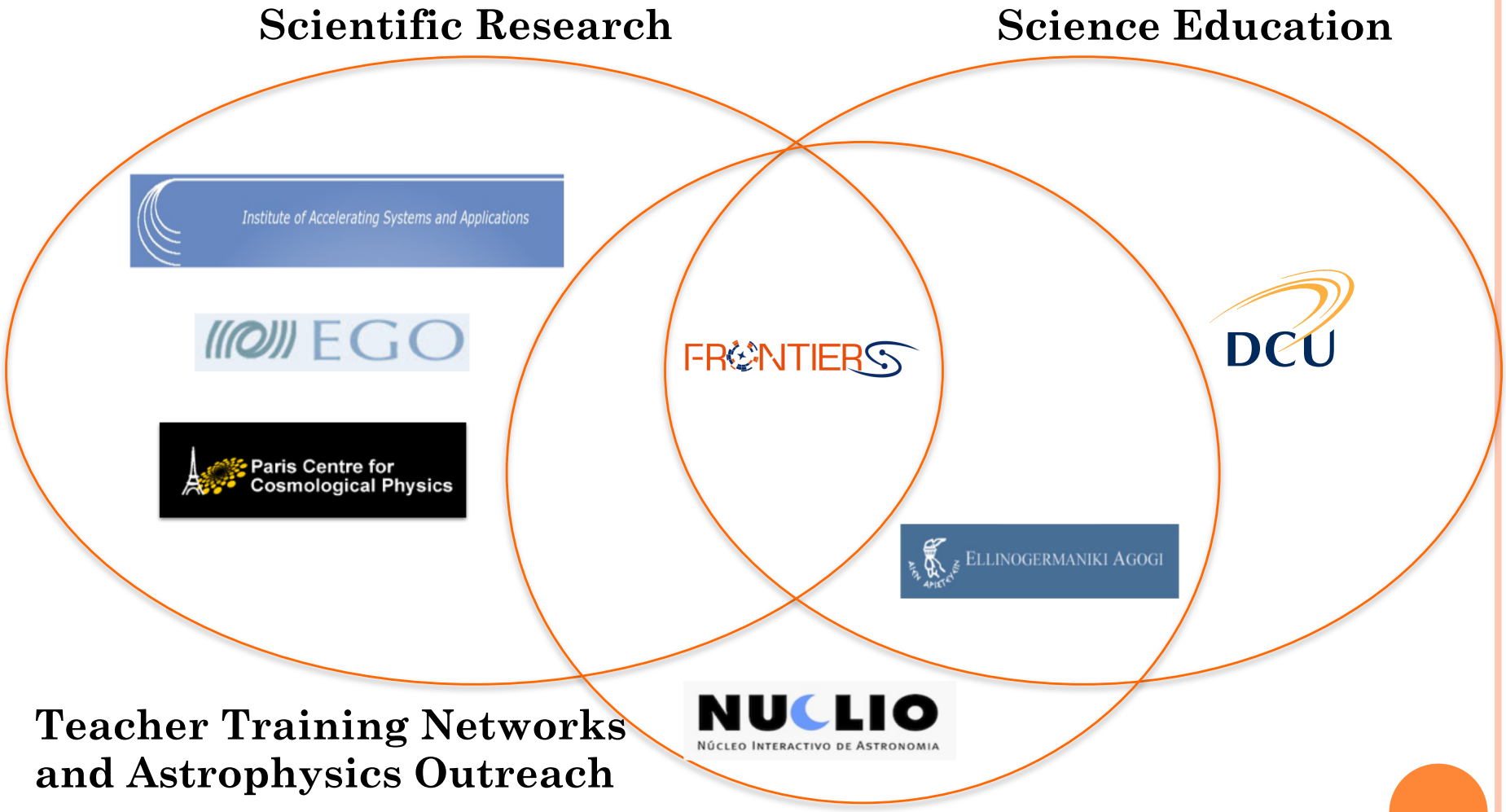
- **It aims to address the challenges of introducing frontier Physics in the Classroom.**

HOW;

By bringing together research and educational institutions from all over Europe



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Investigating already existent outreach practices and drawing lessons learnt from them

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CERN connects with IceCube to bring science to schools

Investigating already existent outreach practices and drawing lessons learnt

CERN's Beam Line for Schools Competition

Leave
Invite
Customize Community
New sub-community

CERN is offering high-school students from around the world the chance to create and perform a scientific experiment on a CERN accelerator beamline.
What better way to learn about physics?

Managed By:
Emmanuel Chaniotakis
Markus Joos
Sarah Aretz

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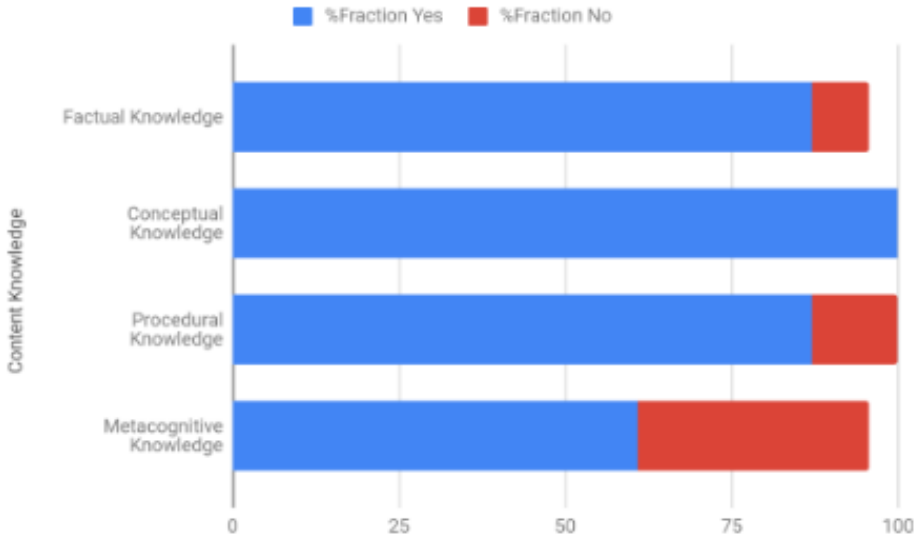
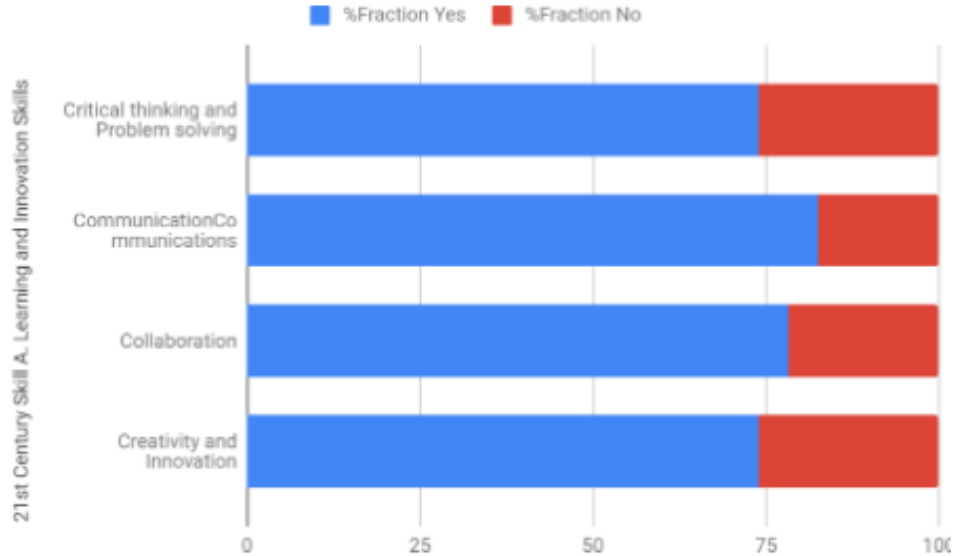
Network of related communties

