



BRINGING NOBEL PRIZE PHYSICS TO THE CLASSROOM

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THE ROLE OF FRONTIERS

- FRONTIERS is a project funded by the Erasmus+ framework of the EU with duration from 2018 to 2021.
- **It aims to address the challenges of introducing frontier Physics in the Classroom.**



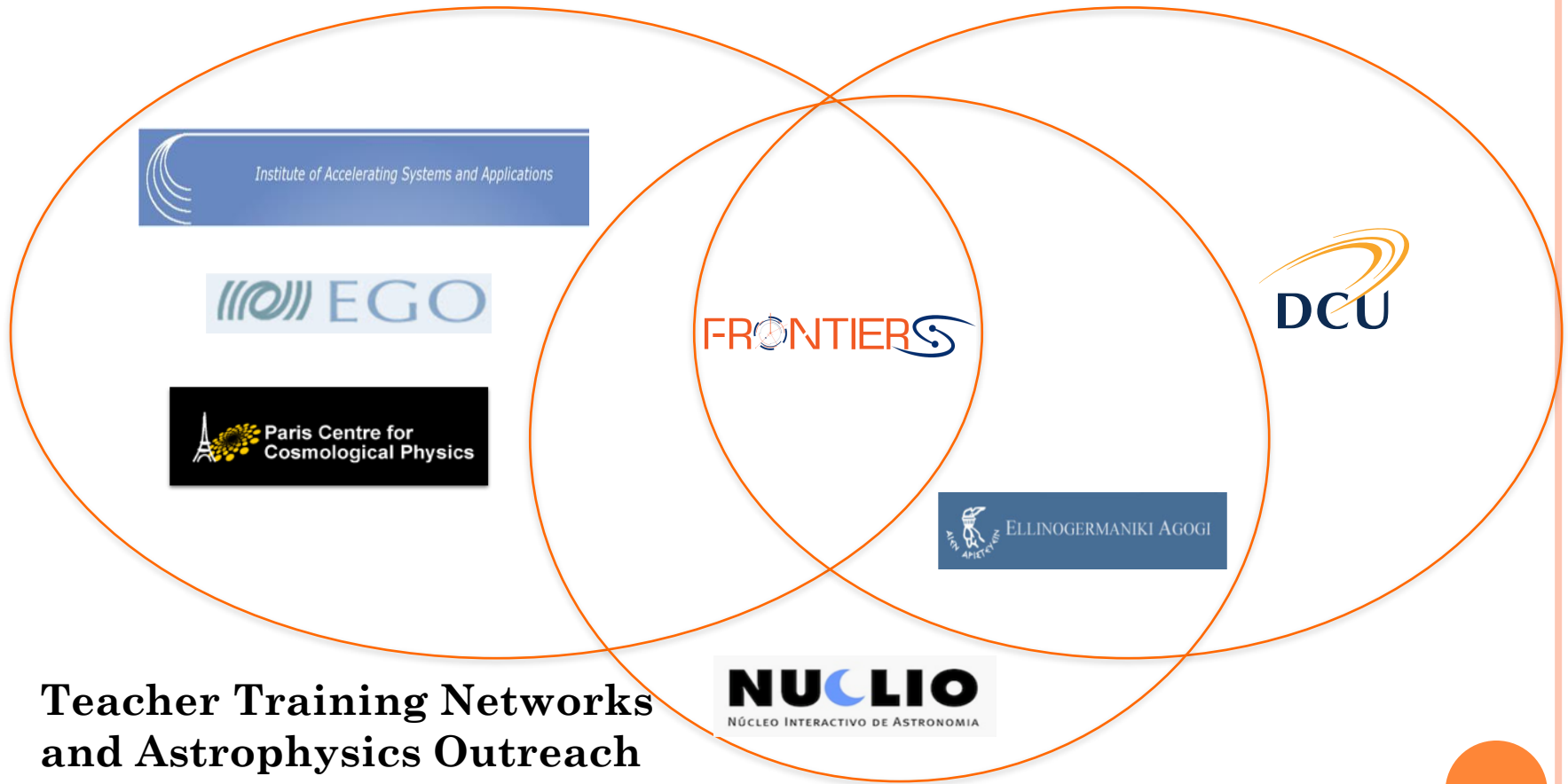
HOW....



