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DELIVERABLE D2.4

Report on creation and activities of teachers' network

Lead Beneficiary: BME

Due date: 31/11/2025 Released on: 15/02/2026

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Csilla Pesznyak	Luyten Jakob Signed by: Luyten Jakob 1787B1475D534C0... 16-feb-2026 | 08:37 CET	Pavel Gabriel Signed by: Gabriel Pavel 1A000C33F68F428... 25-feb-2026 | 14:35 CET

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EXECUTIVE SUMMARY

Nuclear science and technology constitute a cornerstone of modern society, providing critical contributions to energy security, healthcare, environmental stewardship, industry, and scientific innovation. As these fields continue to advance, the need for a well-informed public and a skilled future workforce becomes increasingly significant. For this reason, establishing strong and sustained connections between the nuclear community and high school teachers is of strategic importance.

One of the major challenges of the ENEN2plus project, funded by the European Union, is the establishment of a European nuclear education network for high school teachers. Deliverable D2.4 provides a comprehensive overview of the project's initiatives to build a network of secondary school teachers, aiming to establish long-term cooperation with them regarding the peaceful applications of nuclear science and technology, thereby ensuring the supply of the future nuclear workforce.

In contemporary educational environments, secondary school teachers are increasingly overburdened, carrying substantial instructional as well as administrative responsibilities. This heavy workload makes it particularly challenging to establish and maintain contact with them. Developing a European educational network under the ENEN2plus project that facilitates and coordinates the engagement of high school teachers in nuclear-related topics therefore represents a considerable challenge, especially given the limited amount of free time available to educators.

Consequently, initiating collaboration requires careful planning and sensitivity to these constraints. To ensure the effectiveness and long-term sustainability of such a network, in-person meetings were essential at the outset, as personal interaction provided a foundation for trust, commitment, and durable cooperation.

During the course of the project, two workshops were successfully organized, and a personal network was established that enabled direct communication with high school teachers in several countries. These teachers were then able to share the information with their colleagues within their respective countries.

The first workshop for teachers was organized in parallel with the 3rd Nuclear video competition for secondary schools in Budapest, Hungary by the Budapest University of Technology and Economics. At this event there were 15 participants from 10 countries. The second workshop was organized together with the IAEA Knowledge Management Division in Vienna, Austria, where there were 16 participants from 10 countries.

Collaboration between educators and nuclear professionals provides multiple benefits. Through professional development programs, classroom materials, laboratory demonstrations, and opportunities for direct engagement with experts, teachers gain access to reliable information and contemporary scientific perspectives. This partnership enables them to integrate nuclear topics more effectively into curricula, making their lessons more engaging, evidence-based, and reflective of current technological developments.

One of the most important results of this cooperation and excellent network was the development of a summer school program and its organization in five countries with the help

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of the ENEN2plus project. The report also presents the nuclear summer schools in detail organized in Hungary, Ukraine, Croatia, Romania and Serbia.

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1. INTRODUCTION

This project report presents the significance, outcomes, and challenges of the collaboration established with high school teachers.

Secondary school teachers play a key role in shaping the scientific literacy, attitudes, and career aspirations of young people. They serve as trusted communicators who introduce students to complex scientific concepts and help them understand the relevance of these topics to real-world challenges. Once teachers possess up-to-date and accurate knowledge of nuclear science and technology, they are better equipped to guide students, address misconceptions, and encourage critical thinking about issues such as nuclear science, nuclear energy and technology, medical applications, nuclear safety, and environmental monitoring.

Nowadays, high school teachers are overburdened, facing numerous educational and administrative responsibilities, which makes it very difficult to establish contact with them. Creating a European educational network that ensures and coordinates the cooperation of secondary school teachers in the field of nuclear topics is a significant challenge, especially due to their limited availability. They cannot be absent from their workplace during teaching hours, and during the summer break many are reluctant to give up their well-deserved free time. For the sake of effectiveness, in-person meetings are essential in the initial stages, as high school teachers are the only way to ensure long-term success.

During the ENENplus project, connection and communication was established with the secondary school teachers from the different countries, but only relating to the secondary school nuclear competition. We have considered that it was important to maintain contact with the teachers who had previously participated in one of the two competitions considered. The first workshop programme was developed in consultation with them.

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2. ENEN2PLUS 1ST WORKSHOP FOR SECONDARY SCHOOL TEACHERS

Introduction

According to the description of task T2.4, the objective was "to increase the number of secondary school teachers and pupils receiving information on education and career opportunities before choosing their higher education and/or profession"

The close aim of the workshop was to elaborate a recommendation to organize summer camps for secondary school pupils, where nuclear-related knowledge is disseminated. This event was organized in parallel with the 3rd Nuclear competition for secondary schools. The suggested list of interesting talks and actions had to be wide enough so that each country could choose a set from it, which suited the possibilities and specialities of the country.

Venue: Budapest University of Technology and Economics, Budapest, Hungary

Date: 4-6 July 2023.

Participants: 15 secondary school teachers from 10 countries: Belgium, Bulgaria, Czech Republic, Croatia, Hungary, Italy, Romania, Portugal, Spain, Ukraine.

Program

The planned **program** of the Workshop was the following:

Tuesday 4th July: 13:30 – 14:30 Introduction

14:30 – 15:00 Break

15:00 – 17:00 Get to know each other (presentation of each participant)

Wednesday 5th July

09:00 – 10:30 Suggesting ideas about the possibilities of a scientific camp

10:30 – 10:45 Break

10:45 – 12:15 Collaboration team work - discussions

12: 15 - 13:30 Lunch

13:30 – 14:30 Ideas about the possibilities of each country's camp – presentation – volunteer participants

14:30 – 15:00 Break

15:00 – 16:30 Discussion of the interim report – outcome of the first two days

Thursday 6th July

09:00 – 17:00 Finalizing the recommendations of the workshop

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Figure 1. Group picture of the 1st teacher workshop in Budapest, Hungary

Recommendations of the workshop

During the first teachers' workshop, the participating teachers outlined the program of the nuclear summer school, which would be held in the native language of each organizing country. The ENEN2plus project had originally planned at least three nuclear summer schools in the native language, but strong interest and enthusiasm led 6 countries to apply to organize the events, of which five countries actually held them, while one country withdrew.

The teachers reached a clear consensus that the summer schools should be designed as comprehensive, well-balanced programs that combine academic rigor with an engaging and supportive learning environment. Their shared view was that the curriculum should provide students with a solid grounding in both general physics and the fundamental principles of nuclear science. Establishing this dual foundation is essential: while nuclear science builds upon core physical concepts such as energy, radiation, atomic structure, and matter interactions, many high school students require reinforcement of these basics in order to fully understand more specialized nuclear topics.

In addition to covering theoretical knowledge, the teachers emphasized the importance of including strong experimental components. Hands-on laboratory activities, demonstrations, and guided experiments would allow students to observe physical phenomena directly, apply theoretical concepts in practice, and develop critical scientific skills such as measurement, data analysis, and interpretation. This experiential approach not only deepens understanding but also increases motivation and curiosity, as students can see the tangible outcomes of scientific inquiry.

The program should also incorporate a scientific excursion, such as a visit to a research institute, laboratory, university department, or relevant industrial facility. Such visits provide students with first-hand insight into real-world applications of nuclear science and physics, introduce them to professional researchers and engineers, and help them better understand potential

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academic and career pathways in STEM fields. Exposure to authentic scientific environments can significantly strengthen students' interest and sense of relevance.

At the same time, the teachers stressed that the summer school should not be structured as an intensive academic course without breaks. Adequate time for leisure activities, informal discussions, and social interaction should be built into the schedule. Recreational programs, team-building activities, and opportunities for relaxation are important for maintaining students' enthusiasm and preventing cognitive overload. A positive social atmosphere also encourages collaboration, communication, and peer learning.

Finally, the teachers highlighted that the overall experience must be enjoyable and inspiring. The program should be designed in a way that presents nuclear science as an exciting and accessible field rather than as an overly complex or intimidating subject. By combining solid scientific content, interactive learning methods, real-world exposure, and enjoyable community-building activities, the summer schools can foster long-term interest in physics and nuclear science, rather than discouraging talented high school students from pursuing further studies in these areas.

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3. ENEN2PLUS 2ND WORKSHOP FOR SECONDARY SCHOOL TEACHERS

Introduction

The 2nd workshop for secondary school teachers was organized at the International Atomic Energy Agency, in Vienna, Austria by Csilla Pesznyak (ENEN2plus WP2) and Helena Zhivitskaya (IAEA, Nuclear Knowledge Management Section).

Figure 2. Group picture of the participants of the 2nd teacher workshop at the IAEA

Program of the event

The event was organised to be engaging and not overly demanding, avoiding an excessive number of theoretical lectures and focusing on interactive sessions instead. Therefore, the presentations were centred on the research activities carried out by the project partners and their objectives, giving students the opportunity to ask questions and gain an insight into the world of nuclear research. Thanks to this, the students actively participated in all sessions of the program demonstrating great curiosity and interest. Also, the teachers were involved by asking them to provide a presentation about their school and the nuclear program in their country of origin and the related issues.

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The agenda of the five-day event was the following:

IAEA
International Atomic Energy Agency
Atoms for Peace and Development

Consultancy Meeting on Enhancing Nuclear Education in Secondary Schools: Current Challenges, Resources, and Teacher Support

IAEA Headquarters

Vienna, Austria

Room M0E15, M building

1–4 April 2025

Ref. No.: EVT2500436

AGENDA

Tuesday April 01, 2025

Time (Vienna)	Topic	Speaker
OPENING SESSION		
Chair: Helena ZHIVITSKAYA, Csilla PESZNYAK		
10:30 – 12:30	Welcome remarks	Helena ZHIVITSKAYA (IAEA) Csilla PESZNYAK (ENEN)
	Self-Introduction of the Meeting Participants	All
12:30-14:00	Lunch Break	
14:00-15:30	IAEA (60 min)	Helena ZHIVITSKAYA (IAEA)
	Mission of the ENEN (30 min)	Csilla PESZNYAK (ENEN)
15:30-15:50	Coffee Break	
COUNTRY PRESENTATIONS		
15:50-16:50	Belgium (30 min)	Joeri VERTONGEN
	Bulgaria (30 min)	Diana YORDANOVA
16:50-17:00	Summary of this day	Csilla PESZNYAK

Wednesday April 02, 2025

Time (Vienna)	Topic	Speaker
COUNTRY PRESENTATIONS		
Chair: Gabor STELCZER		
9:00-10:30	Croatia (30 min)	Marlena CUKTERAS
	Hungary (30 min)	Kristóf TÓTH
	Italy (30 min)	Silvia FAGGIOLI
10:30-11:00	Coffee Break	
11:00-12:30	Ireland (30 min)	Alva PHELAN
	Poland (30 min)	Katarzyna TATARA
	Romania (30 min)	Razvan BALASOV
12:30-14:00	Lunch Break	
14:00-15:30	Serbia (30 min)	Jovana KNEZEVIC
	Spain (30 min)	Francisco BARRADAS
	Turkey (30 min)	Emine KURT
15:30-16:00	Coffee Break	
16:00-16:50	Teachers' expectations	All Rapporteur: Marlena CUKTERAS
16:50-17:00	Summary of this day	Csilla PESZNYAK