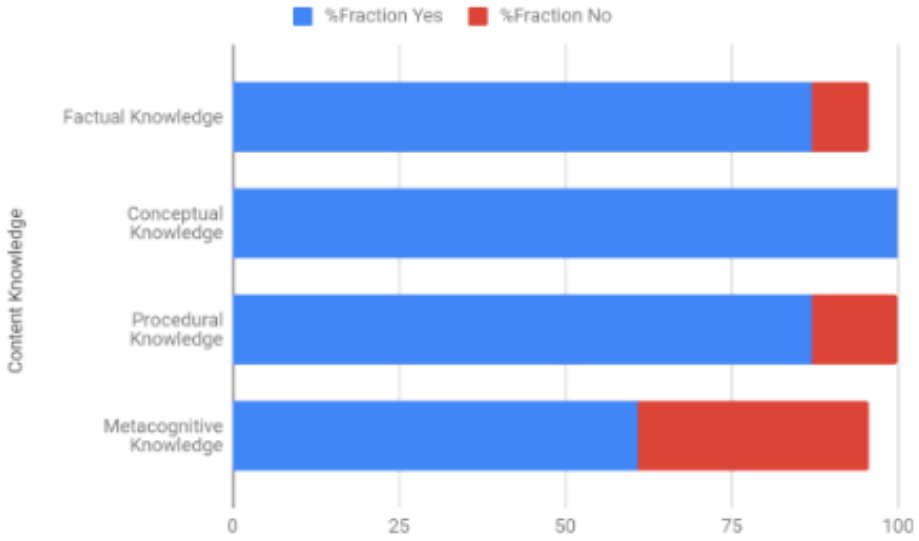
INVESTIGATING ALREADY EXISTENT OUTREACH PRACTICES AND DRAWING LESSONS LEARNT

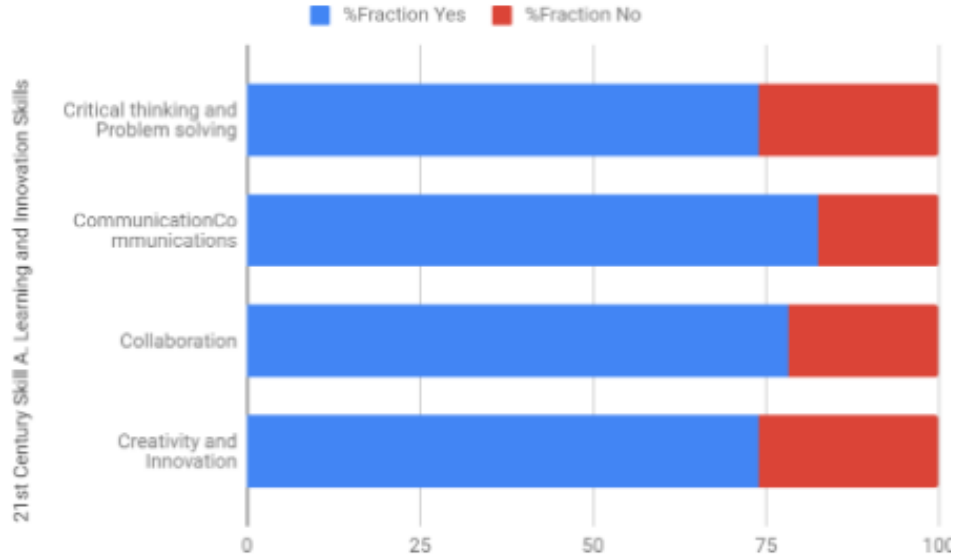
Investigating already existent outreach practices and drawing lessons learnt





Investigating already existent outreach practices and drawing lessons learnt

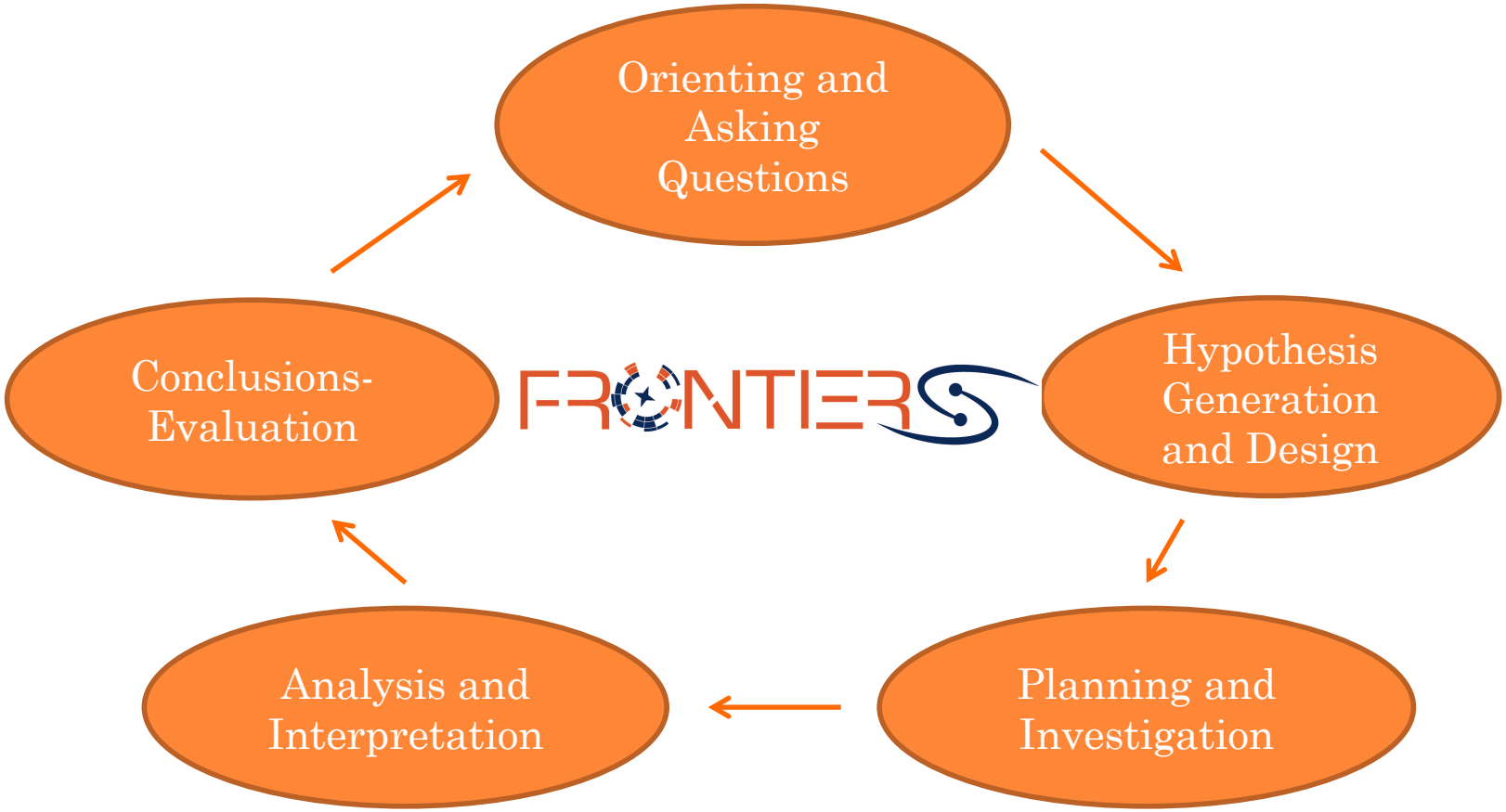




Adopting the inquiry based science education pedagogy

- Learners are **engaged** by scientifically oriented questions.
- Learners give priority to **evidence** which allows them to develop and **evaluate explanations** that address **scientifically oriented questions**.
- Learners **formulate explanations** from evidence to address scientifically oriented questions.
- Learners **evaluate their explanations** in light of alternative explanations, particularly those reflecting scientific understanding.
- Learners **communicate and justify** their proposed explanations.