BY BRINGING TOGETHER RESEARCH AND EDUCATIONAL INSTITUTIONS FROM ALL OVER EUROPE

Scientific Research

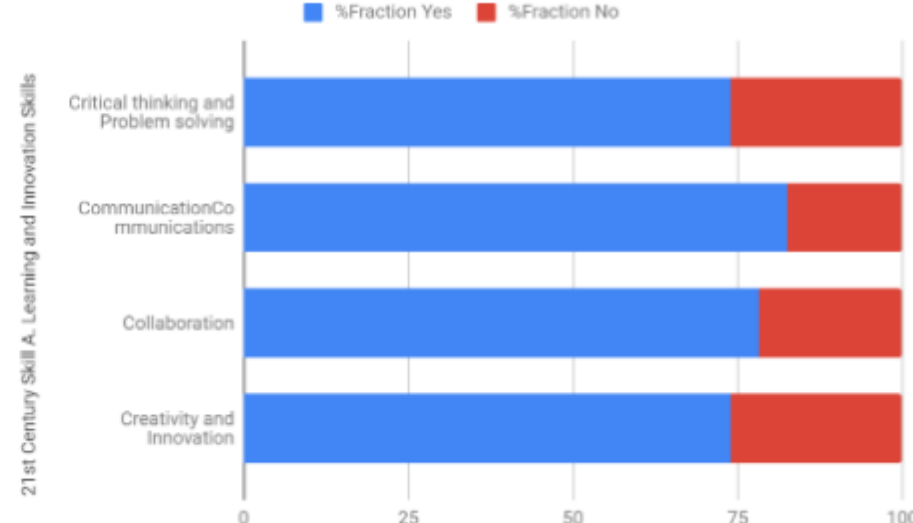
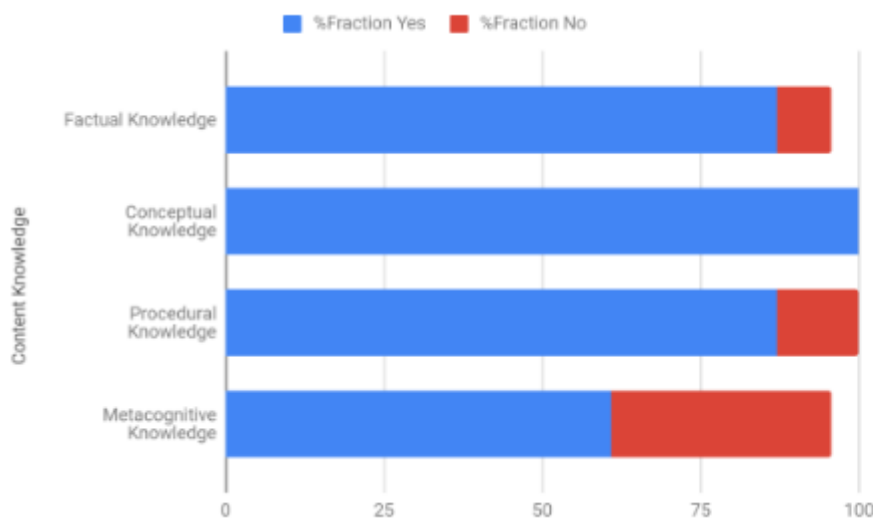
Science Education



Frontiers has been funded within the framework of the European Union Erasmus+ programme



