Image credit: Ioanna Kasampa

PLAYING WITH PROTONS

FRONTIERS *Online Training Course, 20 July 2020*

ESiA European School Innovation Academy

Playing with Protons

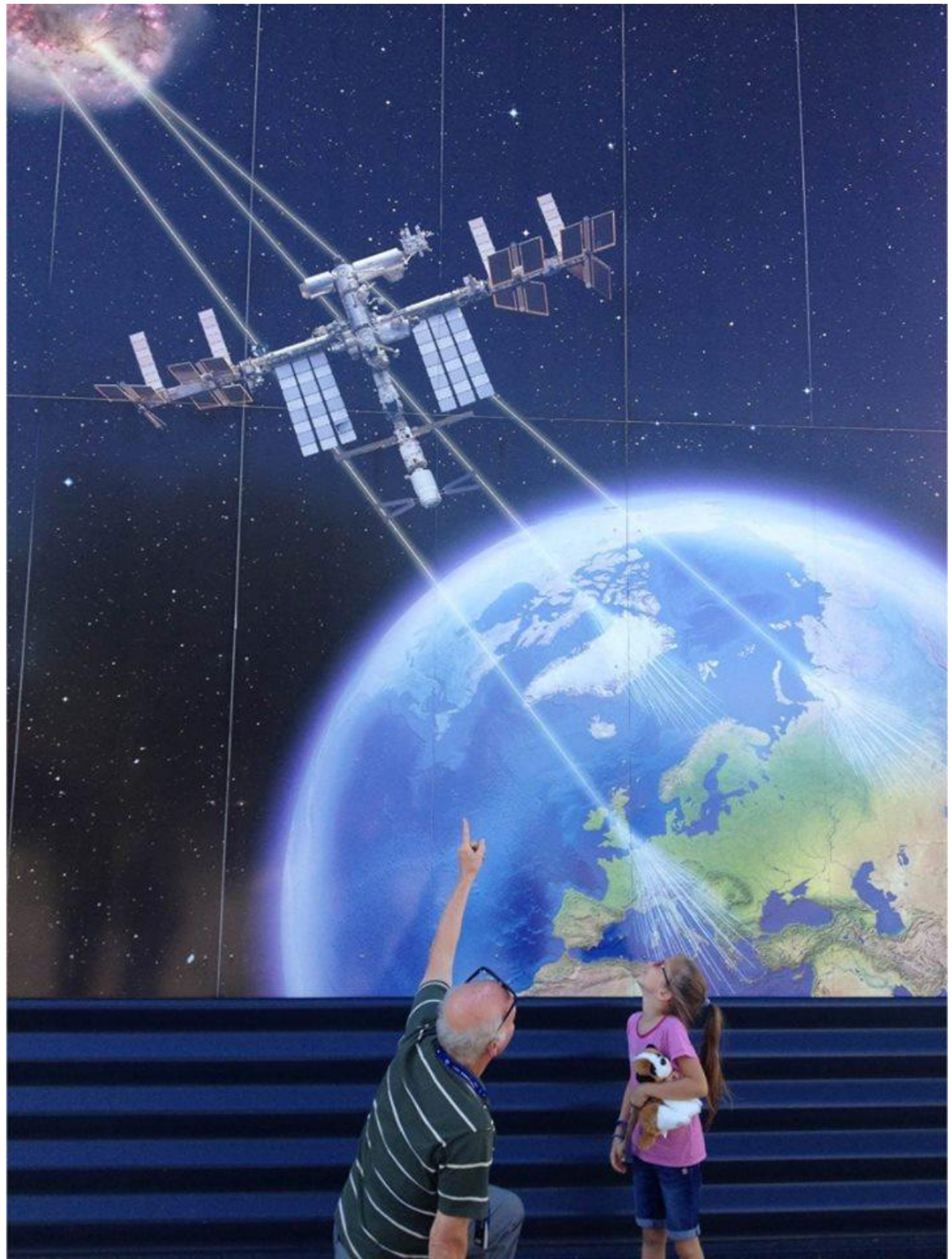
Engaging primary students in physics, discovery & innovation

Dr. Angelos Alexopoulos

Why

"Children naturally enjoy observing and thinking about nature." (Eshach & Fried, 2005, p. 315)