Adopting the inquiry based science education pedagogy



https://www.youtube.com/watch?v=TJQAfJwVGyk

- **Orienting and Asking Questions**. The topic of the lesson is introduced, assumptions the students may have are challenged, and questions they may have are formulated.
- **Hypothesis Generation and Design**. During which the students develop one of their questions into a hypothesis.
- **Planning and Investigation**. In which the hypothesis previously developed is tested.
- **Analysis and Interpretation**. Where the students analyse the data collected from their investigation and refute or confirm the hypothesis.
- **Conclusion and Evaluation**. When the students communicate their findings.

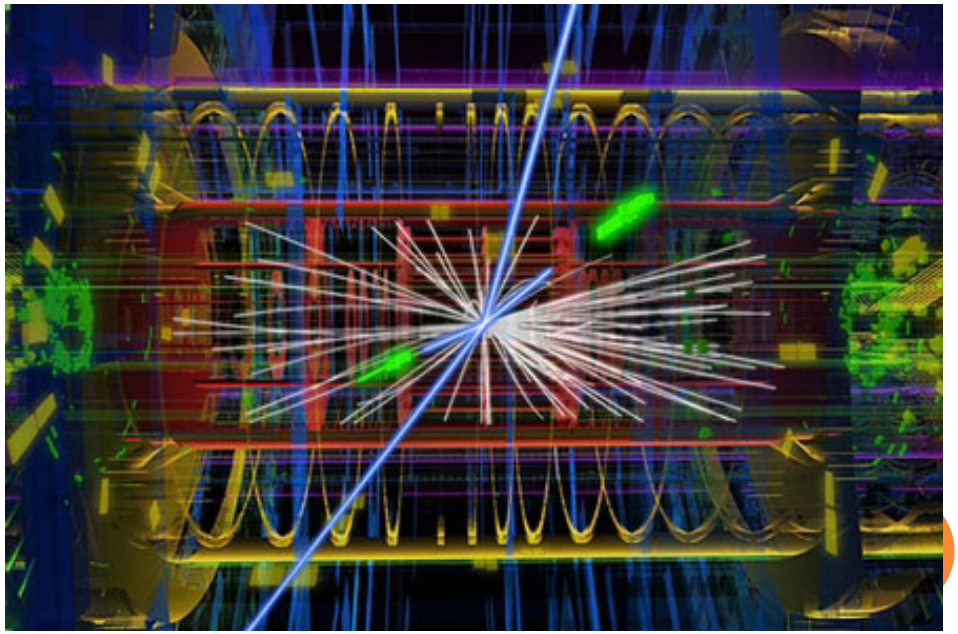
DEVELOPING THE FRONTIERS DEMONSTRATORS:

CUTTING EDGE EDUCATIONAL ACTIVITIES FOR YOUR CLASSROOM

FRONTIERS will prepare 20 demonstrator lessons that are about a modern physics topic for secondary school; ready to be used (or adapted); follow an inquiry methodology; available @ ISE platform:

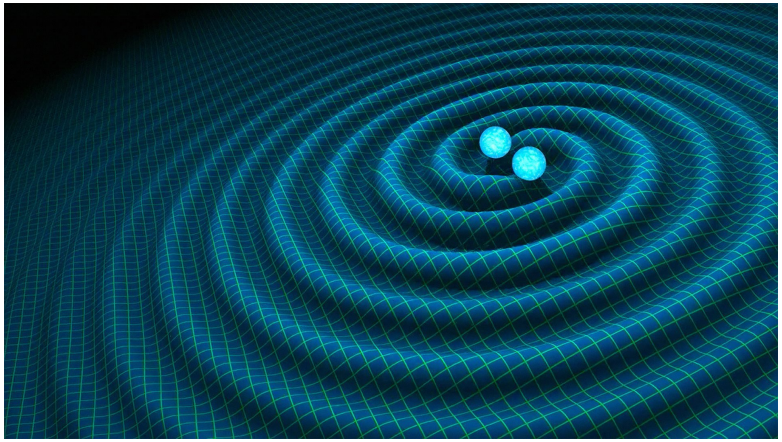
High Energy Physics

- Discover the Z and Higgs Bosons
- World Data Day
- Magnetic Field
- Let's Accelerate particles
- The ALICE Experiment at CERN
- Mass- Energy Equivalence



Gravitational Wave Astronomy

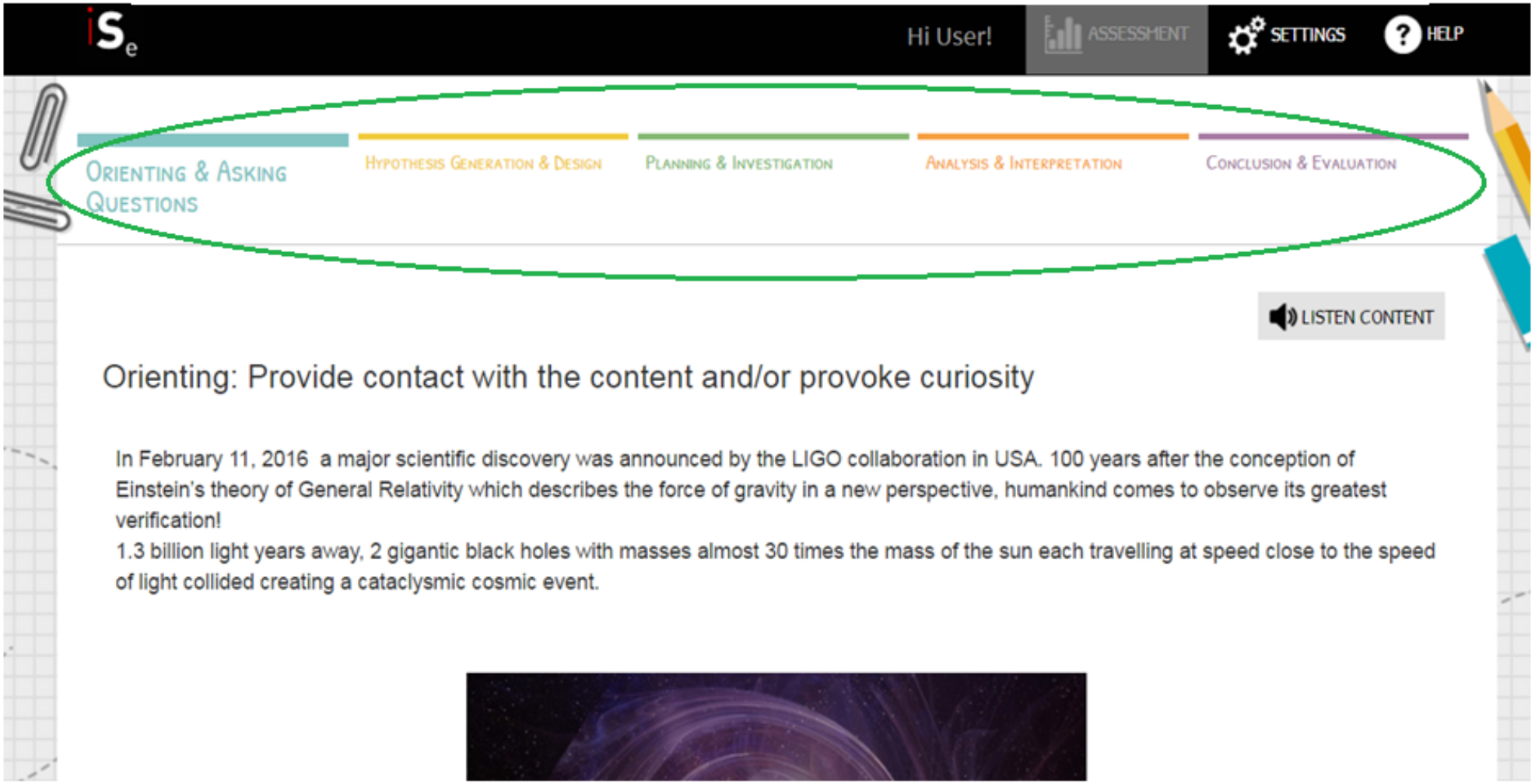
- VIRGO Virtual Visit
- VIRGO Control (Class) Room
- Gravitational Wave Noise Hunting
- Finding black-holes in a chirp”
- The Michelson Interferometer
- Earthquake Interferometer



