(Project Number: 945301)

DELIVERABLE D5.1

Lead Beneficiary: UNIVLEEDS

Due date: 31/07/2022 Released on: 16/12/2022

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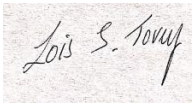
For the Lead Beneficiary	**Reviewed by Work package Leader**	**Approved by Coordinator**
Lois S Tovey 	**Paul Scully** 	**Mojmír Němec** 

Start date of project: **01/10/2020** Duration: **36 Months**
Project Coordinator: Assoc. Prof Mojmír Němec
Project Coordinator Organisation: CTU VERSION: 1.3

Project co-funded by the European Commission under the Euratom Research and Training Programme on Nuclear Energy within the Horizon 2020 Programme		
Dissemination Level		
PU	Public	**X**
RE	Restricted to a group specified by the Beneficiaries of the A-CINCH project	
CO	Confidential, only for Beneficiaries of the A-CINCH project	

Version control table

Version number	Date of issue	Author(s)	Brief description of changes made
1.0	10/10/2022	L. Tovey, S. Foster	Draft
1.1	11/11/2022	J. Peroutková	MST check
1.2	12/12/2022	P. Scully	WP leader check
1.3	16/12/2022	M. Němec	Coordinator's approval

Project information

Project full title:	Augmented Cooperation in Education and Training in Nuclear and Radiochemistry
Acronym:	A-CINCH
Funding scheme:	Coordination and Support Action
ECGA number:	945301
Programme and call	H2020 EURATOM, NFRP-2019-2020
Coordinator:	Mojmír Němec
EC Project Officer:	Kateřina Ptáčková
Start date – End date:	01/10/2020 – 30/09/2023 i.e. 36 months
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"This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945301."

CONTENTS

1 INTRODUCTION

The A-CINCH consortium organized an NRC summer school for high school students during July 2022 in Leeds, UK. The overall aim of the school was to introduce students to the basics of nuclear & radiochemistry and raise awareness of the range of careers available in this field.

The school included an introduction to nuclear and radiochemistry, hands-on and online activities, a site visit and career presentations/discussions.

Twenty four 16 & 17 year olds from across the UK attended.

2 SUMMER SCHOOL

The summer school programme (Appendix 1) was put together in conjunction with A-CINCH project partners. It was comprised of an introductory talk on nuclear and radiochemistry, an ice-breaker activity on nuclear forensics, a mix of hands-on and online activities, a site visit, career presentations, a panel discussion and team presentations.

Marketing of the school (see Appendix 2 for Flyer) commenced in January 2022 with a variety of channels being used including the project website, University of Leeds website, National STEM learning centre, STEM Community, RSC teacher mailing list, Linkedin, social media, and networks etc. After a slow start, places soon filled up and the school was eventually oversubscribed.

A number of project partners / organisations contributed to the successful running of the school:

ULEEDS, CEFAS, NNL (Project Partners)	Academia and Industry
NTU (End User Advisory Group)	Academia
Sellafield Ltd	Industry
AWE	Industry
Leeds Teaching Hospitals	Medicinal Chemistry
University of Birmingham	Academia
University of Bristol	Academia

The students were split into four teams (Becquerel, Curie, Meitner, Rutherford) which rotated around the following activities:

- Geochronology
- Salt irradiation
- Radiopharmaceuticals
- Separation of lanthanides
- Tour of active lab
- VR nuclear verse
- Student assignments.

For the student assignment activity each team was given a choice of two assignments (Appendix 3) to work on during the course of the school. On the final day each team presented their findings. The presentations were marked against set criteria (Appendix 4) and the team giving the best presentation were awarded prizes.

Careers presentations were given by AWE, CEFAS, Leeds Teaching Hospitals, National Nuclear Laboratory, Sellafield Ltd and the University of Birmingham.

For the panel discussion students were encouraged to submit questions in advance on Padlet.

For the site visit we were fortunate enough to have an exclusive visit to Westinghouse/Springfields Fuels and the National Nuclear Laboratory facility at Preston.

Evening activities included a course dinner and bowling.

At the end of the school, we conducted an online feedback survey accessed via a QR code (see appendix 5 for survey questions and responses).

Overall, the feedback was good with students saying that they learnt a lot from the activities and presentations and particularly enjoyed the hands-on activities and the site visits.

3 CONCLUSIONS

The A-CINCH summer school for high school students held at the University of Leeds was a great success with students enjoying the format of the school and learning about NRC.

Clear demand for such schools.