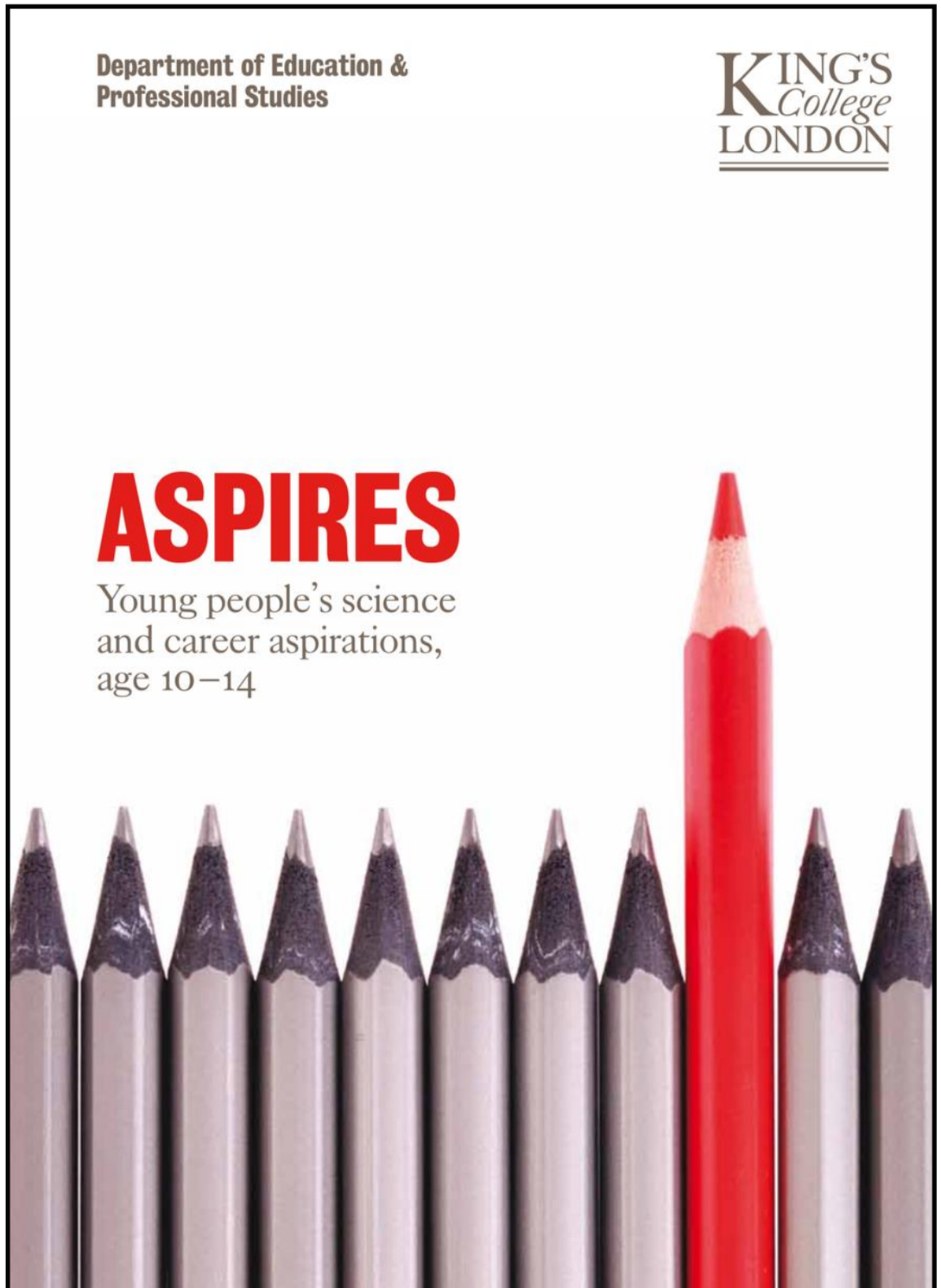
"It is, therefore, incumbent on the science educator to provide children with environments, materials, and activities, to develop their scientific reasoning while these 'windows of opportunity' are still open." (ibid., p. 334)



Why

"Action needs to begin at primary school - age 14 is too late."

"Efforts to broaden students' aspirations, particularly in relation to STEM, need to begin in primary school. Currently most activities and interventions are targeted at secondary school students."



Challenges & obstacles in primary STEM Ed

Foremost, none of the 22 participating teachers felt that their school placed enough emphasis on STEM education at the primary level. Further, only a few teachers felt that they had enough support from their school, regional or national government or any other stakeholders for implementing STEM in their primary-level teaching. The type of support needed was clustered in three groups of interconnected topics, namely:

A. Nistor[1]; P. Angelopoulos[2]; A. Gras-Velazquez[1]; M. Grenon[3]; S. Mc Guinness[3]; D. Mitropoulou[2]; M. Ahmadi[4]; M. J. Coelho[5]; I. M. Greca[6]; E. Kalambokis[7]; A. Korra[8]; A. Lazoudis[9]; I. Lefkos[10]; T. Michetti[11]; G. Njegovanovic[12]; H. Otten[13]; C. Palazi[14]; H. Tran[13]; T. Tsaknia[9]; N. Tsochatzidis[15]

FOSS - the Open Technologies Alliance (2), Cell EXPLORERS, NUI Galway
iroup of Leiden University (4), CCEMS - Centro de Competência Entre Mar
Burgos (6), Anatolia College (7), Meridian International Elementary School
(9), University of Macedonia (10), Lunar Mission One (11), Primary School
iverse Awareness (13), Network for internet safety at schools (14),
stitute of Central Macedonia (15)

[1] The need for **high quality teacher training** to support primary school teachers in bringing innovation to their STEM teaching.

[2] The need to offer teachers **access to high quality teaching resources** and materials to guide them through approaching STEM with young pupils.

[3] The need to create a so-called "**STEM culture**" based on a shared understanding among key education stakeholders of the role STEM education can play in preparing pupils for the future.

nt among practitioners that the manner by which science is taught
ools influences students' perceptions and attitudes towards science,
subjects and careers later on. Primary school teachers can play a
n feel insufficiently prepared to approach STEM subjects in their
ave been discussed between 20 STEM education stakeholders and
s participating in the 13th Scientix Projects Networking Event. As a
were proposed to tackle the most challenging aspects of delivering
in primary classrooms: raising the quality of teacher training,
high quality teaching resources and raising the STEM culture in primary education. This observatory presents a set of actionable recommendations for projects/organisations looking to address these challenges.

Key words: Science, Technology, Engineering and Mathematics Education (STEM education), primary education, recommendations, teacher training, resources

Primary Teacher PD at CERN

Experience the unique culture of cutting-edge science, technology and innovation at the world's largest particle physics laboratory.

Develop creative educational scenarios and lesson plans that build on and enrich the primary curricula with modern physics ideas to increase the interest, motivation and wonder of students.

Try out new teaching approaches, especially hands-on activities and experiments with everyday materials, to increase their confidence when teaching physics in particular and science in general.

Get inspired and motivated to share newly acquired knowledge and wonder-full experience with peers, parents and the local community.