Astrophysics – Astroparticle Physics

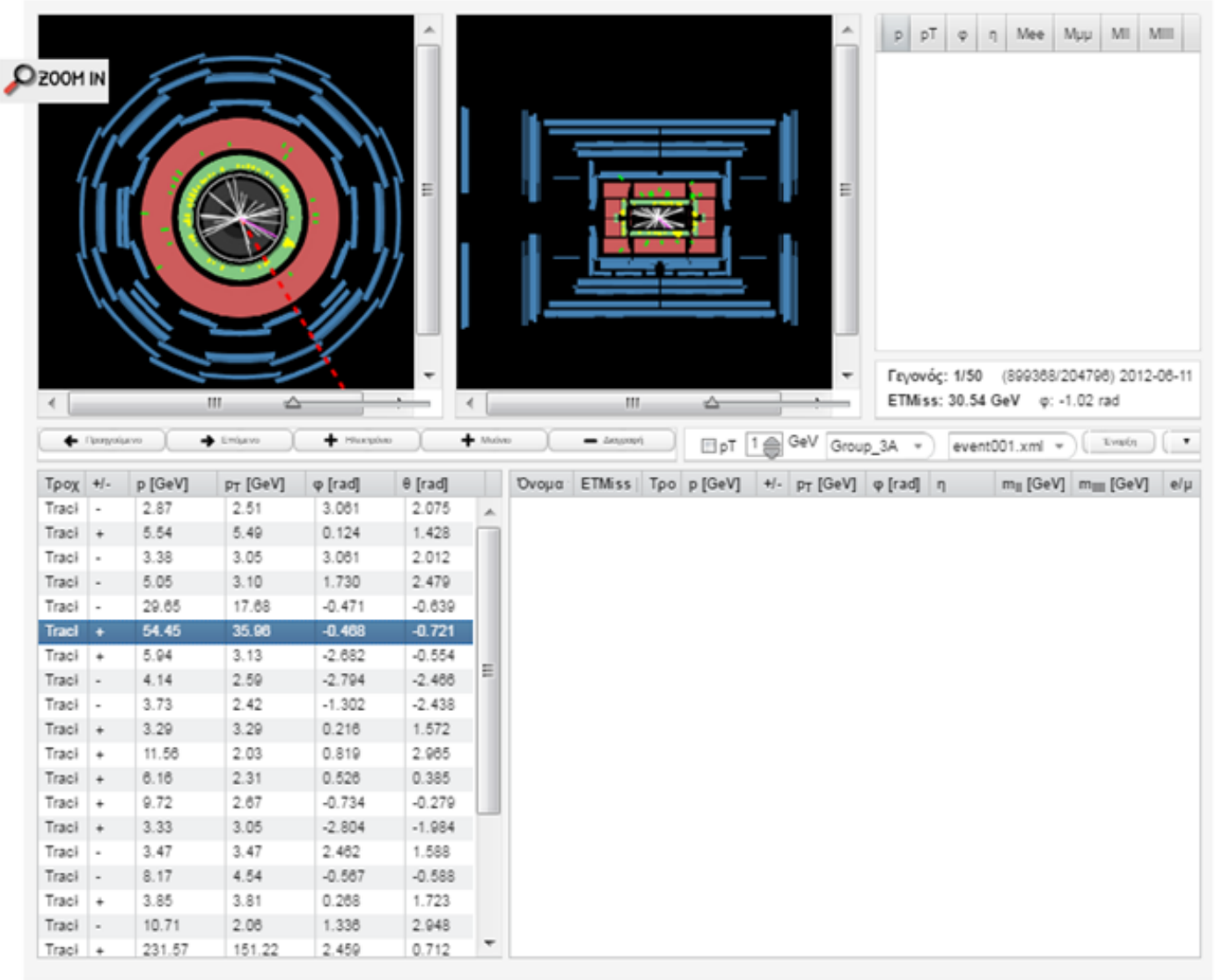
- Black Holes
- Solar Rotation
- Discovering Alien Worlds
- Build your own cloud chamber
- Relativistic Muons and Time Dilation
- Cosmic Rays
- Neutrino Astronomy
- Age of the Universe

5 phases of IBSE in educational Scenario



- Building "bridges" to connect with school curricula.