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Thursday, April 03, 2025

Time (Vienna)	Topic	Speaker
NATIONAL SUMMER SCHOOLS		
Chair: Lois TOVEY		
9:00-10:30	Croatia	Marlena CUKTERAS
	Hungary	Péter TARJÁN
	Discussion	All
10:30-11:00	Coffee Break	
GROUP WORK		
11:00-12:30	Calculation examples (3-4 from each country)	Group 1
	ENEN materials for secondary schools	Group 2
	Nuclear excursions (in Europe)	Group 3
12:30-14:00	Lunch Break	
14:00-15:30	Discussion of the group activities	ALL Rapporteur:
15:30-16:00	Coffee Break	
16:00-16:50	What more we can do ...	All Rapporteur:
16:50-17:00	Summary of this day	Csilla PESZNYAK

Friday, April 04, 2025

Time (Vienna)	Topic	Speaker
TEACHERS' NETWORK		
Chair: Gabriel PAVEL		
9:00-10:30	Group photo	All Rapporteur:
	How we can network...	
	Action plan for the future	
10:30-11:00	Coffee Break	
11:00-12:00	STEM AWARD CEREMONY Gabriel PAVEL, Csilla PESZNYAK (ENEN)	
12:00-13:00	Lunch Break	
13:00-13:30	Concluding remarks	All
13:30-14:00	Closing of the meeting	Helena ZHIVITSKAYA (IAEA) Gabriel PAVEL (ENEN)

1. Overview of current challenges and opportunities

The meeting started with a broad discussion on the current state of nuclear education in secondary schools and key challenges were identified:

1. Radiation safety concerns: Most of the participants in the discussion stressed the extreme importance of radiation safety, especially with regard to children. The need for solid safety protocols and comprehensive education on radiation measurement and accident prevention was emphasized.
2. Resource constraints: Many schools lack adequate funding for laboratory equipment and practical learning materials (e.g. films demonstrating laboratory techniques).
3. Teacher capacity building: There is a significant need for improved teacher training, particularly regarding EU radiation regulations and safety standards. All attendees agreed to participate in various workshops and webinars that will help them with new teaching approaches
4. Gender imbalance in STEM: Several attendees emphasized that there is an underrepresentation of girls in science and physics, and that ways should be found to increase the current number, which is also one of the Sustainable Development Goals

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5. Short attention span: The impact of digital media (e.g. TikTok) on students' attention spans requires adapting educational content to be more concise and engaging (e.g. short videos).
6. Language barriers: Changing languages (e.g. between Spanish and English) creates communication challenges in the ability of both teachers and students to participate in workshops and projects.
7. Bureaucratic obstacles: Launching educational initiatives often faces bureaucratic obstacles and requires effective management of institutional processes.

A multifaceted approach is needed to address these challenges, focusing on safety, resources, teacher training, inclusiveness, and effective communication.

2. Summer School Planning and Material Development

A significant part of the meeting was devoted to planning and refining materials for the upcoming summer schools and national workshops. Discussions focused on:

1. National Summer School Planning: Examples of good practice in organizing national summer schools in Croatia and Hungary would be used to plan other summer schools.
2. Calculation Examples for Classroom Use: Teachers would like to have a unified notebook or book that would collect appropriate calculation examples for secondary school students in the nuclear science field.
3. Video Selection for Classroom Use: Existing videos would be reviewed and a selection made for recommendation in the classroom (ANEX I.)
4. Nuclear Field Trip Planning Document: A document with details of the nuclear field trip, including suggested locations and links, is needed, which would be created in the following session.
https://www.google.com/maps/d/u/3/viewer?mid=1wUuqw1t0ogkKEtrsBnXzByK5H1foSJ4&ll=50.83651275741385%2C8.475795025699558&z=4

5. Classroom Resources Development: Classroom resources with easy-to-use instructions would be needed.

3. Teacher support and training initiatives

The meeting addressed the critical need for strong support mechanisms for teachers. The key points of the discussion included:

1. Teacher training on radiation safety: Proposal for training teachers on radiation regulations and protection within the framework of EU safety standards.
2. Teacher development programmes: Proposals for teacher development programs focused on self-improvement.
3. Networking opportunities: Facilitating networking among teachers globally to foster collaboration and exchange of best practices. A global teacher networking platform would be used for this.
4. Local workshops: A condition for continued funding by the European Commission was the organization of local workshops upon return from the training, to share knowledge learned.

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4. Project Retrospective and Future Directions

The meeting concluded with a review of past projects and a discussion of future initiatives:

1. Summer Camp/School Evaluation: A review of the past summer program involving 20 participants highlighted significant impact and prompted requests for future participation.
2. International Student Exchange Program: Plans were being developed for a student exchange program with locations in Serbia and Romania.
3. Future Competitions: Successful funding will lead to a fifth competition in 2027, building on the four previous events.
4. Youth Career Event Proposal: A career event was proposed that leverages the existing network of young generations and utilizes online platforms for accessibility.

STEM AWARD

The STEM Excellence Award for teachers is presented to active secondary school educators who have significantly promoted STEM subjects in general, and nuclear-related topics in particular, at the secondary school level. Such STEM initiatives may include anything from a custom-designed school trip or project to tailor-made teaching materials or even a serious (board) game.

Teachers who implemented initiatives to advance STEM education could be nominated by colleagues, other school staff, students and parents, as well as national bodies such as nuclear agencies or teacher associations.

All submissions — 12 eligible applications from 4 European countries — were evaluated by the jury based on the following criteria:

- Teaching excellence (subject expertise, use of innovative, effective, and engaging teaching methods, demonstrated improvement in student outcomes, etc.);
- Innovation and creativity;
- Impact on students (inspiration, inclusivity, etc.);
- Sustainability and scalability of the initiative;
- Evidence and documentation;
- Community engagement and collaboration with partners;
- Relevance to nuclear science and technology.

More information can be found on the website: https://stemteachersaward.enen.bme.hu/

The jury consisted of the following experts: Csilla Pesznyak (BME), Walter Ambrosini (CIRTEN), Gabriel Pavel (ENEN), Barbara Ferrucci (ENEA), Lois Tovey (UNIVLEEDS), Jakob Luyten (SCK CEN) and António Paulo (IST).

The laureates were invited to participate in the second ENEN2plus teacher's workshop, co-organised with IAEA, with ENEN2plus mobility support. The four laureates received the STEM award. In Figure 3 below, the laureates (Kristóf Tóth from Hungary, Marlena Cukteras from

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Croatia, Emine Kurt from Turkey and Silvia Faggioli from Italy nominated by the ENEN) are presenting their award.

Figure 3. Laureates of the STEM Excellence award with ENEN and IAEA representatives

Flyer STEM Excellence Award for Secondary School Teachers

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4. NATIONAL NUCLEAR SUMMER SCHOOLS

4.1 National summer school in Hungary

Venue: András Mester Nuclear Camp; Keszthely, Hungary,

Date: 01-06 July, 2024

Organizer: Péter Tarján PhD university professor, Sándor Újvári MSc secondary school teacher

The professional programme, the announcement poster, the application form and the application for ENEN support were prepared by Péter Tarján. Sándor Ujvári maintained communication with the participants.

Programme

01 July Monday

12-14	Arrival
14-18	Orientation
18-19	Dinner
19-22	Remembering András Mester, the founder of the camp Getting acquainted activities (Icebreaker activities?)

02 July Tuesday

08-09	Breakfast	
09-10	Talk: Intro into nuclear physics 1 Péter Tarján University of Nyíregyháza	Talk: Nuclear medicine Ádám Gáldi Budapest University of Technology and Economics
10-11	Talk: Intro into nuclear physics 1 Péter Tarján University of Nyíregyháza	Talk: Nuclear reactor safety István Neubauer Paks 2 Nuclear Power Plant Ltd.
11-12	Talk: Intro into nuclear physics 1 Péter Tarján University of Nyíregyháza	Talk: Fusion Dániel Réfy Hun-Ren Centre for Energy Research
12-13	Lunch	
13-14	Student presentations	
14-18	Outdoors time at Lake Balaton	
18-19	Dinner	
19-20	Spectacular experiments Sándor Ujvári Kornél Lánczos Grammar School, Székesfehérvár	

03 July Wednesday

All-day trip to the Hun-Ren Centre for Energy Research.

In the evening: Experiments with lasers, Péter Tarján, University of Nyíregyháza

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04 July Thursday

08-09	Breakfast
09-10	Talk: The Higgs boson Dezső Horváth Hun-Ren Wigner Research Centre for Physics
10-11	Talk: Fundamental interactions Csaba Sükösd Budapest University of Technology and Economics
11-12	Talk: The Curie family Katalin Radnóti Eötvös Loránd University, Budapest
12-13	Lunch
13-18	Hands-on laboratory measurements and simulations.
18-19	Dinner
19-21	Interactive nuclear quiz FINE (Youth for Nuclear Energy)

05 July Friday

08-09	Breakfast
09-11	Talk: Cosmic radiations Ákos Horváth Eötvös Loránd University, Budapest
11-12	Talk: Dealing with nuclear waste Margit Fábián Hun-Ren Centre for Energy Research
12-13	Lunch
13-18	Guided trip to Keszthely Experiments in electricity and magnetism by László Farkas János Vajda Grammar School, Keszthely
18-19	Dinner

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06 July Saturday

08-09	Breakfast
09-10	Talk: Experimental particle physics Balázs Ujvári University of Debrecen
10-11	Talk: Detector development Balázs Ujvári University of Debrecen
11-12	Evaluation and closing of the camp
12-13	Lunch
13-	Departure

Catering, accommodation and bus transport were arranged by László Farkas and Margit Fábián. The programme of the visit to the HUN-REN Centre for Energy Research and the ordering of T-shirts was organised by Margit Fábián. Gergő Pokol and Beáta Jarosievitz contributed useful ideas. The camp leaders were Sándor Ujvári and Péter Tarján. Márton Vavrik and Csongor Szegedi-Csinády (from the Youth for Nuclear Energy branch of the Hungarian Nuclear Society) participated in the camp as junior supervisors. As a local organiser, László Farkas provided invaluable help in organising both the professional and recreational activities. As in previous years, the camp was hosted by the Vocational School for Catering in Keszthely, Hungary.