Development

CMS AND CERN INSPIRE UK PRIMARY-SCHOOL TEACHERS TO PLAY WITH PROTONS

2014

2016

2017

2019/20

Supporting bodies

Implementation*

5 courses at CERN

2 countries

155 schools 346 teachers

8,915 students

*In 3 school years (2016-19)

Implementation: (Mean) multiplication ratio

Awards & recognitions

Particles4U (IPPOG)

Primary School (Age 12 and under) Winners

2nd and 6th Primary Schools of Artemida, Athens, Greece

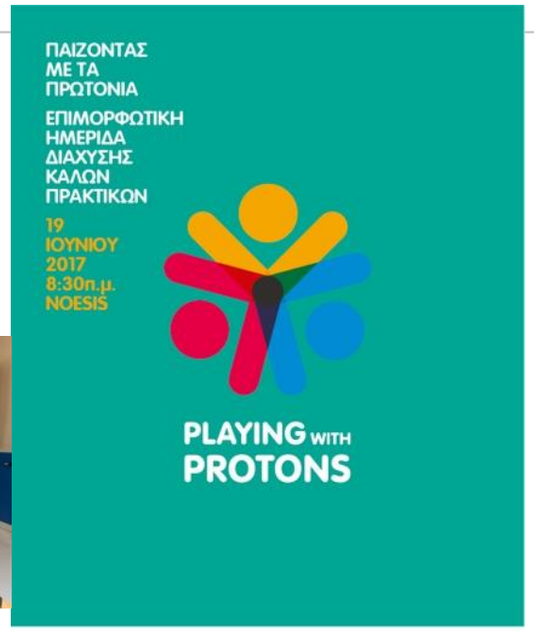
Students from the 2nd and 6th primary schools of **Artemida**, a region near **Athens**, **Greece** combined particle physics with humor and to imagine a dialogue among particles. Thier video is called **"The Quark Show."**

Looking…Up! (IAU OAD)

Science Communication Awards 2018 ΕΠΙ²

STE(A)M highlights

2016-17



2017-18

6th Intercultural School of Eleftherio-Kordelio, Greece (Image: Kiki Zervou)

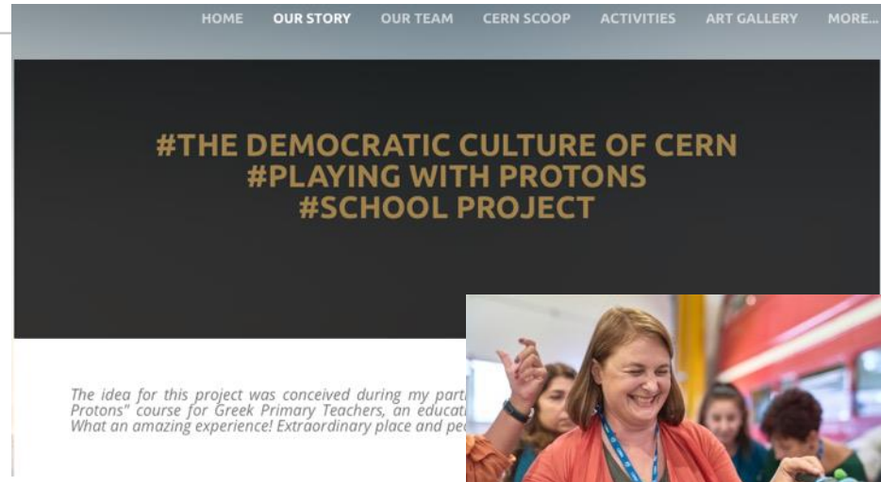
Primary School of Vytina, Greece (Image: Giannis Karountzos)

STE(A)M highlights

2018-19

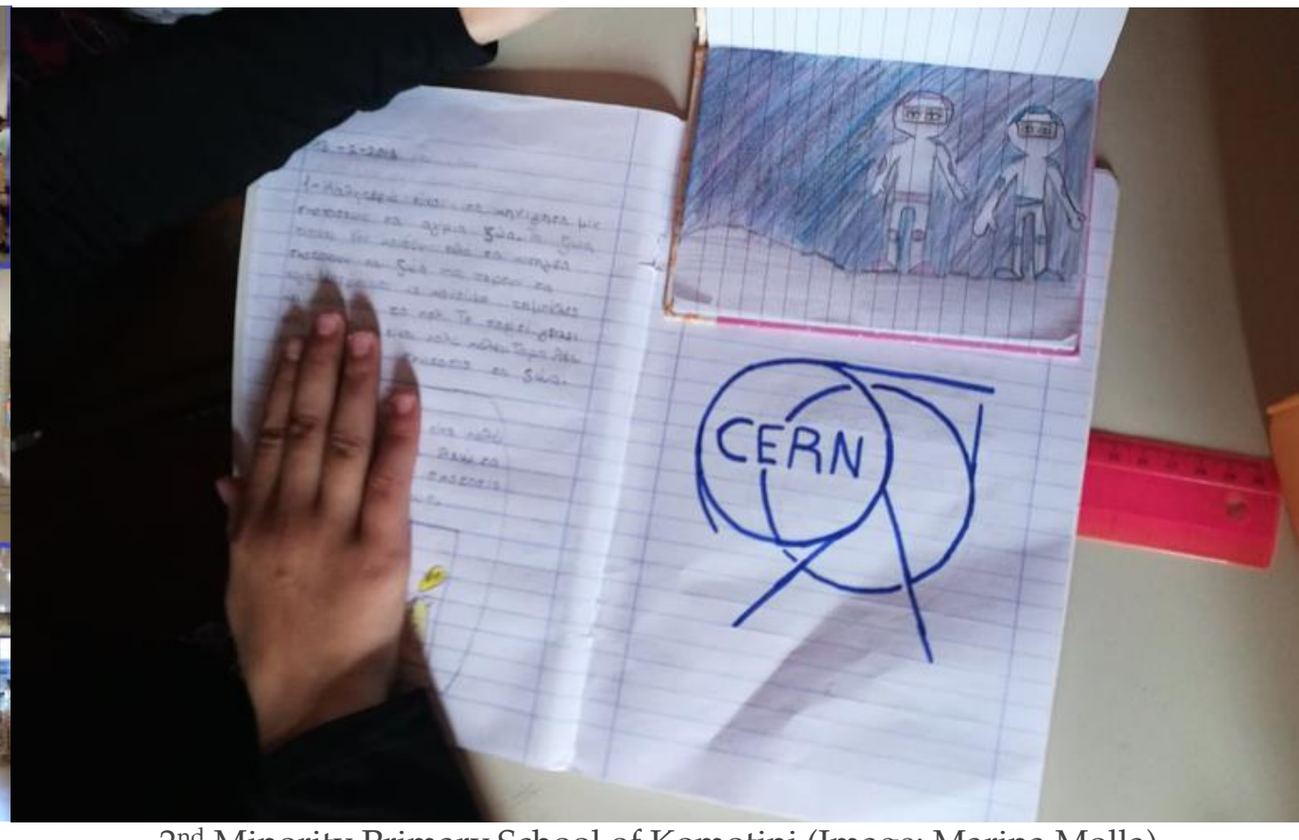
14 schools
52 teachers
512 students

7 schools
28 teachers
270 students
3 countries



2018-19

6th Primary School of Naousa, Greece (Image: Anastasia Lafara)