Embedding virtual e-science applications

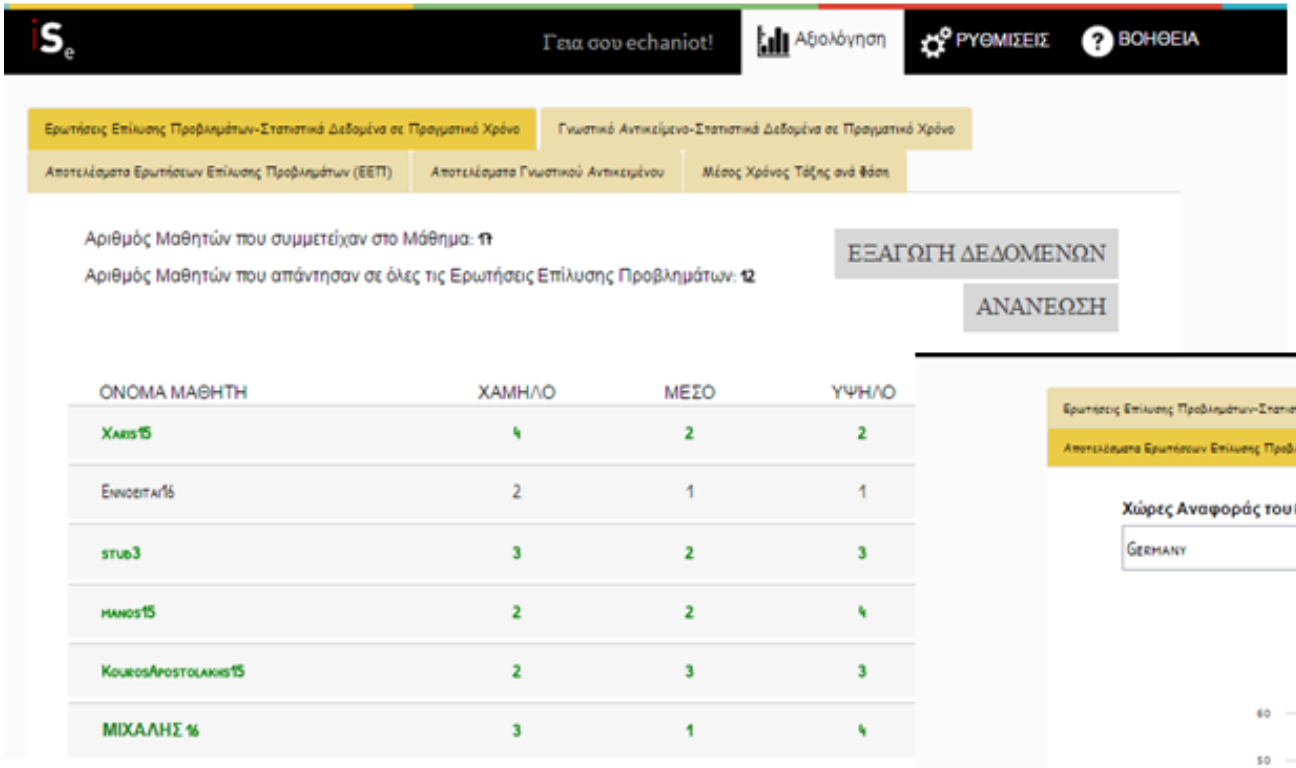


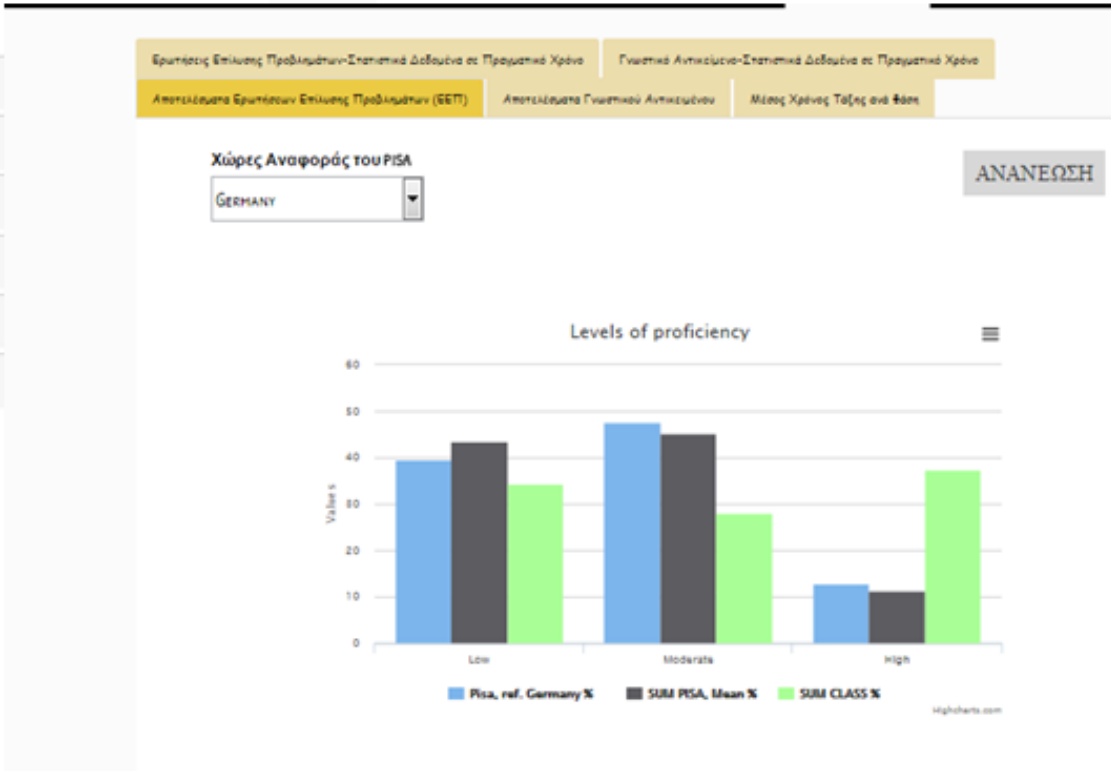
- Στο πάνω μέρος της οθόνης παρουσιάζονται δύο όψεις του ανιχνευτή: Αριστερά μία εγκάρσια τομή του ανιχνευτή (κάθετη στις δέσμες)

- Building "bridges" to connect with school curricula.

Embedding virtual e-science applications

Assessing Problem Solving Skills and Knowledge Items



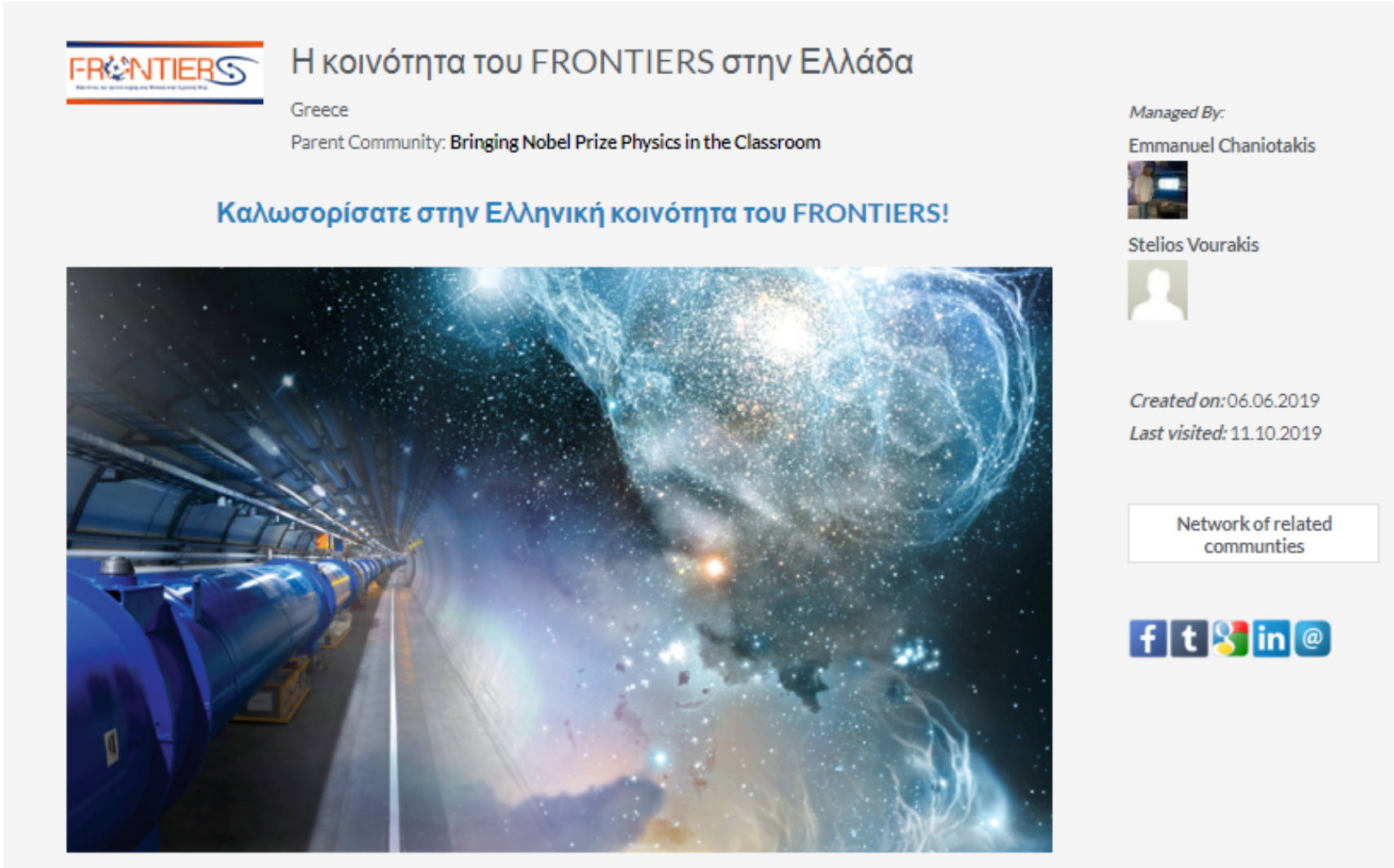


- Building "bridges" to connect with school curricula.