The presentations included introductory sessions alongside lectures by renowned nuclear experts. In total, 14 presentations were given by 11 speakers. The organizers had tried to develop the topics of the technical programme in the light of last year's feedback, including several theoretical and experimental particle physics lectures. On 3 July the participants took part in a full-day bus excursion to the HUN-REN Centre for Energy Research, where lectures and laboratory visits gave an insight into the Centre's research topics. Among the other activities were a laboratory measurement (determining Planck's constant based on the forward voltage of LEDs) and a simulation exercise (modelling the electricity production of a country) in the laboratories of the János Vajda Secondary Grammar School, led by László Farkas, Sándor Ujvári and Péter Tarján. This time there were fewer than usual lab experiments, but more time was devoted to them, so that the lecturers could get more in-depth on both tasks. The participants also enjoyed three spectacular experimental shows courtesy of Örs Asztalos, Péter Tarján and Sándor Ujvári. The activities for "getting acquainted" on the first evening and the nuclear team- and individual competitions (organised by the junior supervisors) were also popular. Sándor Ujvári initiated a problem-solving competition on the first day, for which the solved problems could be submitted until the penultimate day. On the last evening, an informal discussion was organised about the camp, physics and future prospects.

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Figure 4. Experimental work in Keszthely, Hungary.

The local activities were organised by László Farkas, teacher of physics at the János Vajda Secondary Grammar School in Keszthely. Under his guidance the participants could visit the sights of Keszthely, the castle and the model railway exhibition.

Figure 5. Visit to the Centre for Energy Research, Hungary

Figure 6. Group photo in the Centre for Energy Research, Hungary.

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Satisfaction survey

Participants were asked to provide feedback with a Google Form after the camp. This was completed by 19 out of 23 participants. Most of the students had heard about the camp at school or through friends.

In response to the question "Check the talks you liked the most! You can choose up to 5", there was a wide range of responses, with all the talks making it into someone's top 5.

The most popular presentations were:

- Balázs Ujvári's talk on the importance of precise timing in CMS (chosen by 14 out of 23 respondents)
- Ákos Horváth (Eötvös University) on the natural nuclear reactor in Gabon (14)
- Csaba Sükösd's lecture "Close to Creation" (13)
- Dániel Réfy's lecture on fusion (12)

The other professional programmes received a fairly positive evaluation:

- Plasma tube demonstration scored 4.26 on a scale of 5
- Fun experimental show scored 4.84
- The visit to the Centre for Energy Research scored 4.31
- Laser experiment show scored 4,26
- Group quiz led by the junior supervisors scored 4,16
- Lab measurements and simulation 4,37
- Friday evening informal discussion about the camp, physicists and more 4,58

For the question: "If you get the chance, would you come to the next Nuclear Camp?", all 19 participants said YES.

A surprisingly high number of people answered the optional question on what other topics they would have liked to see. The most missed topic seemed to be astronomy and astrophysics, and the organizers considered it definitely worth inviting such speakers to the following year's camp. Other topics that were raised were also taken into consideration.

It was encouraging that, following feedback from the previous year, the particle physics lectures included in the programme proved popular and some participants expressed interest in attending more of them.

Finally, students could write (optional) text comments with useful suggestions for the future. The organizers aimed to heed this feedback the following year (e.g. include longer chunks of leisure time).

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Based on the feedback received after this camp, the following changes were planned:

- Scheduling 3 lectures each morning instead of 4; this way there was actually time to give our brains a bit of rest and/or talk to the lecturers.
- Parallel sessions on the first 2 days: introductory lectures for the younger students (radioactivity, nuclear physics, etc.), technical lectures for the more experienced ones.
- Giving students the opportunity to give a 10-15-minute presentation on a topic of their choice: either their own research or any part of modern physics.

Of these, the first two were implemented (parallel sessions were actually only on the first morning) and proved to be useful changes (although there were still some speakers who overran their allotted time). Student-led mini-lectures had also been planned, but were eventually announced too late, so there were no participants. The organizers noted that more attention would need to be paid to this in the following camp.

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4.2 National summer school in Ukraine

Venue: V. N. Karazin Kharkiv National University, Ukraine

Date: 19-23 August 2024

Organizer: Philip Kuznietsov, PhD university professor

First, about 20 participants were expected in the event - these were to be mostly high school students from the Kharkiv region, as the main principles of the school was in-person participation. But when the registration was opened, more than 60 applications were received from different regions of Ukraine - Ternopil, Kyiv, Vinnytsia, Khmelnytsky. Talking to the applicants, it was found that students were even willing to come to Kharkiv from the western regions of the country to participate, and there was even a participant from Ternopil. As for the impressions from the school, they were hard to overestimate.

Program

Venue	V.N. Karazin Kharkiv National University				
Time/date	19.08.2024	20.08.2024	21.08.2024	22.08.2024	23.08.2024
10.00-11.00	Pylyp Kuznietsov (KKNU) Opening talk. Welcome reception.	Sergii Lytovchenko (KKNU): "Modern reactor materials"	Inna Afanasieva (KKNU): Fusion basic concepts.	Bogdan Mazilin (KKNU): "Nuclear weapons: Myths and Reality"	Kateryna Piliuhina (ENEN): "Current overview of ENEN activities" (online)
11.00-11.15	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
11.15-12.15	Yaroslav Grechko (KKNU): "Kharkiv as Ukrainian nuclear education center"	Sergii Afanasiev (KIPT): "Nuclear criminalistic"	Igor Garkusha (KIPT, KKNU): UA-EU Nuclear Fusion Programme (online)	Gábor Stelczer (National Institute of Oncology), Budapest, Hungary: "Radiation Therapy" (online, English)	Ivan Yakimenko (KKNU): Modern detectors for PET/CT scanners (online)
12.15-13.15	Lunch	Lunch	Lunch	Lunch	Lunch
13.15-14.15	Valeria Trusova (KKNU): Radiopharmaceuticals for cancer diagnostics and treatment	Maksym Malovytsia (KKNU, KIPT): "Future nuclear reactors"	Ilia Demydenko (KKNU): Particle therapy - general overview	Pylyp Kuznietsov (KKNU): Excursion to Nuclear Physics Laboratory	Pylyp Kuznietsov (KKNU): Conclusion and final remarks
14.15-15.15	Danila Lavrenov (UkrNS): "Current overview of UkrNS activities" (online)	Inna Afanasieva (KKNU): Board game "Bunker 3.0"	Ilia Demydenko (KKNU): Introduction to MatRad software	Volodymyr Dyatkov (KIPT): Excursion to facilities and museum	
15.15-15.30	Coffee break	Coffee break	Coffee break		
15.30-16.15	Vitaliy Khomenko UkrNS Team games "How the nuclear power plant works" (Hybrid)		Ilia Demydenko (KKNU): Cancer treatment planning		
16:15-17:00	Vitaliy Khomenko UkrNS Team games "How the nuclear power plant works" (Hybrid)		Ilia Demydenko (KKNU): Results Presentation		

On the first day, a lot of gratitude was expressed for the fact that the school was held in-person and that students had the opportunity to communicate personally. They discussed school issues during coffee breaks, played topical games, and exchanged opinions. This greatly simplified the

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learning process and improved children's attention span. Conducting classes in this form helped students learn new and complex material.

Figure 7. Experimental work during the summer school in Kharkiv, Ukraine.

Basic nuclear science topics were introduced to the participants – nuclear physics and energy, radiation protection, fusion, medical applications and nuclear criminalistic. The students were immersed in the world of nuclear science and discover new horizons. The school was held in Ukrainian language including a talk from an invited speaker (Gabor Stelczer) in English. In total, 16 speakers participated from 5 institutions (KKNU, ENEN, KIPT, UkrNS and National Institute of Oncology, Budapest, Hungary). On the last day of the school, August 23, all students took a test on the Kahoot platform and received certificates and gifts from the organizers. Finally, 22 certificates of attendance were issued with unique ENEN identifiers. KKNU vice rector on research and teaching Anatoliy Babichev made the final greetings to the participants.

Figure 8. All participants received presents (gadgets, power banks, thermal cups, key rings) with special ENEN2Plus and KKNU logos, Kharkiv, Ukraine.

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Figure 9. Group photo, Kharkiv, Ukraine.

Final schedule of the school is available via this link:
https://docs.google.com/spreadsheets/d/1dwCp-VuYlKdeIbISTSKruTdltxv_Vr0EJuPvyoSA0CM/edit?usp=sharing

Photos of the opening day: 19 August 2024: https://photos.app.goo.gl/otjwd67MtBuLVqpQ6

Photos of master class for cancer treatment planning: 21 August 2024
https://photos.app.goo.gl/6nFyCYLdVjhaG5do6

Excursion to KIPT: 22 August 2024 https://photos.app.goo.gl/eypPUpaye9um2Le97

Graduation: 23 August 2024 https://photos.app.goo.gl/jNpwGhYHssM4d9pD8

A special promo identity of the school was developed including School program, School badges, School notebooks, School pens and informational promo support in social media. The school was shown on central Ukrainian TV channel ICTV in "News Marathon"
https://drive.google.com/drive/folders/1aiICvQyibq2Ug6HvBkJFsl-00MMWiVmb
https://drive.google.com/drive/folders/1vtcWvMrMxd6sI9dMPcpgURvBunSBvsiK

Some feedback from School students:

"My name is Maria, I am an 11th grade student of the Kharkiv Lyceum No. 173 of the Kharkiv City Council and I have been interested in nuclear physics for a long time, so the summer school

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was a great opportunity for me to further deepen my knowledge and have a great time! All classes were held in an incredibly friendly and comfortable atmosphere, and the participants of the summer school had the opportunity to communicate with students, teachers, and scientists. It was a very good opportunity for those students who, like me, plan to connect their future with nuclear physics and, in particular, with the activities of the Faculty of Physics and Technology. The program of the school was rich and full of fascinating lectures and practical classes; the excursion to the old KIPT site was especially interesting. I am very grateful to the organizers, and I hope there will be as many such projects as possible in the future!"

Kateryna Chkuaseli was a participant of this event and an 11th grade student at Kharkiv Lyceum #150. "The summer school was incredibly interesting. The lectures covered various aspects of nuclear physics, which emphasizes the versatility of this science. The organizers and participants were very friendly, and the food was delicious. The excursion to the old KIPT site was particularly memorable. They showed both operating facilities and those that are no longer in use. These facilities once served as workplaces for brilliant physicists, and the site itself seems to be preserved in the past, which is both admirable and somewhat sad."

Diana Yuryk, who graduated from Ternopil Secondary School No. 24, shared her impressions of participating in the school: "I have long wanted to better understand nuclear physics, but this topic covers so much information that it is difficult to understand where to start and how to continue studying. That is why I really liked the fact that during this school the lectures were well structured, and each of them had a clear topic, which allowed me to understand everything well and not get confused in the process. As for what I liked the most, it was definitely the excursion to the KIPT educational and research centre. It's one thing to study about scientists who worked in Kharkiv, to listen to accelerators and their components, and quite another to see it all with your own eyes and even have the opportunity to sit on the couch where Landau himself came up with his brilliant ideas. This was my first tour of such a place, and I can say that I was very impressed and would gladly visit a science centre again."