2nd Minority Primary School of Komotini (Image: Marina Molla)

Course evaluation*

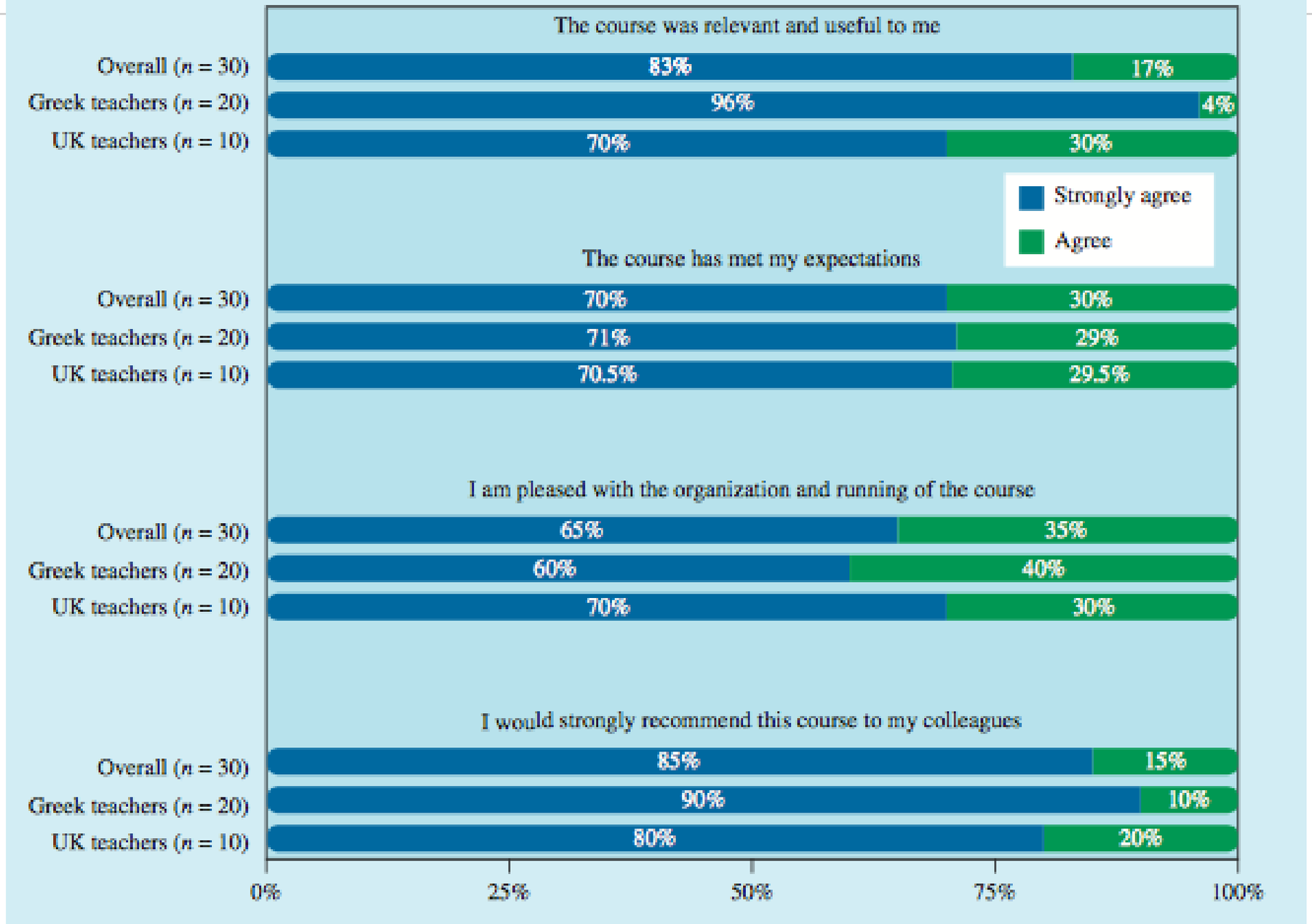


Figure 2. Greek and UK teachers' rating of the course's quality.

Source: Alexopoulos, Pavlidou & Cherouvis (2019)

*3 PD courses (2 GR, 1 UK)

Follow-up evaluation*

Table 5. Impact on teachers' professional development and personal outlook.

Impact on teachers' professional development	Impact on teachers' personal outlook
'I have applied to and taken part in similar training courses in other European organisations. This would not be possible if I had not taken this course'.	'It opened up a new way of perceiving nature'.
'I have taken part in several seminars and presented ways to teach physics with everyday materials. Many schools have invited me to present what I did during the summer course at CERN'.	'The fact that I met and kept contact with great scientists gave me self-esteem, knowledge and confidence'.
'In the next school year, I will lead a new regional network of schools and teachers inspired by Playing with Protons'.	'I became more positive and patient as a person. Maybe more mature...'
'The course triggered my involvement in interdisciplinary STEM projects but also my development as a Scientix ambassador'.	'New horizons, new knowledge, new friendships'.
'I have had the confidence and enthusiasm to share ideas and concepts from the course at our county conference to over 100 teachers'.	'Personally speaking, there was a positive impact on my views and also my knowledge related to physics, cosmology, CERN and more generally of science'.
'I collaborated with other teachers, school advisors and I helped my school secure a grant from a foundation'.	'My professional and also my recreational choices are more closely related to science. Even my relationships with my students, both professionally and personally, have been improved as a result of my involvement with this course'.

Source: Alexopoulos, Pavlidou & Cherouvis (2019)

*3 PD courses (2 GR, 1 UK)

Student impact

CREATIONS
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Dear student,

Thank you for your participation!
All questionnaires are part of a study and your answers are strictly confidential! Your teacher will neither evaluate nor mark it!