Developing national and international communities of practice for educators

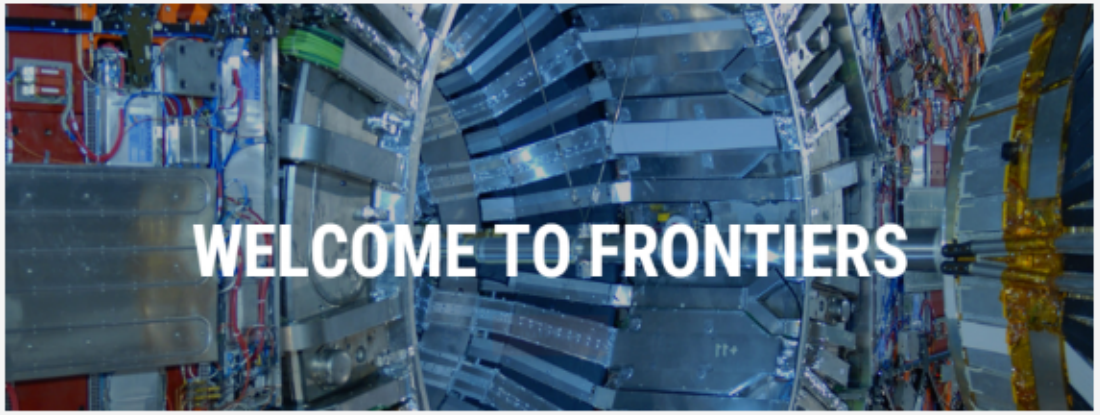
- Giving opportunities for immediate interaction and feedback between researchers and educators.
- Useful for the exchange of good practices.
- With the capacity to host educational content
- Offering you the tools to create your own educational content.

Developing national and international



Bringing Nobel Prize Physics in the Classroom

Domain: Science



Have you ever wondered how we can integrate Modern Physics in the school curriculum? Do you believe that exciting discoveries such as the Discovery of Gravitational Waves or the Discovery of the Higgs Boson can be brought in the classroom in a consistent and understandable fashion? The FRONTIERS Project brings together expertise from frontier scientific research and educational research in formal and informal science learning, along with user communities across Europe, in order to demonstrate how Nobel Prize winning science can be systematically integrated in the school curriculum.

How do I join the FRONTIERS team?

Make your registration (by clicking on register on the top of the page) and press *join community* Your journey just began!
You can also join the FRONTIERS communities in France, Greece, Ireland, Italy and Portugal!

What are the benefits of joining the FRONTIERS team?

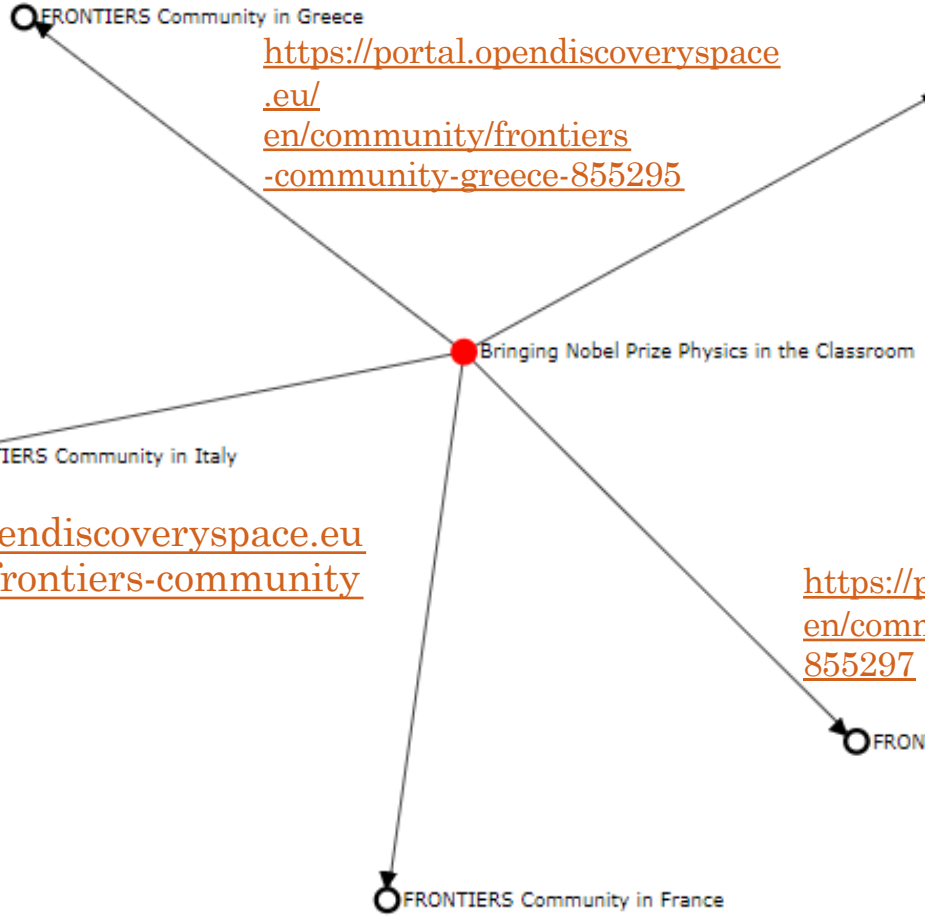
- You will have access to a wealth of educational resources introducing concepts from Astrophysics and Gravitational Wave Astronomy to Particle and Astroparticle Physics using real data!!
- You will be able to organize virtual visits in Large Research Infrastructures such as CERN and VIRGO for your students!!