According to the feedback form, each School activity received more than 50% of marks "1" (fully satisfied). Top rated activities (more than 90%) were:

- Lecture "Fusion: basic concepts", Afanasieva Inna
- Excursion to KIPT, Volodymyr Dyatkov
- Masterclass on Particle Physics, Illya Demydenko

Finally, the format of the following summer school was already being discussed. The ideas included holding such an event on a university campus with permanent residence of participants, which would provide an additional opportunity for informal communication. Since the organisers claim to have a very large community of scientists and their graduates and partners represent the variety of world's leading nuclear research institutions, the school's programme is expected to proceed without difficulty. The organisers expressed their hope that the war in Ukraine would end and they would have more opportunities.

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4.3 National summer school in Croatia

Venue: Ruđer Bošković Classical Gymnasium in Dubrovnik, Croatia

Date: 25–29 November 2024

Organizer: Marlema Cukteras, PhD secondary school teacher

This section presents the complete implementation of the five-day traveling multidisciplinary program/camp for 20 students from the Ruđer Bošković Classical Gymnasium in Dubrovnik (14-18 years old) and other secondary schools of the Dubrovnik-Neretva County, supported by ENEN, with international guests from Bulgaria and Serbia as well as mentors from Croatian institutions. The program popularized nuclear energy, developed STEM skills, and prepared participants for ENEN competitions.

The goal was to bring nuclear physics and nuclear energy closer to students through direct encounters with medical physicists, researchers, and engineers, and to show that "nuclear" primarily means precision, safety, and responsibility in the service of humanity. Additional goals included motivating students for STEM studies, strengthening scientific literacy, developing a critical attitude toward information about radiation and energy, and connecting Croatian schools with the European ENEN community through joint projects and exchanges.

The camp included 20 students from the Dubrovnik-Neretva County, most from the Ruđer Bošković Classical Gymnasium, selected based on their interest in natural sciences and readiness for intensive field work. Particularly valuable was the presence of colleagues Pepa Pavlova and Ani Pavlova from Bulgaria as well as Miloš Garabandić from Novi Sad (Serbia), who brought an international perspective and experiences from their own education systems into the program.

The final day of the camp was enriched by colleague professors from Slavonia, who joined in the role of mentors and presenters in the Lazarets and thus gave the camp a national dimension of networking schools from different regions of Croatia. Throughout the entire program, it was actively emphasized that this is an ENEN activity, thereby giving students insight into the broader European context in which modern nuclear competencies are developed.

About the Ruđer Bošković Diocesan Classical Gymnasium:

The Ruđer Bošković Diocesan Classical Gymnasium in Dubrovnik is a renowned educational institution with a strong tradition in the humanities and sciences. The school is recognized for its commitment to academic excellence, fostering critical thinking, and promoting interdisciplinary learning. It encourages students to participate in national and international competitions, research projects, and scientific initiatives, and is known for nurturing a culture of curiosity and innovation.

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Program Objectives and Implementation

Objectives:

- To popularize nuclear energy and STEM fields among young people from all regions of Croatia
- To develop scientific literacy, critical thinking, and practical skills
- To introduce international scientific practices and challenges through collaboration with the European Nuclear Education Network (ENEN), and other European institutions (CERN, ITER, IAEA)
- To foster cooperation, exchange of experiences, and interregional networking among students
- To develop creativity and communication skills through the creation of original projects, videos, presentations, and works on nuclear energy throughout the camp, culminating in final presentations

Delivery Methods:

- Interactive lectures and workshops
- Field visits to scientific and industrial institutions
- Debates, teamwork, practical exercises, and creative tasks
- Participation in international projects (ENEN, CERN Masterclass, FuseNet, ITER)
- Systematic development of students' own projects, videos, presentations, and creative works throughout the camp
- Teachers’ workshops, job shadowing, and networking

Stakeholders:

- Students aged 14 to 18 and teachers
- Mentors and lecturers:
  - Dr. Marlena Ćukteraš (Ruđer Bošković Diocesan Classical Gymnasium, Dubrovnik)
  - Dr. Hrvoje Hršak (University Hospital Centre Zagreb – Rebro)
  - Dr. Ana Buinac (University Hospital Centre Zagreb – Rebro)
  - Prof. Dr. Mirko Planinić (Faculty of Science, University of Zagreb)
  - Dr. Mihael Makek (Faculty of Science, University of Zagreb)
  - Dr. Vuko Brigljević (Ruđer Bošković Institute – IRB, Zagreb)
  - Dr. Milivoj Uroić (Ruđer Bošković Institute – IRB, Zagreb)
  - Dr. Saša Ceci (Ruđer Bošković Institute – IRB, Zagreb)
  - Prof. Dr. Nikola Godinović (Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split – FESB)
  - Prof. Dr. Kristina Šorić (Rochester Institute of Technology Croatia – RIT Croatia)
  - Prof. Miloš Garabandić (Private Gymnasium Tvrđava, Novi Sad)

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- Prof. Goran Hajnal, Prof. Marija Kušić, Prof. Aljoša Graovac – teachers from Slavonia
- Pepa Pavlova, Ani Pavlova (High School of Natural Sciences and Mathematics **"Acad. Ivan Tsenov", Vratsa, Bulgaria)**

Partners: University Hospital Centre Zagreb – Rebro, Faculty of Science, University of Zagreb, Ruđer Bošković Institute (IRB), Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split (FESB), Rochester Institute of Technology Croatia (RIT Croatia), European Nuclear Education Network (ENEN).

Detailed Daily Schedule

Day 1: Zagreb - KBC Rebro: Health and Medical Physics (Zagreb)

Description: On the first day of the camp, students visited the University Hospital Centre Zagreb-Rebro where dr. Hrvoje Hršak and dr. Ana Buinac held a lecture titled "How important health is and the role of medical physicists in its preservation" and demonstrated the application of nuclear energy in medicine, particularly in diagnostics and tumor treatment through the Gamma Knife center in brain radiosurgery. Students, under the guidance of experts from the Oncology Clinic and Gamma Knife center, saw how nuclear physics is used in brain radiosurgery and tumor treatment and learned about the responsibilities of medical physicists in radiation dose planning, equipment control, and patient protection, emphasizing precision and safety.

Student Experience: Many students were surprised to discover the extensive use of nuclear technology in medicine. Seeing the Gamma Knife in action completely changed their perspective on radiation. Students formed initial bonds during lunch breaks, discussing their different school experiences and finding common interests. By the end of the day, many had already formed project groups based on shared interests in medical applications of nuclear energy.

Figure 10A. Experimental work during the summer school in Zagreb, Croatia.

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Figure 10B. Experimental work during the summer school in Zagreb, Croatia.

Day 2: Faculty of Science (PMF), Ruđer Bošković Institute (IRB) and Natural History Museum: Scientific Institutions and Inspiration (Zagreb)

Description: The program continued with visits to the Faculty of Science (PMF) Zagreb and the Ruđer Bošković Institute (IRB), with lectures and workshops by prof. dr. Mirko Planinić, dr. Mihael Makek, dr. Vuko Brigljević, dr. Milivoj Uroić, and dr. Saša Ceci on modern nuclear physics research, detection technologies, laboratory exercises, and radiation protection. Students visited the Croatian Natural History Museum in Zagreb. Through guided tours and interactive exhibits, they explored the evolution of life, the history of Earth, and the role of physics in understanding natural phenomena. Special attention was given to the museum's collection of radioactive minerals and the natural occurrence of radioactivity in the environment. Students learned about the intersection of geology, biology, and nuclear science, and how natural processes have shaped both the planet and scientific discovery.

Student Experience (PMF and IRB): The second day brought increased confidence as students engaged directly with scientists. Students were particularly fascinated by the laboratory equipment and the opportunity to conduct hands-on experiments. Many took photos and videos for their projects, while others sketched diagrams and took detailed notes. The atmosphere became increasingly collaborative as students from different schools shared insights and helped each other understand difficult concepts.

Student Experience (museum): Students were fascinated by the diversity of specimens and the hands-on exhibits. Many were surprised to learn about naturally occurring radioactive elements and how scientists use them to date rocks and fossils. The interactive displays sparked curiosity and provided inspiration for creative projects. Students took photos, asked questions, and discussed how nuclear science connects with other disciplines. The visit helped students see the broader context of nuclear energy within the natural world and gave them new ideas for their own presentations and videos.

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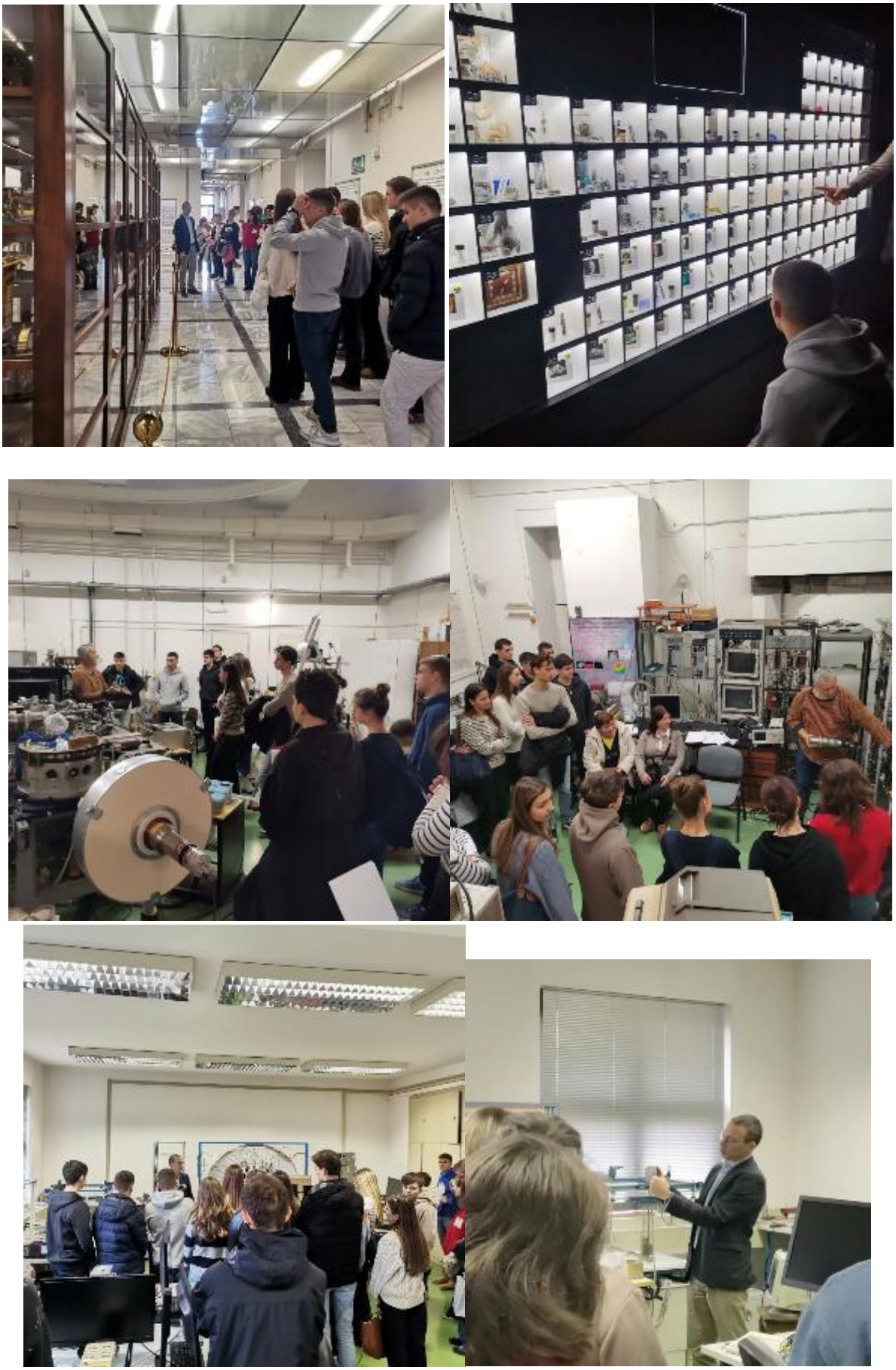