Your personal Code is built up of:

*Required

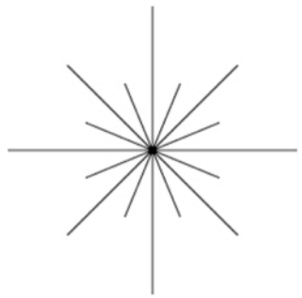
Date of today: *
DD MM YYYY
/ / 2019

Your gender: *
Choose

Your month of birth: *

Now look at the first below and write down as many things as you can for what that figure might be. What does it look like? What could it be? *

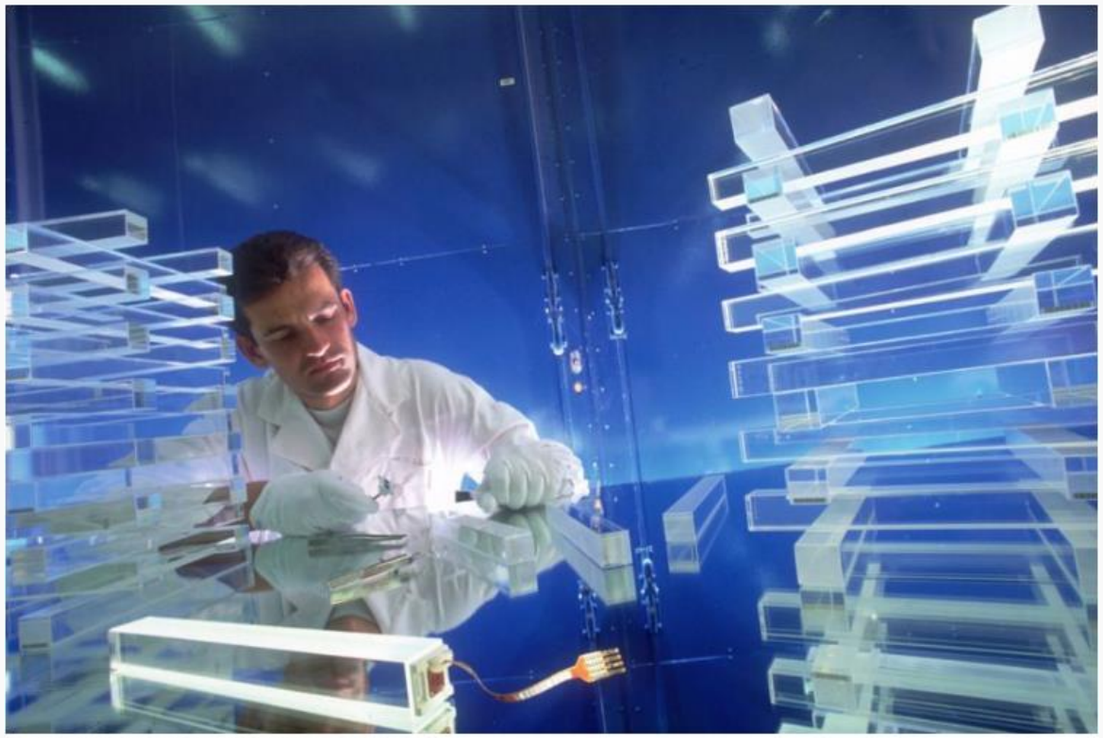
Now make a list of all of the things that this figure could be. Remember, the more things you write down, the better! *



Now for the last Figure. Remember that there are no grades, this is a game, and you should list as many things as you can! *

Student impact*

Τώρα κοίταξε παρακάτω και γράψε όσα περισσότερα πράγματα μπορείς για το τι θα μπορούσε να είναι η κάθε εικόνα. Σε τι μοιάζει; Τι θα μπορούσε να είναι; *



Lead tungstate crystals for the CMS ECAL.

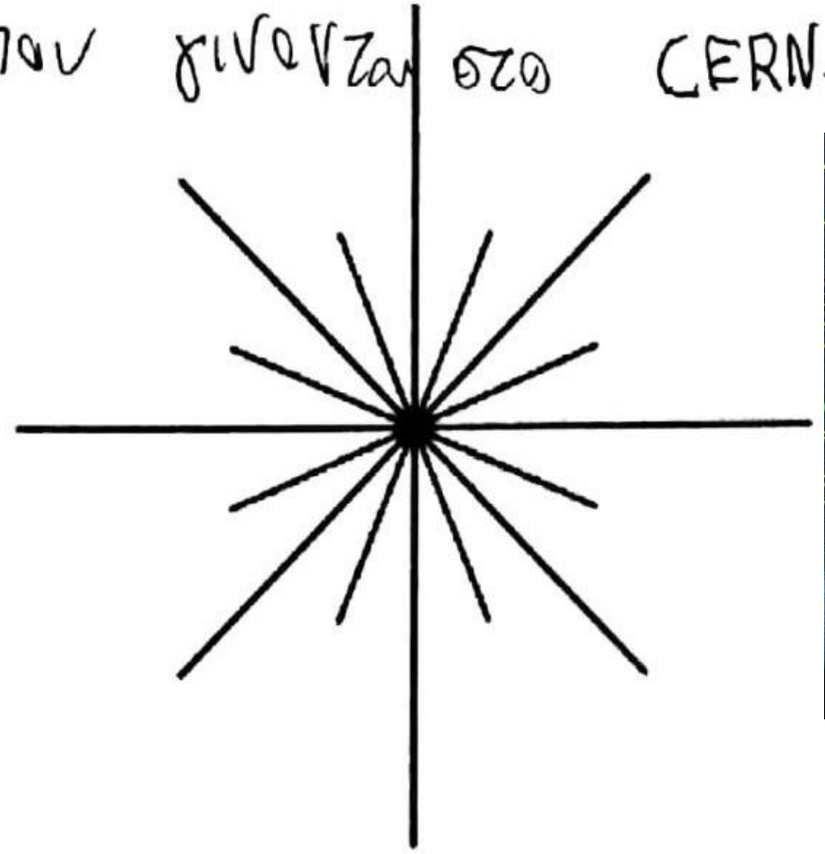
Μου μοιάζει με τα γιαδια που ανιχνεύουν στο CERN στο σιμιθ σιγκρουσις.