Leave
Invite
Customize Community
New sub-community

Managed By:
Emmanuel Chaniotakis

Created on: 16.04.2019
Last visited: 13.06.2019

Network of related communties


FRONTIERS Community in Greece
https://portal.opendiscoveryspace.eu/en/community/frontiers-community-greece-855295
FRONTIERS Community in Ireland
https://portal.opendiscoveryspace.eu/en/community/frontiers-community-ireland-855298
Bringing Nobel Prize Physics in the Classroom
FRONTIERS Community in Italy
https://portal.opendiscoveryspace.eu/en/community/frontiers-community-italy-855296
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FRONTIERS Community in Portugal
FRONTIERS Community in France
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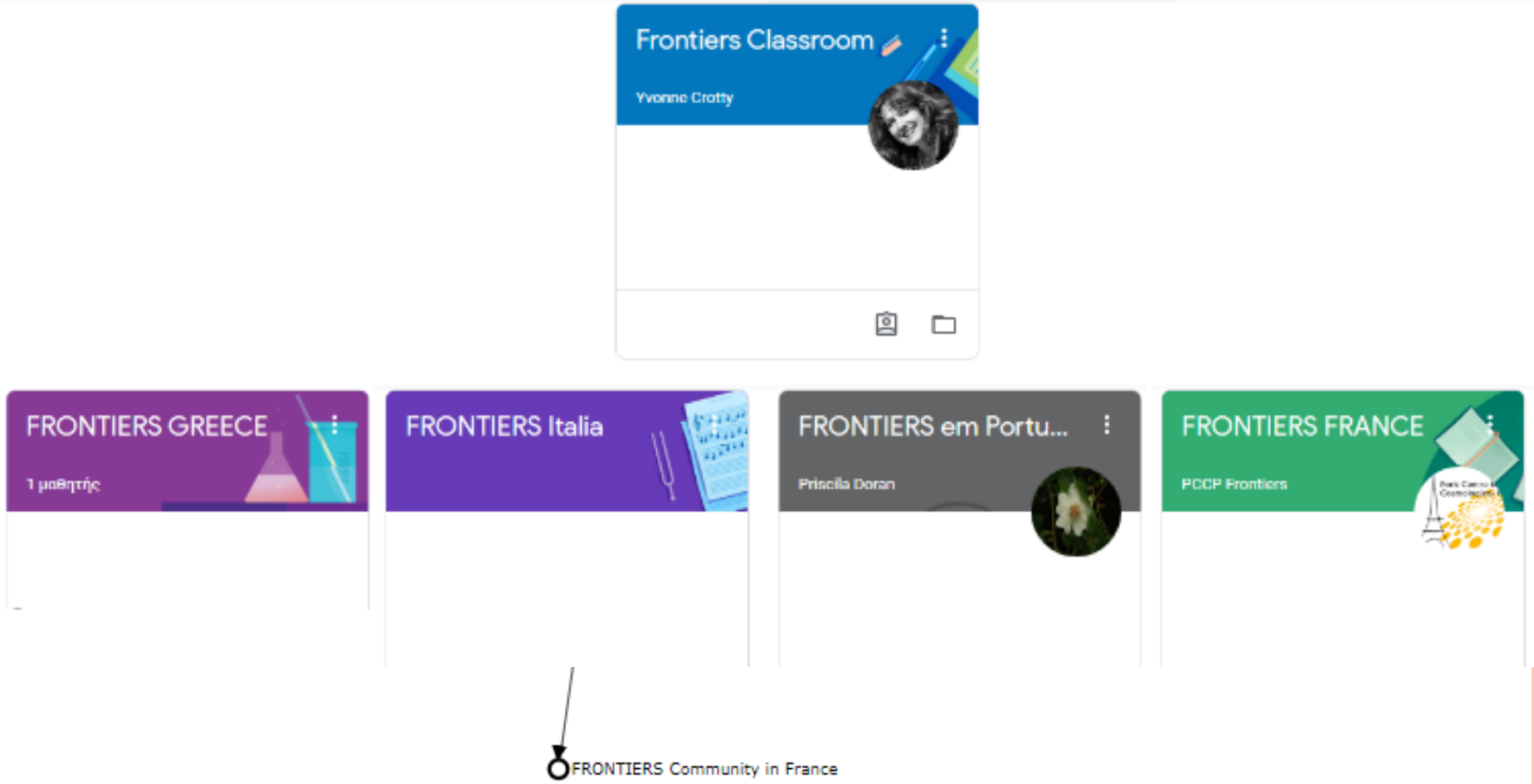

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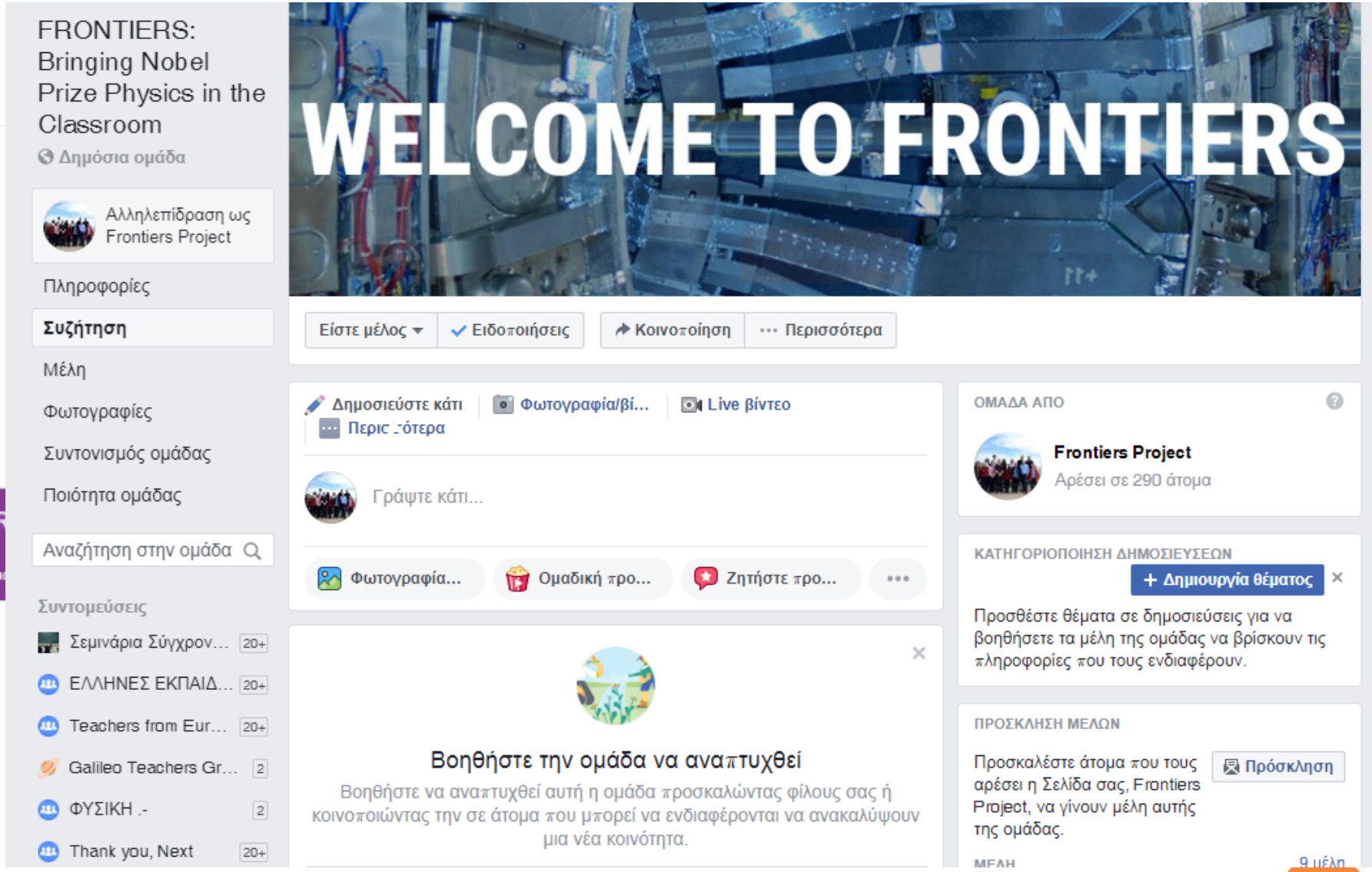