Figure 11. Experimental work during the summer school in Zagreb, Croatia

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Day 3: Rochester Institute of Technology (RIT Croatia): Education Without Borders and Cyber Security (Zagreb)

Description: The third day was dedicated to the visit to Rochester Institute of Technology Croatia (RIT Croatia) in Zagreb, where our hosts presented the opportunities for studying in the American education system while obtaining a double degree, all from the perspective of staying in Croatia. Professor dr. sc. Kristina Šorić and Emma Marunčić held lectures on international studies, STEM careers, and double degrees in the American system, with an emphasis on global citizenship, interdisciplinarity, and project work. Through the slogan "Different from day one", students were shown the importance of global citizenship, interdisciplinarity, and project work, and they recognized that nuclear topics can be integrated into broader ICT and engineering programs. A special workshop on cyber security in nuclear energy included the analysis of real incidents and the simulation of defending the information system of a nuclear facility; teams developed ideas for presentations and videos on digital security.

Student Experience: Students were surprised by the international career opportunities presented and began to see connections between their interests and potential future paths. The team-based activities strengthened relationships, with students from different backgrounds finding their roles within groups. Some emerged as natural leaders, while others contributed creative ideas or technical expertise. By evening, many students were excitedly discussing their project ideas over dinner, with some teams working late into the night on their presentations.

Figure 12. Group photo during the summer school in Zagreb, Croatia

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Day 4: Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture (FESB): Modern Technology and Nuclear Engineering

Description: On the fourth day, departure from Zagreb to Split was made by bus, during which the journey itself served as an opportunity for informal reflection and preparation for the new set of activities. At the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture (FESB), prof. dr. Nikola Godinović led lectures and practical workshops on gamma radiation, photoelectric effect, radiation detection (including isotope 137Cs), and applications in modern technology. Students filmed experiments, collected photos, and documented results for final projects. Additionally, Professor Godinović held a lecture "Three thoughts (tweets) contrary to common sense and modern technology".

Student Experience: By the fourth day, students formed strong bonds and worked together seamlessly. The coastal setting of Split offered a refreshing change of scenery. Students particularly enjoyed building simple radiation detectors and testing them with different materials. The practical, hands-on nature of the day's activities energized the group. Evening discussions on the beach became impromptu brainstorming sessions, with students sketching ideas in the sand and recording videos for their projects against the backdrop of the Adriatic Sea.

Figure 13. Presentation and demonstration during the summer school in Split, Croatia

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Figure 14. Presentation and demonstration during the summer school in Split, Croatia

Day 5: Lazareti - Dubrovnik Creative Quarter: Workshops in Nuclear Energy and Physics

Description: The final day was held in the Lazareti – Dubrovnik's creative quarter – where a workshop and presentation day was prepared open to all students of the city. Students, together with international guests and colleagues from Slavonia (Prof. Goran Hajnal, Prof. Marija Kušić, Prof. Aljoša Graovac), held a series of presentations and workshops on nuclear radiation, aurora borealis, and electromagnetic radiation, finding themselves for the first time in the role of science popularisers in front of peers and younger students. Students presented all works, videos, presentations, and projects that they had been developed during the camp and from ENEN competitions. An exhibition was held, along with a public debate "For and Against Nuclear Energy", camp evaluation, awarding of certificates, and reflection on what was learned.

A series of interactive workshops were held:

- Measuring food radioactivity (Prof. Miloš Garabandić)
- Aurora borealis (Pepa Pavlova, Ani Pavlova)
- Heavy colours (Prof. Goran Hajnal, Prof. Marija Kušić, Prof. Aljoša Graovac)
- ENEN and ITER workshop – nuclear energy and sustainability (Dr. Marlena Ćukteraš)
- Nuclear power plant operation simulation
- Radiation physics and protection
- Building reactor models
- Creative workshop: Nuclear energy in comics and video (Students actively worked on finalizing their works, presentations, videos, and models. Mentors provided feedback and encouraged creativity.)

Student Experience: The final day brought a mixture of pride, excitement, and sadness that the camp was ending. The public debate revealed how much students had learned, with sophisticated arguments presented by both sides. Many participants expressed surprise at their

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own growth, noting increased confidence in public speaking and deeper understanding of complex scientific concepts. The certificate ceremony was emotional, with students exchanging contact information and making plans to stay in touch. As they departed, many students expressed determination to continue their projects and to apply for the ENEN competition, inspired by the success of previous participants from the Ruđer Bošković Diocesan Classical Gymnasium.

Figure 15. Presentation and demonstration during the summer school in Dubrovnik, Croatia

You can find more information on the following websites:

https://www.facebook.com/lazaretihub?__cft__[0]=AZY6oB7k7SSMvn7JI00CRUWQIK1kh-NMoY3A6Vms3BXCanlJshGoaTlO-PneKTTl8LvZgYMd2s_pxwaKq3XFt95Wdg4bZMhaMyT3AeGavvhdPXZUoXKKWrhOGt1Pbpx4xsWkglGPube9cFns0Co4yZOiyu5-Wj18RmSBKEK1aFwgGasj2A5llkJN2ZqQvub75L-MdYF3FK96hd8XkGOWuQBv&__tn__=-UC%2CP-y-R

https://www.facebook.com/events/1102769064970475/?acontext=%7B%22event_action_history%22%3A[%7B%22mechanism%22%3A%22attachment%22%2C%22surface%22%3A%22newsfeed%22%7D]%2C%22ref_notif_type%22%3Anull%7D

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This camp achieved all the goals from the document, including the development of scientific literacy, team skills, creative works, and European cooperation, with plans for expansion.

Pedagogical Approach and Results

Through the camp, an experiential learning approach was applied: each visit began with a short introduction, continued with demonstrations and conversations with hosts, and ended with structured reflection in the bus or evening workshops. Students kept a camp diary, noting key terms, questions, and impressions, which later served as the basis for preparing final presentations in the Lazarets and future workshops. Student feedback showed a significant increase in understanding the role of nuclear energy and radiation in medicine, research, and technology, as well as greater readiness to consider studies in physics, medical physics, and engineering. Partners from hospitals, institutes, faculties, museums, RIT Croatia, and Lazarets expressed interest in continuing cooperation and participating in future editions of the camp, which confirmed the sustainability of the model.

Impact

- Increased scientific literacy and interest in STEM fields
- Breaking myths and prejudices about nuclear energy
- Developed teamwork, communication, and presentation skills
- Strengthened cooperation and networking among students from all regions of Croatia
- Participation in international scientific projects and collaborations (ENEN, ITER, CERN)
- Development of creativity through the creation of original works, videos, and projects
- Boosted self-confidence and sense of accomplishment among participants
- Created lasting connections between students from different regions and backgrounds.

Challenges

- Complexity of topics for students of different ages
- Organizational challenges of a multi-day program, logistics, and travel
- Need for additional educational materials in Croatian
- Coordination of student and teacher arrivals from all over Croatia and Europe
- Managing different knowledge levels and learning styles among participants.

Lessons Learned

- Practical and team-based learning is the most motivating and engaging for students
- Creative tasks and the creation of original works foster deep understanding and long-term motivation
- Interregional and international cooperation enriches the experience for all participants
- Cyber security is an important and interesting aspect of modern energy
- Exchange of teaching practices and teacher networking raises the quality of teaching
- The process of learning, collaboration, and growth is as important as the final result
- Students often exceed their own expectations when given challenging but supportive opportunities.

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4.4 National summer school in Serbia

Venue: Grammar school "Isidora Sekulić'' and grammar school "Tvrdjava", Novi Sad, Serbia

Date: 23-27 June 2025

Organizer: Milos Garabandić MSc teacher of physics

- Visiting professors: Marlena Ćukteraš and Saša Ceci from Croatia

Program

Day	Time	Activity
Monday	13:00 – 14:00	Miloš Garbandić – Introduction of students, camp and timetable, guests…
	14:00 – 15:00	Introduction of students to the ENEN organization
	15:30	Lunch
Tuesday	10:30 – 12h	Planetarium- prof Mirko- Nuclear process in our universe
	12-13h	Mileva Marić Einstein Museum
	13:30-15h	Lunch
Wednesday	09:00 – 15:00	**Belgrade-bus** Breakfast-Sandwiches. Vinča Nuclear Institute – Calibration, mini reactor, lecture
	15:00	Lunch at the Institute
	16:30 / 17:00-22h	Visit to Nikola Tesla Museum and city sightseeing
Thursday	12:30 – 15:00	Prof. Dr. Borislava Petrović – Tour of the Radiotherapy Department, lecture, and quiz
	16-17h	Lunch
Friday	8h	Departure to Vrdnik Spa by rented bus, lectures held in a rented hall.
	9– 12:00	Doc. Dr. Jovana Knežević – Faculty of Sciences: Radioecology Prof. Dr. Saša Ceci- Quantum physics with nuclear physics Dr. Marlena Ćukteraš –Future projects and physics
	12:30 – 14h	Lunch at Vrdnik

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The visit to the Faculty of Sciences in Novi Sad, as well as to the Laboratory for Nuclear Physics and Nuclear Research, was postponed due to the faculty blockade and the current political situation in the country.