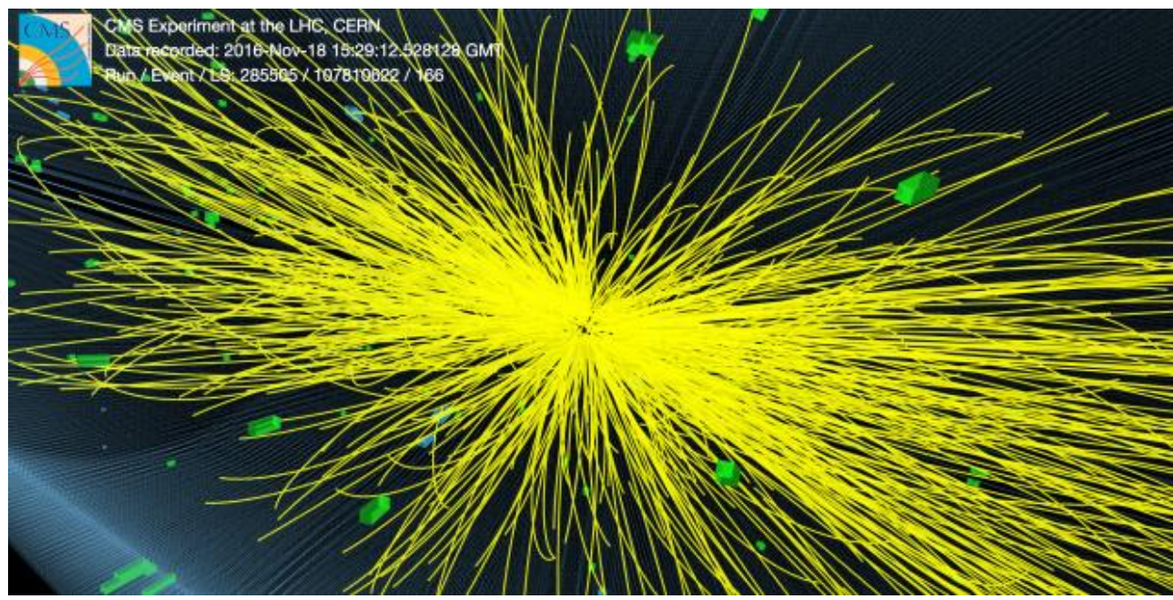
* Based on student assessment in Vytina Primary School, Greece

Student impact*

Τώρα φτιάξε μια λίστα με όλα τα πράγματα που θα μπορούσε να είναι το παρακάτω σχήμα. Θυμήσου, όσο περισσότερα πράγματα γράψεις, τόσο το καλύτερο! *

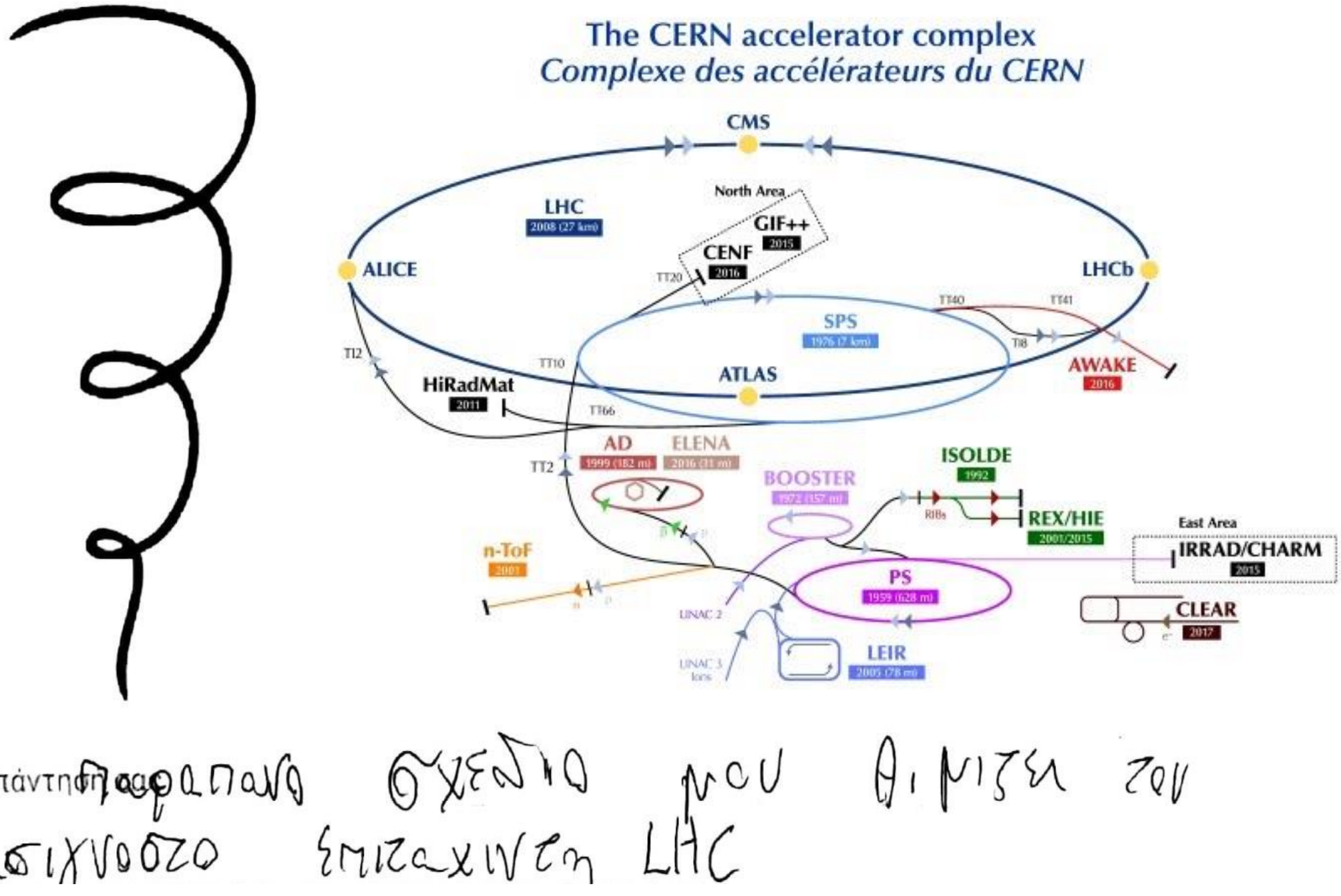
Επίσης μου θύμισε τηλ εξυχαμένες εκρήξις που γίνονται στο CERN.