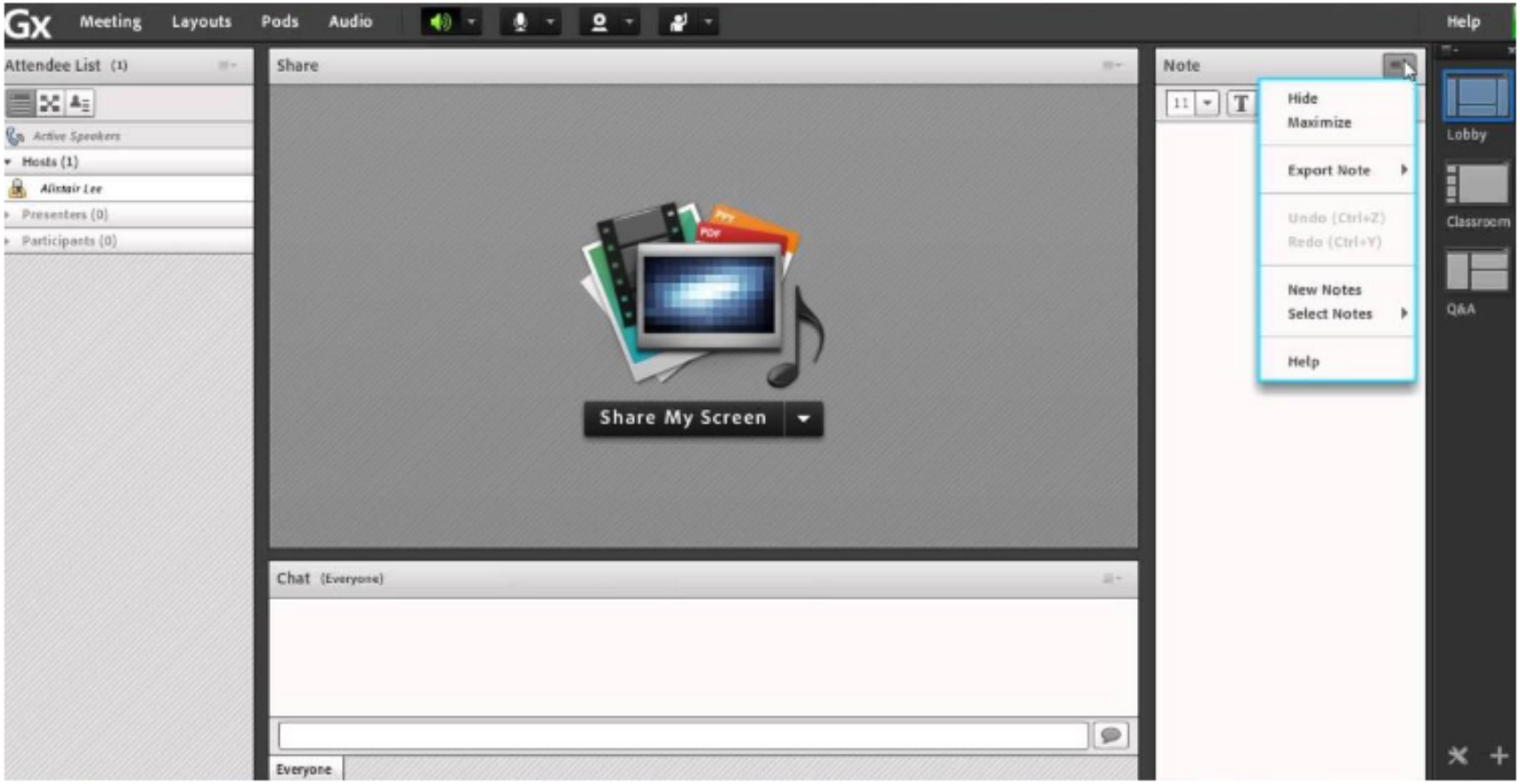
https://portal.opendiscoveryspace.eu/en/community/frontiers-community-france-855299

Offering continuous training and support for the implementation of frontiers activities in your classroom.

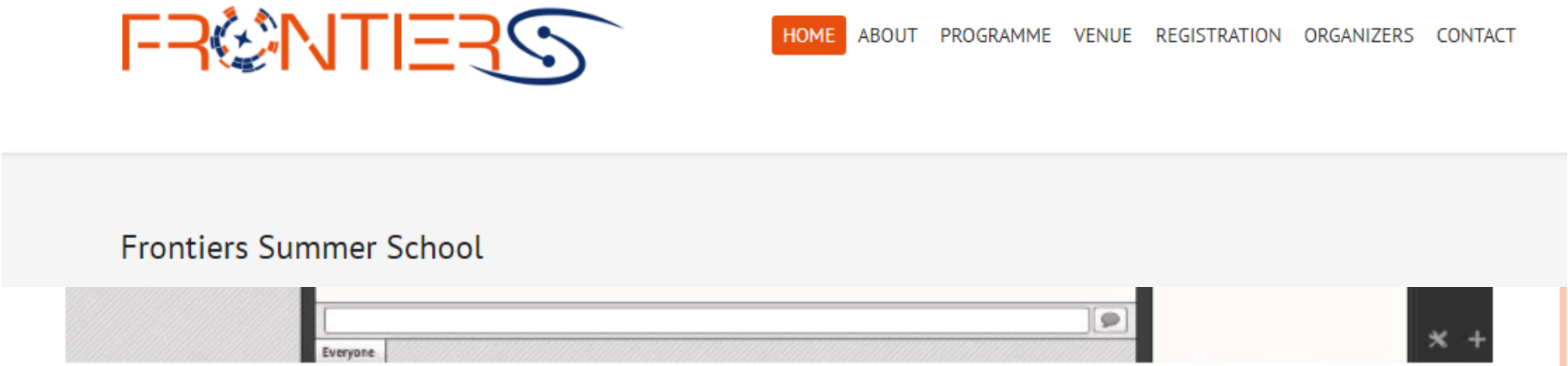
- Through the systematic organization of in situ and online training workshops for continuous professional development..

- Through the organization of summer and winter schools.

Offering continuous training and support for the implementation of frontiers activities in your classroom



OFFERING CONTINUOUS TRAINING AND SUPPORT FOR THE IMPLEMENTATION OF FRONTIERS ACTIVITIES IN YOUR CLASSROOM



IF..

- You believe that it is worthwhile to introduce topics such as the discovery of Gravitational Waves or of the Higgs Boson in your classroom in a systematic and understandable fashion.
- You want your students to be able to perform virtual visits at VIRGO or CERN, to analyze real data and to interact with leading experts in Physics and Education research.
- You want to receive continuous training and support in these scientific topics.
- You want to become part of our international community of educators and researchers with who you will be able to interact, collaborate, exchange ideas and practices.

IF..

- You believe that it is worthwhile to introduce topics such as the discovery of Gravitational Waves or of the Higgs Boson

We invite you to become members of the FRONTIERS family!

these scientific topics.

- You want to become part of our international community of educators and researchers with who you will be able to interact, collaborate, exchange ideas and practices.

How do I become a FRONTIERS teacher?

It is done in 5 easy steps:

- Subscribe to our newsletter!
- Register to the project and become a FRONTIERS teacher: http://bit.ly/join-FRONTIERS
- Contribute to our Facebook group!
- Participate in our training workshops to be announced soon!
- Implement at least one FRONTIERS activity in your classroom!

Throughout your engagement with FRONTIERS you will be offered continuous support and training, you will receive online badges and you will be able to participate in educational competitions with great prizes!

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- Register to the project and become a FRONTIERS teacher: http://bit.ly/join-FRONTIERS
- Contribute to our Facebook group!
- Participate in our training workshops to be announced soon!
- Implement at least one FRONTIERS activity in your classroom!

THANK YOU VERY MUCH

For further details visit:

FRONTIERS website:
www.frontiers-project.eu

Facebook page:
https://www.facebook.com/frontierseu

Facebook group:
https://www.facebook.com/groups/665957563876838/

Don't hesitate to contact us : info@frontiers-project.eu