APPENDICES

Appendix 1 Programme

Augmented Cooperation in Education and Training in Nuclear and Radiochemistry

Summer School July 10th - 14th 2022 University of Leeds, UK

Course Programme

UNIVERSITY OF LEEDS

Emergency contact details	

Course Programme

Sunday 10th July		
Time	**Activity**	**Venue**
14:00-18:00	Registration & check-in	Devonshire Hall
17:00-18:00	Dinner	Devonshire Hall Dining Hall
18:00-22:00	Free time	Junior Common Room
22:00	Register with overnight supervisors	Devonshire Halls
22:30	Quiet please	Own rooms

Rotation	Activity	Host	Location
A	Active Lab tour	Dr Alastair Baker/Prof B Hanson	GM59 (Active Lab)
B	Geochronology	Hannah Limbach / Freya Mickleburgh	1.15
C	Salt irradiation	Frances Schofield / Cicily Hillebrand	1.14
D	Radiopharmaceuticals	Abigail Sherwood / Anny Di Somma	1.14
E	VR nuclear verse	Dr Ross Springell	2.02
F	Work on assignment	Group supervisor	SCaPE IT Cluster
G	Separation of lanthanides	Hannah Limbach / Freya Mickleburgh	1.15

Course Programme

Monday 11th July – Day 1					
Time	**Activity**				**Venue**
07:45-08:00	Register with overnight supervisors				Devonshire Hall
08:00-09:00	Breakfast				Devonshire Hall Dining Hall
09:00-09:30	Assemble and walk to campus				Devonshire Hall to SCaPE
09:30-09:45	Welcome and introduction – Prof Bruce Hanson				SCaPE Lecture Theatre B (LTB)
09:45-11:15	Introduction to nuclear and radiochemistry – Dr Nick Evans				SCaPE Lecture Theatre B (LTB)
11:15-11:30	Break				FUSE Cafe
11:30-12:30	Icebreaker activity nuclear forensics – Dr Matt Higginson				GR25 Bragg
12:13-13:30	Lunch				Refectory in LUU
Team	**Meitner**	**Curie**	**Becquerel**	**Rutherford**	**See Table**
13:30-14:30	A	B	D	E	
14:30-14:45	Break				FUSE Cafe
14:45-15:45	C	A	B	F	See Table
15:45-16:45	G	D	A	B	See Table
16:45-17:15	Assemble to walk to Devonshire Halls and Free Time				
17:15-18:00	Dinner				Devonshire Hall Dining room
18:00-18:45	Free time				Devonshire Hall
18:45-19:15	Walk to bowling				
19:15-21:30	Bowling				Ten pin, Merrion
21:30-22:00	Walk to Devonshire				
22:00	Register with overnight supervisors				Devonshire Hall
22:30	Quiet please				Own room

Course Programme

Tuesday 12th July – Day 2					
Time	**Activity**				**Venue**
07:45-08:00	Register with overnight supervisors				Devonshire Hall
08:00-09:00	Breakfast				Devonshire Hall Dining Hall
09:00-09:30	Assemble and walk to campus				Devonshire Hall to SCaPE
	Meitner	**Curie**	**Becquerel**	**Rutherford**	
09:30-10:30	B	E	C	A	
10:30-11:30	F	G	E	D	
11:35-11:45	Break				FUSE Cafe
11:45-12:45	E	F	G	C	
12:45-13:45	Lunch				Refectory in LUU
Team	**Meitner**	**Curie**	**Becquerel**	**Rutherford**	**See Table**
13:45-14:45	D	C	F	G	
14:45-15:30	Career Presentations – AWE & CEFAS				LTB SCaPE
15:30-16:00	Break				FUSE Cafe
16:00-17:00	Panel Discussion with Q&A				LTB SCaPE
17:00-17:30	Free time at SCaPE				SCaPE
17:30-18:00	Assemble to walk to restaurant				
18:00-20:00	Course dinner				New Conservatory restaurant
20:00-20:30	Walk back to Devonshire				
20:30-22:00	Free time				Devonshire Hall
22:00	Register with overnight supervisors				Devonshire Hall
22:30	Quiet please				Own room

Course Programme

Wednesday 13th July – Day 3		
Time	**Activity**	**Venue**
07:15-07:30	Register with overnight supervisors	Devonshire Hall
07:30-08:00	Breakfast	Devonshire Hall Dining Hall
08:00-10:00 estimated	Board Coach to Preston	Coach
10:00-12:30 estimated	Site visit (2 groups – **Meitner & Curie and Becquerel & Rutherford)**	NNL, Preston
09:45-11:15	Lunch	NNL, Preston
11:15-11:30	Site visit (groups switch)	NNL, Preston
16:30-18:15 estimated	Return to Devonshire Hall, Leeds	Coach
18:15-19:00	Dinner	Devonshire Hall Dining room
19:00-22:00	Free time	Devonshire Hall
22:00	Register with overnight supervisors	Devonshire Hall
22:30	Quiet please	Own room

Course Programme

Thursday 14th July – Day 4		
Time	**Activity**	**Venue**
07:45-08:00	Register with overnight supervisors	Devonshire Hall
08:00-08:30	Breakfast	Devonshire Hall Dining Hall
08:30-09:00	Assemble and walk to campus	
09:00-10:30	Work on group assignments	Various – see supervisors
10:30-10:45	Break	FUSE Cafe
10:45-12:30	Group Presentations	LTB SCaPE
12:30-13:30	Lunch	Refectory LUU
13:30-15:20	Career presentations – Leeds Teaching Hospitals, NNL, Sellafield	LTB SCaPE
15:20-16:00	Break	FUSE Cafe
16:00-16:15	Final address and prizes	LTB SCaPE
16:15	End of school	