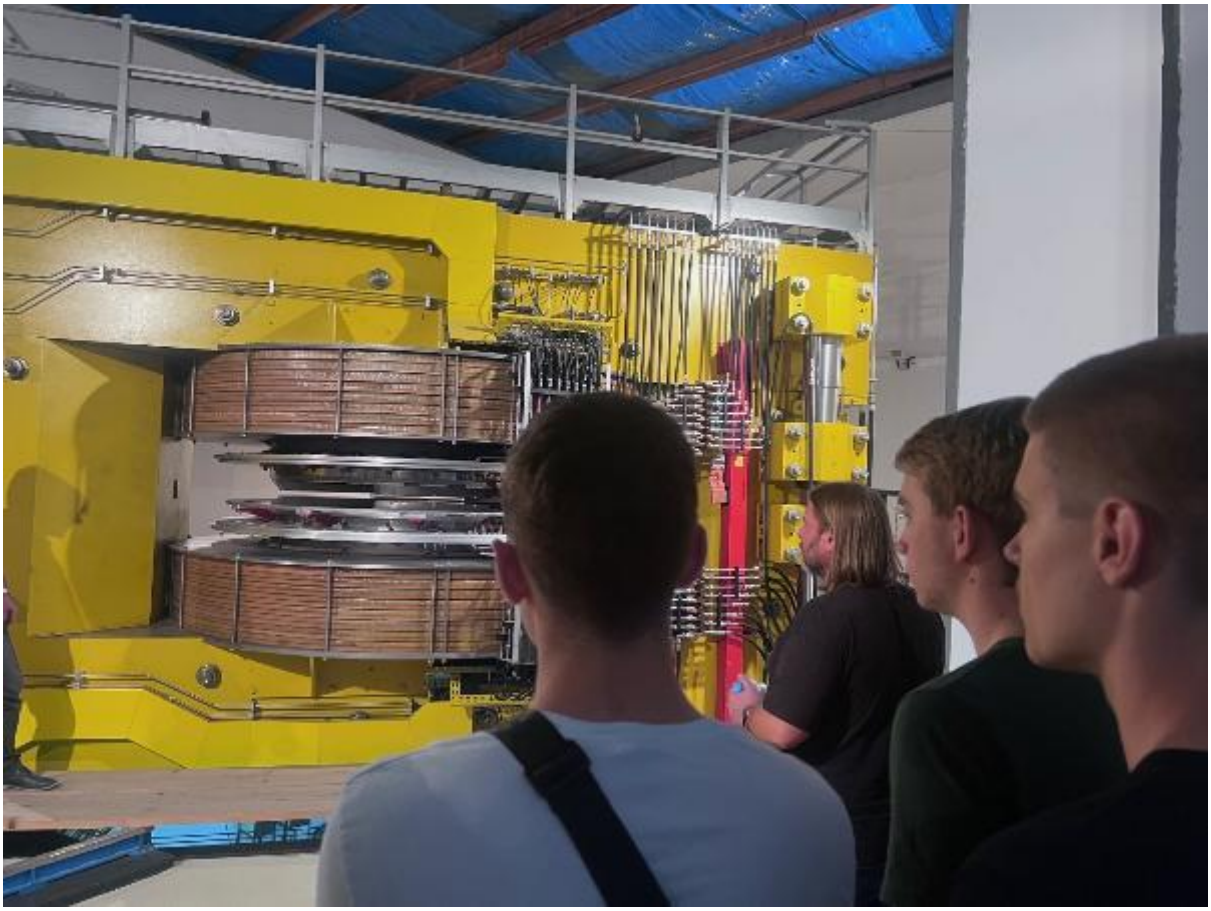

Figure 16. Scientific visit during the summer school in Novi Sad, Serbia

Visit of "Gimnazija Isidora Sekulić" students within the Nuclear Camp 2025 Programme

Within the framework of the Nuclear Camp 2025 programme, organized under the patronage of the European Nuclear Education Network (ENEN), the Institute hosted a highly successful visit of students and teachers from "Gimnazija Isidora Sekulić" from Novi Sad on June 25, 2025. Twenty students participated in the visit, accompanied by their subject teachers. The organization of this event, on behalf of the Institute, was overseen by Dr. Dunja Drakulić and Dr. Filip Veljković, with the support of Director Dr. Slavko Dimović, deputy director Dr. Marija Janković, and assistant director for security Dr. Milica Ćurčić.
Following a welcoming address by the Institute's Director, Dr. Slavko Dimović, Dr. Marija Janković delivered a presentation that provided a detailed overview of the Institute's rich history, current directions in scientific research, numerous projects, and innovative activities continuously implemented at the Institute.

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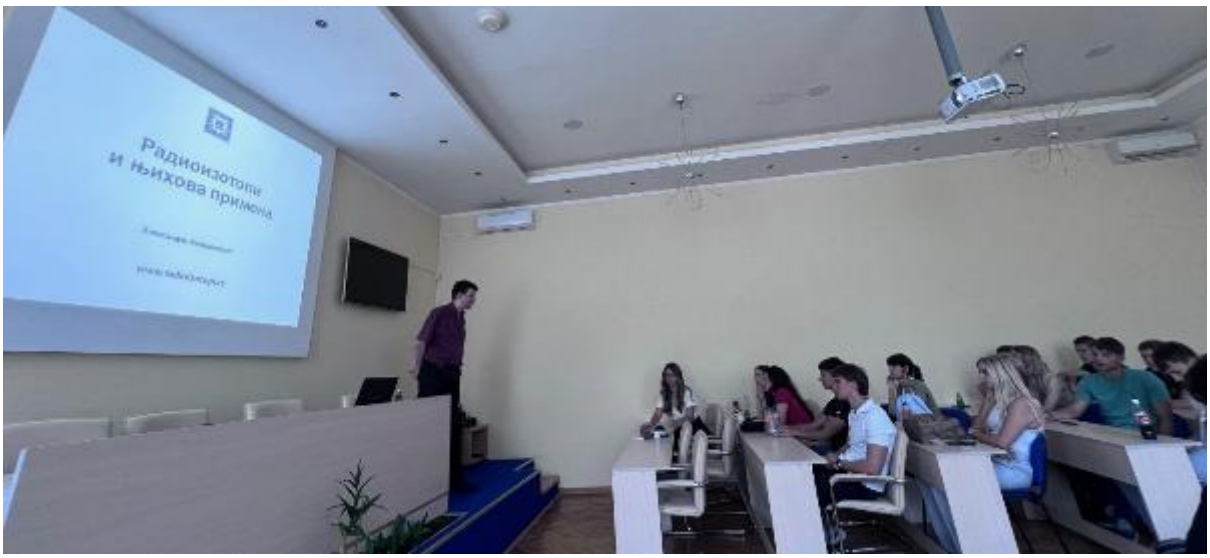

Figure 17. Presentation during the summer school in Novi Sad, Serbia

As part of Nuclear Camp 2025, visitors toured key research units and attended expert lectures accompanied by equipment demonstrations. Dr. Predrag Božović presented the work of the Laboratory for Radiation Protection and Environmental Protection, while Dr. Jasmina Grbović Novaković and Engineer Ivan Trajić gave a lecture and showcased the equipment of the Laboratory for Physics.

Figure 18. Scientific visit in the Space Museum, Serbia

Activities and instrumentation of the Laboratory for Nuclear and Plasma Physics were presented by Dr. Nikola Novaković and Dr. Sanja Milošević Govedarević. A lecture on the activities of the Laboratory for Radioisotopes was delivered by Mr. Aleksandar Vukadinović in the ceremonial hall of the Laboratory for Physical Chemistry.

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Through interactive lectures and practical demonstrations during the tour, students and teachers gained valuable insight into the broad spectrum of multidisciplinary research conducted at the Institute.
This visit represented a significant step in encouraging future generations to pursue science and in fostering cooperation between academic institutions and the secondary education system.

Figure 19. Group photo during the summer school in Novi Sad, Serbia

The Nuclear Camp was a great success, with students showing exceptional interest and enthusiasm throughout all activities. They had the opportunity to learn a lot about the various applications of nuclear physics in medicine, energy, and research. Through visits to institutions and interactive lectures, they expanded their knowledge and curiosity about this important field. The participants expressed a strong desire for similar camps to be organized in the future. Overall, the camp inspired many to further explore science and consider careers in nuclear physics and related disciplines.
Before the start of the camp, several articles were published in the local newspapers.
https://www.dnevnik.rs/lat/vesti/drustvo/mala-grupa-izabranih-ucenika-krece-naucnu-misiju-pocinje-kamp-na-terenu-evo-gde-zasto-2025-06-18
https://www.mojnovisad.com/vesti/isidorina-gimnazija-domacin-nuklearnog-kampa-id70274.html

Some feedback from School students:

a) What did you like the most?

1. Vinca nuclear centre
2. Tesla museum
3. Friendly atmosphere

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b) Most interesting area of nuclear physics?

1. Medical physics
2. Radioactivity
3. Nuclear energy and powerplants

c) Did it help understand physics?

1. Yes, it helped me, because I didn't know that how physics and medicine can be connected and interesting.
2. Through the lectures and visits, I managed to connect the theoretical knowledge from school with real-life applications, especially in the field of nuclear physics.
3. The camp broadened my horizons in the field of nuclear physics.
4. Yes, new information and new connection with already good knowledge.
5. It helped me connect all dots from previous lessons, and it will be useful in the future.

d) Organization and logistics feedback?

1. I liked the organization and logistics—the schedule of activities was clearly planned, and the lectures were well organized.
2. Everything was well-organized, on time, and smooth.

e) Would you recommend this camp to your friends?

Figure 20. Feedback from the students in Novi Sad, Serbia.

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4.5 National summer school in Romania

Venue: "Nuclear Group" Summer School Măgurele, Romania

Date: 24-30 August 2025

Organizer: Gabriel Stanescu, PhD university professor

Introduction

The "Nuclear Group" Summer School, part of the Magurele Science and Technology Summer School, was organized at the "Horia Hulubei" National Institute for Research and Development in Physics and Nuclear Engineering (IFIN-HH), Măgurele. The event was organized under the ENEN2plus project (WP2 – Outreach towards pupils and teachers), with the aim of introducing secondary school students to key aspects of nuclear science and technology, combining theoretical lectures, laboratory visits, workshops, and recreational activities.