* Based on student assessment in Vytina Primary School, Greece

Student impact*



Το αγαπημένο μου σχέδιο μου άρεσε το παιχνίδι επιταχυντή LHC

* Based on student assessment in Vytina Primary School, Greece

Student impact**

education sciences

MDPI

Article

How Creativity in STEAM Modules Intervenes with Self-Efficacy and Motivation

Cathérine Conradty [1,*], Sofoklis A. Sotiriou [2] and Franz X. Bogner [1]

[1] Centre of Math & Science Education (Z-MNU), Department of Biology Education, Faculty-II, University of Bayreuth, 95447 Bayreuth, Germany; franz.bogner@uni-bayreuth.de
[2] R&D Department, Ellinogermaniki Agogi, 153 51 Pallini, Greece; sotiriou@ea.gr
* Correspondence: catherine.conradty@uni-bayreuth.de

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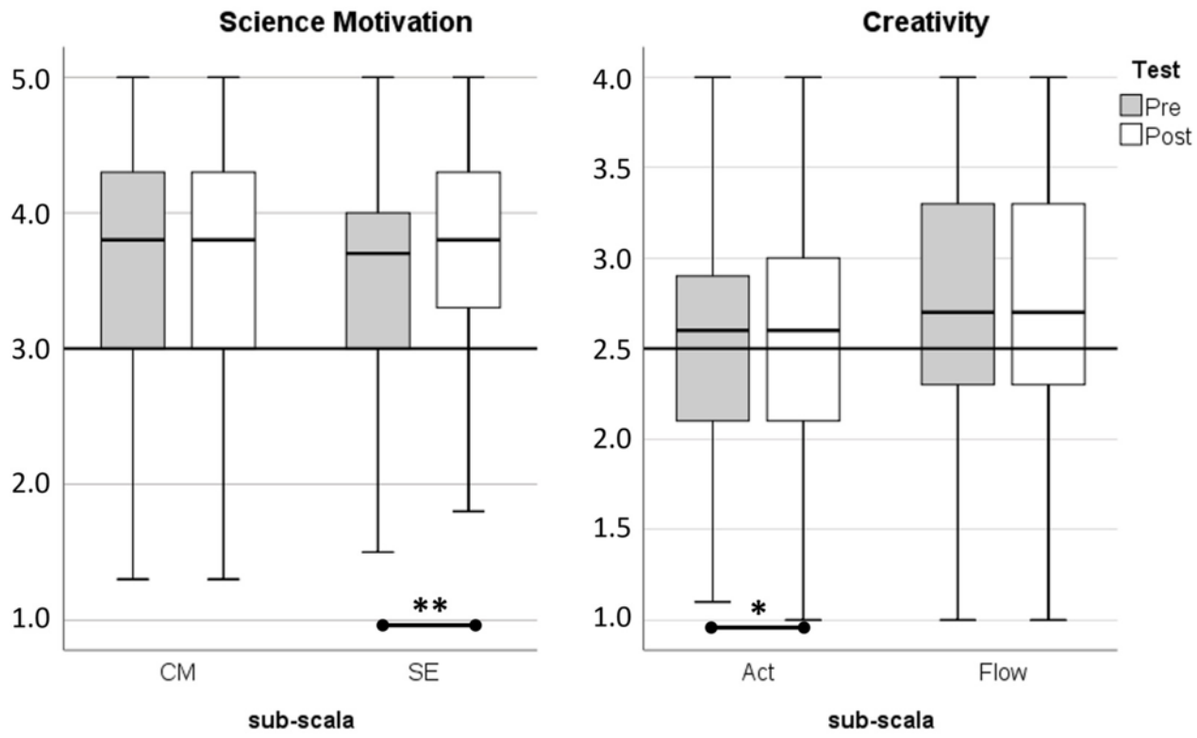
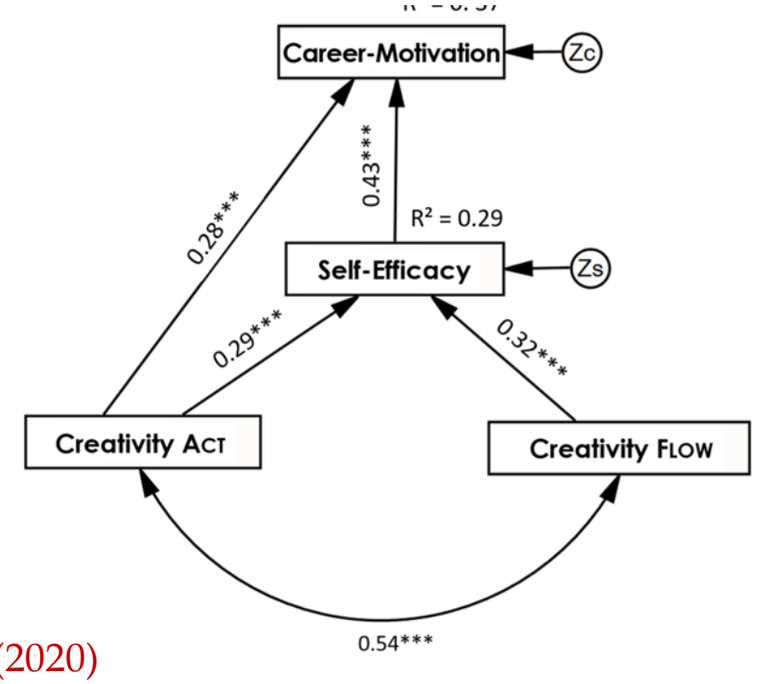
Abstract: Many current curricula, in going beyond traditional goals, increasingly foster creativity in science classrooms, declaring creativity a core skill of the 21st century. For enhancing creativity in science classrooms, the subject Arts is considered to offer a potential way from STEM (Science, Technology, Engineering, Mathematics) to STEAM (STEM with Arts)). The Horizont-2020 project CREATIONS prepared more than 100 creativity-enhancing STEAM modules based on the 5E instructional model. STEM subjects were mathematics, biology, physics, chemistry or technology, and often interdisciplinary for different school and class levels between the ages of nine and nineteen. All modules provided a social environment fostering creativity where students imagine, explore, experiment, test, manipulate, and speculate. Exemplarily, five modules including physics, math, and biology, were selected, for monitoring motivation and creativity. The first was measured on the level of career-motivation and self-efficacy, the latter focused on two sub-constructs: active cognition such as idea processing (ACT), and a mental state of creative immersion (FLOW). Subjects were a sample of 995 students (9–18 years). In summary, no gender impact or age effect appeared in any of the monitored variables. Participation intervened with Self-Efficacy and ACT, while Career Motivation or FLOW did not. ACT as a cognitive variable associated with creativity might be more sensitive to changes, whereas FLOW as a parameter measuring a state of mind related to emotion appears more stable. Path analysis supported the role of creativity for Career-Motivation by promoting Self-Efficacy. Conclusions for appropriate educational settings to foster STEAM environments are discussed.