INVESTIGATING ALREADY EXISTENT OUTREACH PRACTICES AND DRAWING LESSONS LEARNT

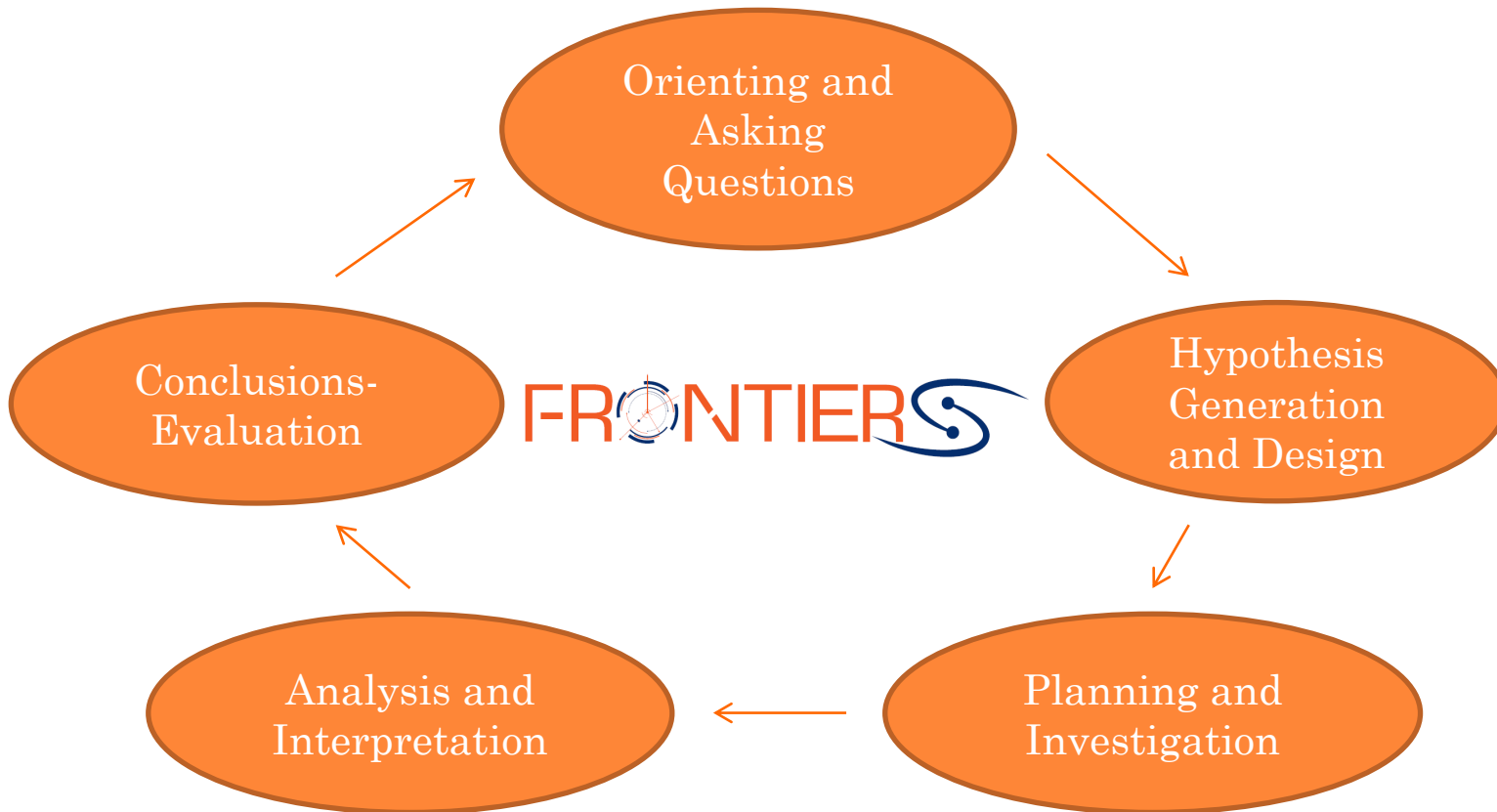


ADOPTING THE INQUIRY BASED SCIENCE EDUCATION PEDAGOGY

- 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

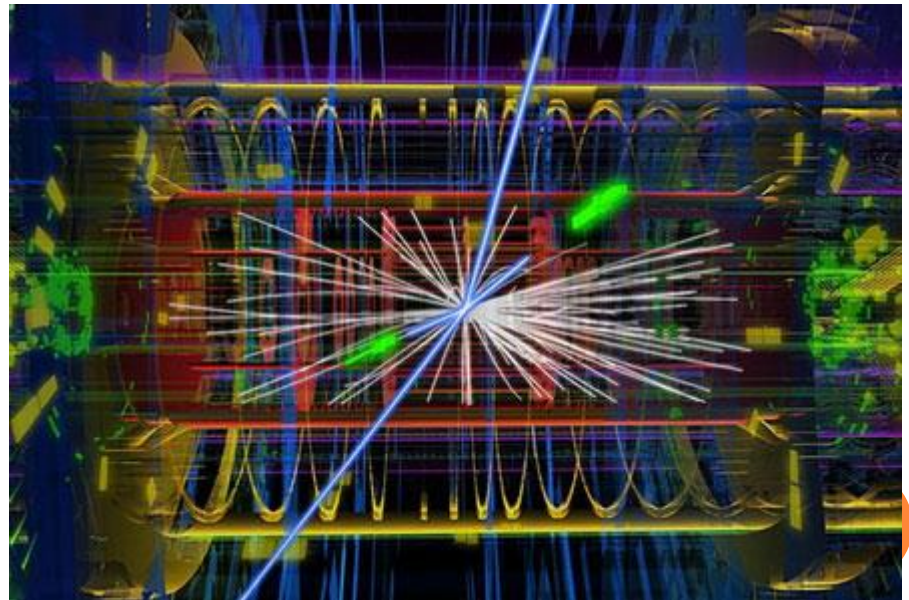
DEMONSTRATORS:

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:

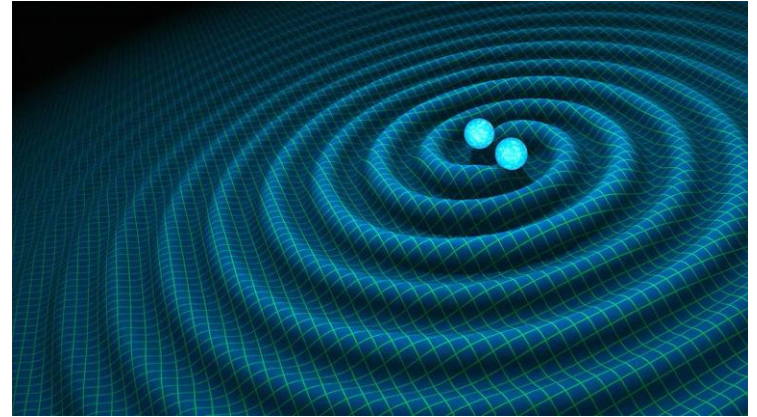
High Energy Physics

- 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



Embedding virtual e-science applications

The screenshot displays a virtual e-science application interface. At the top, there are two side-by-side views of a particle detector cross-section. The left view is a zoomed-in circular cross-section with concentric rings and a central detector. The right view is a perspective view of the detector's internal structure. Below these views is a control panel with buttons for navigation and a status bar showing event information: "Γεγονός: 1/50 (899368/204798) 2012-06-11" and "ETMiss: 30.54 GeV φ: -1.02 rad".

Below the control panel is a table of particle tracks. The table has columns for track type, charge, and various kinematic variables. The 10th row is highlighted in blue.

| Τροχ | +/- | p [GeV] | p _T [GeV] | φ [rad] | θ [rad] | Όνομα | ETMiss | Τρο | p [GeV] | +/- | p _T [GeV] | φ [rad] | η | m ₀ [GeV] | m _{inv} [GeV] | ε/μ |
|-------|-----|---------|----------------------|---------|---------|-------|--------|-----|---------|-----|----------------------|---------|---|----------------------|------------------------|-----|
| Traci | - | 2.87 | 2.51 | 3.061 | 2.075 | | | | | | | | | | | |
| Traci | + | 5.54 | 5.49 | 0.124 | 1.428 | | | | | | | | | | | |
| Traci | - | 3.38 | 3.05 | 3.061 | 2.012 | | | | | | | | | | | |
| Traci | - | 5.05 | 3.10 | 1.730 | 2.479 | | | | | | | | | | | |
| Traci | - | 29.65 | 17.68 | -0.471 | -0.639 | | | | | | | | | | | |
| Traci | + | 54.45 | 35.90 | -0.468 | -0.721 | | | | | | | | | | | |
| Traci | + | 5.94 | 3.13 | -2.682 | -0.554 | | | | | | | | | | | |
| Traci | - | 4.14 | 2.59 | -2.704 | -2.488 | | | | | | | | | | | |
| Traci | - | 3.73 | 2.42 | -1.302 | -2.438 | | | | | | | | | | | |
| Traci | + | 3.29 | 3.29 | 0.218 | 1.572 | | | | | | | | | | | |
| Traci | + | 11.56 | 2.03 | 0.819 | 2.965 | | | | | | | | | | | |
| Traci | + | 6.16 | 2.31 | 0.526 | 0.385 | | | | | | | | | | | |
| Traci | + | 9.72 | 2.67 | -0.734 | -0.279 | | | | | | | | | | | |
| Traci | + | 3.33 | 3.05 | -2.804 | -1.984 | | | | | | | | | | | |
| Traci | - | 3.47 | 3.47 | 2.462 | 1.588 | | | | | | | | | | | |
| Traci | - | 8.17 | 4.54 | -0.567 | -0.588 | | | | | | | | | | | |
| Traci | + | 3.85 | 3.81 | 0.268 | 1.723 | | | | | | | | | | | |
| Traci | - | 10.71 | 2.06 | 1.336 | 2.948 | | | | | | | | | | | |
| Traci | + | 231.57 | 151.22 | 2.459 | 0.712 | | | | | | | | | | | |

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



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 communities



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.





FRONTIERS WINTER SCHOOL

29th – 31st January and 5th – 7th February

- **How can I learn more about the winter school?:** <https://esia.ea.gr/frontiers-winter-school/>
- **What is the agenda?:** <https://indico.ego-gw.it/event/133/timetable/>
- **How do I register?:**
You can register here <https://indico.ego-gw.it/event/133/registrations/230/>

Hurry up! Some spots are still available



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.



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!

- Subscribe to our [newsletter](#)!
- Join the FRONTIERS [international community](#) and national community in [Italy](#)!
- 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