Flyer

Figure 21. Flyer of the summer school in Măgurele, Romania

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Program

MAGURELE SCIENCE AND TECHNOLOGY SUMMER SCHOOL

"Nuclear Group" Summer School

Sunday, August 24, 2025

Arrival of Participants

13:00 – 18:00

Recreational Program

Treasure Hunt Măgurele

Association of Physics Students, University of Bucharest

19:00 – 21:00

Movie Night

Association of Physics Students, University of Bucharest

Monday, August 25, 2025

9:00 – 9:40

Welcome Message from the Summer School Partners

Bogdan Popovici, Organizer of the Summer School of Science and Technology at Măgurele, Researcher at IFIN-HH

Prof. Daniel David, PhD, Minister of Education and Research (video message)

Dr. Alexandru Andrei, President of the National Research Agency

Dr. Ionuț Ursu, Scientific Secretary of IFIN-HH

Prof. Virgil Băran, PhD, Head of the Doctoral School of the University of Bucharest

Dr. Octavian Micu Dobrin, Senior Researcher I, Director of the Laboratory of Astrophysics, Cosmology and Theoretical Physics, Institute of Space Science – INFLPR Branch

Prof. Ion Lucian, PhD, Dean of the Faculty of Physics, University of Bucharest

Dr. Andrei Neacșu, Scientific Director of the Institute of Atomic Physics

9:40 – 10:10

Nuclear Energy – the Energy of the Future, a Carbon-Free, Scalable, Safe and Reliable Energy Source

Andrei Rădulescu, S.N. "Nuclearelectrica" S.A.

10:10 – 10:40

Innovation Saves the Planet: Sustainability and the Technologies of the Future!

Teodora Vasâlcă-Cimpoi, Communication Expert on Energy and Climate Change Topics, Founder of @NewsEnergy.ro

11:10 – 11:40

Environmental Platform for Bucharest

Alina Kasprovschi, Bucharest Community Foundation

11:40 – 12:30

Panel Discussion "Science for Earth: A Sustainable Future through Responsibility"

Andrei Rădulescu, S.N. "Nuclearelectrica" S.A.

Teodora Vasâlcă-Cimpoi, Communication Expert on Energy and Climate Change Topics, Founder of @NewsEnergy.ro

Alina Kasprovschi, Bucharest Community Foundation

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12:30 – 13:00
Students Meet the Mentors
14:00 – 17:00
Activities in Research Laboratories
19:00 – 21:00
Recreational Program
Board Games and DND
Association of Physics Students, University of Bucharest

Tuesday, August 26, 2025
9:00 – 12:00
Visit to IFIN-HH laboratories
13:00 – 18:00
Activities in the research laboratories
19:00 – 21:00
Recreational program
Team activities
Association of Physics Students, University of Bucharest

Wednesday, August 27, 2025
9:00 – 18:00
Activities in the research laboratories
19:00 – 21:00
Recreational program
Sports activities
Association of Physics Students, University of Bucharest

Thursday, August 28, 2025
9:00 – 18:00
Activities in the research laboratories
18:00 – 20:00
Recreational program
Karaoke night
Association of Physics Students, University of Bucharest

Friday, August 29, 2025
9:00 – 12:00
Visits to INCDFM, INFP, ISS laboratories
13:00 – 14:00

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MAGURELE SCIENCE AND TECHNOLOGY SUMMER SCHOOL

14:00 – 16:00
Workshop session
Natsuka Kamei, Cristi Bîzoi; Mihai Cuciuc, IFA; Luca Trifan, Maria Boboacă, SciFablab
Activities:
Ukiyo – Japanese print technique
Ionizing radiation experimental session
Electronics workshop
19:00 – 21:00
Recreational program
Team activities
Association of Physics Students, University of Bucharest

Saturday, August 30, 2025
9:00 – 11:00
Workshop session
Natsuka Kamei, Cristi Bîzoi; Mihai Cuciuc, IFA; Luca Trifan, Maria Boboacă, SciFablab
Activities:
Ukiyo – Japanese print technique
Ionizing radiation experimental session
Electronics workshop
13:00 – 19:00
Recreational program
Environmental cleanup in IFIN-HH Park, Măgurele
Association of Physics Students, University of Bucharest

Figure 22. Presentation during the summer school in Măgurele, Romania

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Program Highlights

The Summer School brought together pupils, researchers, and invited experts in nuclear sciences. The agenda included both scientific sessions and cultural/social activities. The detailed program of the event is presented on the previous pages.

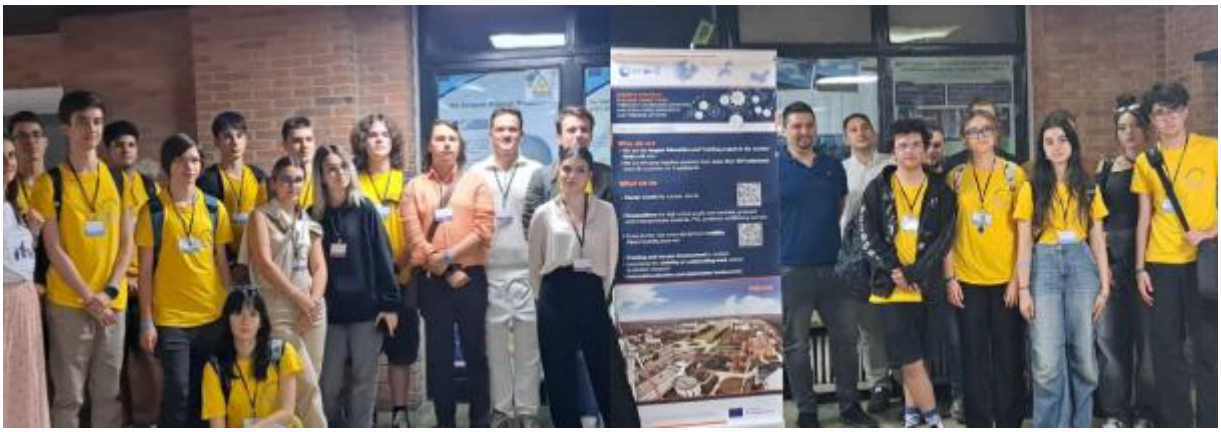

Figure 23. Group photo during the summer school in Măgurele, Romania

Thematic Focus

The group of pupils was divided into smaller research subgroups. Each subgroup focused on one of the specific topics proposed in the flyer (Fig. 22), working alongside mentors and researchers. This structure allowed participants to experience collaborative research and to present their results. Research activities were conducted on the following topics:

- Radon - the invisible danger in your own home
- Traces of time in climate and ice: Livingston Island, Antarctica
- Monitoring radiation background and environmental parameters in scientific laboratories
- How do we repair a crystal... with ions?
- Measuring nanometric displacements using optical interferometry
- Invisible Particle Hunters - station for observing cosmic and telluric radiation in the environment.

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Figure 24. Experimental work during the summer school in Măgurele, Romania

Conclusions

The Summer School successfully combined education, research practice, and community building, fulfilling the objectives set by the ENEN2plus project. By dividing participants into subgroups, each student had the opportunity to actively engage with one of the scientific themes and gain practical experience in a research setting. The event attracted enthusiastic participation from pupils interested in STEM, offering them exposure to nuclear science, radiation protection, medical and environmental applications, and waste management. The event demonstrated the strong collaboration between IFIN-HH, ENEN, the University of Bucharest, and other partners, while also highlighting the importance of youth engagement in science and technology.

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5. LESSONS LEARNED FROM THE ACTIVITIES OF TEACHERS' NETWORK

During the secondary school teachers' workshops, participants openly discussed the challenges they face when teaching nuclear science. They emphasized the importance of open communication and resource sharing to support development and progress across geographic boundaries.

The discussion emphasized that open communication and effective information exchange are essential for meaningful progress. Participants agreed that sharing ideas, expertise, and available resources—such as equipment and educational materials—significantly enhances development, particularly when collaboration extends beyond geographical boundaries. To support this, the need for more efficient and engaging collaboration methods was explored. Strengthening connections with secondary schools and universities was identified as a practical way to encourage skill-sharing and joint activities, while the creation of a centralized platform was proposed to simplify coordination and access to information.

This centralized platform was realized within the frames of the ENEN2plus project, you can find the link below:

General URL: https://nuclear-education.eu/

URL to 'Resources' section: https://nuclear-education.eu/resources/

A collaborative, community-based approach to resource development was considered more effective than individual efforts. By distributing workloads and combining expertise, participants noted that more comprehensive and higher-quality educational resources could be produced. At the same time, concerns were raised regarding project effectiveness, particularly where internal partnerships lack clear direction.

The group also reflected on challenges related to problem-solving and group dynamics, highlighting that successful solutions depend heavily on active participation. While producing a large number of shared resources may help address existing gaps, sustained engagement from all contributors remains essential. Resistance to new working methods was acknowledged as a common issue, especially in environments already burdened by heavy workloads. However, it was noted that innovative approaches can ultimately save time and effort once initial hesitation is overcome, leading to greater efficiency.

Additionally, structured information-sharing systems were discussed, with an emphasis on region-specific dissemination supported by a dedicated platform for educators. Such a system would require registration and the selection of expertise areas before granting access to resources. On a broader scale, the establishment of a global nuclear science teacher database was proposed to support future collaboration by collecting contact details and professional information from educators worldwide, although concerns were expressed that complex registration procedures might limit participation.

Key action points include strengthening open communication channels, developing a centralized collaboration and resource-sharing platform, promoting summer school story,

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different competitions through social media, and exploring alternative educational platforms to broaden outreach.

Networking among teachers from different countries has clearly demonstrated that the challenges educators face on a daily basis are remarkably similar. While identifying and discussing these shared difficulties is essential for establishing strong cooperation, it is even more important to work collaboratively to find effective solutions together. During the time spent together, colleagues had the opportunity to exchange experiences, share best practices, and establish face-to-face professional relationships that will contribute to their future success, which the participants greatly appreciated.

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6. CONCLUSIONS

Collaboration between secondary school teachers and nuclear experts brings many benefits. Through professional development programs, classroom materials, laboratory demonstrations, and direct contact with experts, teachers have access to reliable information and contemporary scientific perspectives. This partnership allows them to use their experience and more effectively integrate nuclear topics into curricula, making lessons more engaging, evidence-based, and reflective of current technological developments.

Furthermore, strengthening these relationships supports broader societal aims. It helps cultivate a new generation of students who are informed about nuclear issues, open to scientific careers, and capable of contributing thoughtfully to public discussions on energy policy, sustainability, and technological advancement. Such engagement not only encourages students to pursue pathways in STEM fields but also promotes a more scientifically literate society prepared to evaluate the benefits and challenges associated with nuclear technologies.

In summary, fostering a close personal collaboration between the nuclear science and technology sector and high school educators is essential for accurate knowledge dissemination, effective science education, and the long-term development of both the nuclear workforce and the informed citizenry needed in a rapidly evolving technological world.