Keywords: creativity; self-efficacy; STEM education; STEAM (enriched with arts); inquiry-based science education; science classroom





CREATIONS
Developing an Engaging Science Classroom

** Conradty, Sotiriou & Bogner (2020)

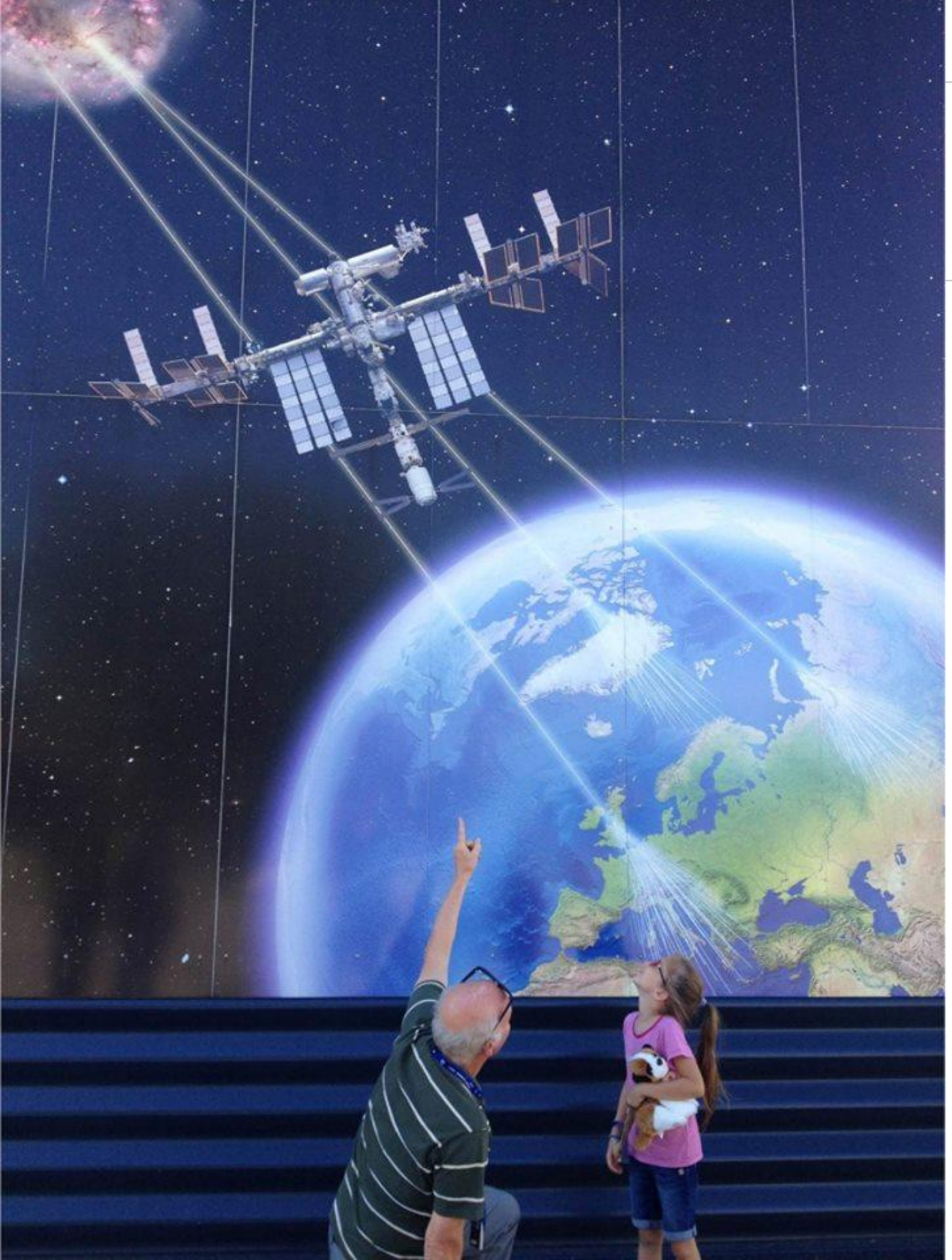
In conclusion

- "Playing with Protons" has so far proved a ***successful primary teacher training course***

- Evidence suggests that "Playing with Protons" has a **positive effect on student creativity** and, subsequently, on **science career motivation**

- Further work on the cultivation of an ***ethic of interdependent contribution to a shared purpose*** (i.e. the effective engagement of all primary students with modern physics, scientific discovery and innovation) and ***the success of others***

- In this sense, value creation is contingent upon the extent to which ***community members believe that others have contributions to make towards this shared creation***



Thank you!

Contact

protons-info@cern.ch

@playprotons

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