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7. ANEX I. LIST OF E-MATERIALS FOR THE SECONDARY SCHOOL LEVEL PUPILS

Basic knowledge about the nuclear field

a. http://www.passmyexams.co.uk/GCSE/physics/index.html

   This site provides general information about radioactivity, radiation properties, uses, effects and so on, also explaining half-life and chain reaction concepts, by means of animations and videos. Language: English.

b. http://www2.lbl.gov/abc/

   Resource (mainly presentations) for high school teachers and students about radiation and energy, nuclear reactions, decay modes, among others. It also includes a glossary of nuclear science terms. Language: English.

c. https://study.com/academy/lesson/nuclear-power-lesson-plan.html

   Web page with information (video) about radioactive decay (Chapter 8). An account is needed (30-days free, 59.99 $/month). Language: English.

d. https://www.youtube.com/watch?v=Zw0pHT47AAU

   4-minutes video from the CNSC explaining what radiation is (runner for the PIME Award). Language: English.

e. https://www.neok12.com/Nuclear-Power.htm

   Educational videos (~ 2-10 minutes) and games for kids about nuclear issues: what is radiation, radioactive decay, type of radioactive particles, fission and fusion reactions, and so on. Language: English.

i. http://nuclearconnect.org/know-nuclear/science

   Brief articles about radiation, biological effects, and radiation detection. Language: English.

f. https://www.foronuclear.org/es/el-experto-te-cuenta/119909-que-sabes-de-la-radiacion

   Summary about radiation : concept, sources, classification. Language : English, Spanish.

g. https://www.iaea.org/Publications/Factsheets/English/radlife

   IAEA web page with information about the ionizing radiations, types of radiations, radiation dose concept, a little explication about the levels of radiation and an explication of risk and benefits of radiations: This material has a higher level than others. Language: English.

h. https://www.nuclear-power.net/nuclear-power/nuclear-reactions/

   Explanation about what a nuclear reaction is, types and notation. Language: English.

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i. https://chem.libretexts.org/Textbook_Maps/General_Chemistry/Map%3A_Chemistry_(Averill_and_Eldredge)/20%3A_Nuclear_Chemistry/20.2%3A_Nuclear_Reactions

This section of the web page explains the common modes of nuclear decay. Language : English.

j. https://t2.lanl.gov/nis/tour/sch002.html

More complete description of nuclear reactions, nuclear radiation types, and targets and products of nuclear reactions. Language: English.

s. http://highschools.sckcen.be/nl/Educatief_materiaal

Material about nuclear fusion for pupils and teachers. Language: Dutch and French.

Different sectors:

Nuclear energy

k. http://www.passmyexams.co.uk/GCSE/physics/index.html

This site provides a short description of nuclear reactors, including some animations. Language : English.

l. https://study.com/academy/lesson/nuclear-power-lesson-plan.html Web page with a video related to nuclear energy (Chapter 5). An account is needed (30-days free, 59.99 $/month) Language: English.

d. https://www.neok12.com/Nuclear-Power.htm

Educational videos (5-10 minutes) and games for kids. Among these videos there are some explaining how energy from nuclear fission and fusion is obtained. Language: English.

e. https://www.calacademy.org/educators/lesson-plans/nuclear-energy-whats-your-reaction

Web page with PDF documents and videos about nuclear energy from the California Academy of Science. It also includes activity plans to be followed by teachers. Language: English (some videos also in Spanish).

f. http://nuclearconnect.org/in-the-classroom/for-students/nuclear-energy

Brief description about nuclear energy. Language: English.

g. http://nuclearconnect.org/know-nuclear/applications/energy

Short and clear article about nuclear energy with a video. This web page also includes a section (http://nuclearconnect.org/know-nuclear/talking-nuclear/top-10-myths-about-nuclear-energy) collecting mythbusters around nuclear energy. Language : English.

h. https://www.youtube.com/watch?v=rcOFV4y5z8c

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5-minutes video explaning Nuclear Energy and how does it work? Language: English (with option of subtitles in several languages).

i. https://www.youtube.com/watch?v=pVbLlnmxIbY

Video that comments on 3 Reasons why nuclear energy is awesome! The other side of the coin is another video (https://www.youtube.com/watch?v=HEYbgyL5n1g) in which the cons of nuclear energy are detailed. Language: English (with option of subtitles).

j. https://www.youtube.com/watch?v=ciStnd9Y2ak

Opinion video of about 20 minutes entitled Why I changed my mind about nuclear power. Language: English (with subtitles option for Spanish, Portuguese or French).

k. https://www.youtube.com/watch?v=Ta3z3pGK0vU

National Geographic video explaining what nuclear energy is. Language: English (with subtitles option).

l. https://www.youtube.com/watch?v=_UwexvaCMWA

Video explaining how nuclear power plants work, focused on the PWR system. Language: English.

m. https://sukjaro.hu/SCsaba/EnergiaTermeles/

An interactive, browser-based simulation in which your goal is to compile the energy mix of a country. You can experiments with different types of power plants and see how they change the system reliability, cost of electricity and CO2 production. Help and a didactic task list is available from the Help menu. There is an accompanying paper (with a lab report example) on it, which is accessible here:
https://www.sciencedirect.com/science/article/pii/S0029549323006568

Medical applications

a. http://nuclearsafety.gc.ca/eng/resources/infographics/index.cfm

Infographics published by the Canadian Nuclear Safety Commission about medical imaging and radiotherapy, nuclear medicine, diagnostic imaging, etc. This page also faces some nuclear Mythbusters related to medical applications (http://nuclearsafety.gc.ca/eng/resources/infographics/index.cfm). Language: English.

b. http://nuclearconnect.org/know-nuclear/applications/medical-uses

Summary about nuclear applications in medicine. Language: English.

c. https://www.youtube.com/watch?v=4BRL7UcUZhY

Video from the IAEA (International Atomic Energy Agency) about the role of nuclear techniques in medicine (diagnosis and treatment) and the implications

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of use radiation (quality and safety) specifying the role of IAEA in the area. This video has a suitable level for secondary school students. Language: English.

d. https://www.youtube.com/watch?v=v38-I58H2Uc&t=4s

Short video (~3 minutes) to introduce the basic concepts of nuclear medicine separated in diagnosis and treatment. Very clear and suitable for secondary school students. Language: English.

e. https://www.youtube.com/watch?v=wfPza-R2sAY

Video from the AIPES Nuclear Medicine Awareness Working group for introducing nuclear medicine (in a more completed way then the previous one). The different phases of nuclear medicine are detailed and application in the different medicine areas is commented. The level is suitable for secondary school students. Language: English.

f. https://www.nibib.nih.gov/science-education/science-topics/nuclear-medicine

Web page from the NIBIB (National Institute of Biomedical Imaging and Bioengineering). It includes a summary of nuclear medicine which advanced contents. Language: English.

g. https://www.youtube.com/watch?v=ZgAi4wQLqZ0

Learn Oncology video: In this video, the main concepts of how radiotherapy works are explained in an attractive and easy to understand way. This video explains basics on ionizing radiation and their effects in tumour and normal tissue. Language: English.

h. https://www.youtube.com/watch?v=XcaChXkQmbM

Video of about 4 minutes from LLUHealth, where nuclear medicine as a career profile is explained by real workers. Language: English.

Radiation protection

a. https://www.csn.es/en/proteccion-radiologica

The web page of the Spanish Nuclear Safety Council (CSN), which is the sole competent authority in Spain for nuclear safety and radiation protection matters, has a site with information about radiation protection and the specific tasks or activities to protect workers, the population and the environment. Language: Spanish.

b. http://www.oecd-nea.org/brief/brief-10.html

The web page of the Nuclear Energy Agency contains interesting documentation about radiological protection. Language: English.

c. https://www.iaea.org/newscenter/multimedia/videos/the-iaea-and-safety-radiation-protection-in-medicine

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Short video about radiological protection in nuclear medicine. It is explained the use of nuclear medicine, protocols and methods and treatments to reduce the damage of ionising radiations on patients.

d. https://www.youtube.com/watch?v=uKkjrUtmg68

In this video, it is explained the radiation safety topic. This video presents what is the IAEA organization and their functions. It explains what are ionising radiations and presents the basis of radiological protection.

e. https://www.youtube.com/watch?v=5b1-I5jx1j4

More specific video about occupational radiation protection (and also about industrial professions in the nuclear field).

Language: English.

f. http://highschools.sckcen.be/nl/Educatief_materiaal

Material for pupils and teachers about radiological protection. Language: Dutch and French.

Waste management

a. http://www.passmyexams.co.uk/GCSE/physics/radioactive-waste.html

This site provides a basic understanding about radioactive waste categories understanding. Language: English.

b. http://nuclearsafety.gc.ca/eng/resources/educational-resources/index.cfm

This link from the Canadian Nuclear Safety Commission provides explanation, infographics and a video about radioactive waste. Language: English.

c. https://www.iaea.org/newscenter/multimedia/videos/radioactive-waste-journey-disposal

Video from the IAEA about radioactive waste. Language: English.

i. http://nuclearconnect.org/know-nuclear/science/transporting

Brief article about how to transport nuclear waste. Language: English.

j. http://highschools.sckcen.be/nl/Educatief_materiaal

Material (videos, brochures, etc.) for pupils and teachers about radioactive waste. Language: Dutch and French (videos also in English).

Nuclear professions

a. https://www.youtube.com/watch?v=1x_qV6WwYds

Video of Imperial College London. In this video, teachers and graduate students explain their experience about nuclear engineering careers. Language: English.

b. https://www.youtube.com/watch?v=F7FKc2RW1dM

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Video from Odessa National Polytechnic University. This video described in detail the work and responsibilities of a nuclear engineer. The format is not unsuitable but its contents are still interesting. Language: English.

c. http://nuclearconnect.org/in-the-classroom/for-students/nuclear-engineering

Section of the Center of Nuclear Science and Technology Information web page dedicated to explain the job of a nuclear engineer. In this same web page there are other sections dedicated with information about different careers related to nuclear (nuclear medicine technologists, Safety Professionals at the Nuclear Regulatory Commission, etc.) Language: English.

d. https://www.ge.com/careers/working-at-ge/job-functions

Same information as in the previous link, but for the General Electric company. Language: English.

e. https://www.radiologyinfo.org/en/info.cfm?pg=professions-nuclear-medicine

RadiologyInfo.org web page where different profiles of nuclear medicine are described in detail. Language: English.

Other applications

a. http://nuclearconnect.org/know-nuclear/applications

Section of the Center for Nuclear Science and Technology Information web page regarding nuclear applications. Language: English.

b. http://www.world-nuclear.org/nuclear-basics.aspx

Web page from the World Nuclear Association with articles regarding the uses of nuclear technology in agriculture, medicine, etc. Language: English.

c. https://www.foronuclear.org/en/ask-the-expert/120347-applications-nuclear-technology

Complete summary about nuclear applications. Language : English, Spanish.

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[2] Deliverable 1.3 of WP1 (ENENplus NFRP12-755576) – "1st EU wide nuclear science competitions for secondary school pupils".

[3] Deliverable 1.4 of WP1 (ENENplus NFRP12-755576) – "2nd EU wide nuclear science competitions for secondary school pupils".

[4] DELIVERABLE D2.3: Report on the organization of nuclear awards. ENEN2Plus.

[5] DELIVERABLE D2.5: Report on the organization of the nuclear competitions. ENEN2Plus.

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