Appendix 2 Flyer

AUGMENTED CINCH

Summer School July 10th - 14th 2022
University of Leeds, UK

Augmented Cooperation in Education and Training in Nuclear and Radiochemistry

About the Summer School

This 4-day intensive summer school is designed to give attendees an insight into careers in nuclear and radiochemistry fields. Highlights include:

- Lab-based and VR activities including nuclear energy, nuclear waste, nuclear forensics, environmental monitoring and nuclear medicine
- A tour of the radiochemistry lab at the University of Leeds
- Panel discussion event with recent graduates in the field
- Career presentations from academics and industry experts
- Group assignments with prizes for outstanding work
- Site visit to National Nuclear Labs (NNL)/Westinghouse Fuels facilities at Preston, UK

Venue

The A-CINCH Summer School will take place at the University of Leeds' School of Process and Chemical Engineering. Accommodation is at Devonshire Hall (a student hall of residence).

UNIVERSITY OF LEEDS

About A-CINCH

A-CINCH is an EU wide project which aims to increase the number of students and trainees in the field of nuclear and radiochemistry by developing a wide mix of e-learning and in-person teaching tools and courses, including a highly innovative Virtual Laboratory and lab robotics.

The summer school is intended for:

16-18 year olds from across the EU and the UK with an interest in science and in learning about the diverse careers available in nuclear and radiochemistry. A basic of knowledge of English is required for all students.

Registration

Please visit https://leeds.onlinesurveys.ac.uk/a-cinch-summer-school-2022-signup-form-copy for registration

Places are **fully funded** and include accommodation, full board, an evening activity and a one-day site visit.

Deadline for registration: **Extended until 24/06/22**

A written "Confirmation of Participation" will be issued to each participant after completion of the course.

Contact - Dr Lois S Tovey
l.tovey@leeds.ac.uk

Appendix 3 Summer school assignments

Team Curie

Task 1 – Decommissioning

From the 1950's through to the present, Sellafield site has been the home to many nuclear facilities supporting the UK nuclear fuel cycle activities. Many of these facilities closed decades ago and have left the UK with some of the most challenging decommissioning issues in the world. The most prominent are the legacy ponds and silos used to originally store fuel from the Windscale Pile reactors.

We would like you to prepare a **12 minute presentation** before **3 minutes of questions** on decommissioning at Sellafield site, paying special attention to the technological and environmental challenges. You may wish to consider the following:

• What are main challenges faced by Sellafield as it attempts to decommission its legacy facilities?

• What type and how much waste might be generated by decommissioning, as compared to "normal" operations?

• How are universities helping Industry to develop techniques or technologies that will bring about or quicken decommissioning?

Task 2 – Nuclear waste

In 1956, the UK commissioned Calder Hall, the first nuclear power station to generate electricity at an industrial scale. We have therefore been generating nuclear waste for 62 years and will generate more from the new build reactor fleet.

We would like you to prepare a **12 minute presentation** before **3 minutes of questions** on the types of nuclear waste, the risks associated with it and the strategy for dealing with it. You may wish to consider the following:

• What goes in and what comes out of a pressurised water reactor? Which part of used or 'spent' fuel is considered to be waste and is any of it still useful? Would reprocessing make a significant difference to the amount of waste from spent fuel?

• Waste does not just come from spent nuclear fuel. From mining uranium and processing it into fuel to decommissioning the plant, each stage of the fuel cycle generates waste. Identify some examples of waste generated at different stages of the fuel cycle.

• Under the UK classification, what are the different categories of waste and roughly how much of each type do we have in the UK?

• What strategies do we have for dealing with each category of waste? How do we process our waste before we store it? What facilities does the UK need to build to process and store this waste and are there any existing examples of these facilities outside the UK? Other than economic factors, what other issues might make it difficult to build these facilities?

Team Rutherford

Task 1 – Small Modular Reactors

The UK is about to build its first Gen III+ reactor at Hinkley Point C. This site will contain 2 large French designed pressurised water reactors (PWRs) and many more new build reactors are expected over the next 20 years. However, there is always pressure on nuclear to become more economic and safe, to use fuel more efficiently and reduce the burden of waste on future generations. Hence, certain parts of the international nuclear community is proposing a break with large reactor units like HPC and a move to smaller, more modular units that have lower capital costs.

We would like you to prepare a **12 minute presentation** before **3 minutes of questions** on small modular reactors. You may wish to consider the following:

- What is a small modular reactor and how does it differ from a conventional design like HPC?
- Which type of SMRs are being developed and by whom?
- How would SMRs fit into a nuclear electricity generating strategy in the UK?

Task 2 – UK nuclear

Recently, in an effort to reduce its carbon output and bridge the upcoming *energy gap*, the UK has committed to continue to produce nuclear energy through a significant programme of new build reactors. There are, however, several challenges facing such a commitment, including securing the necessary investment to finance new reactors and ensuring that they provide energy at an economically competitive rate.

We would like you to research the UK's nuclear strategy for the future and how they plan to tackle the difficulties involved. Present your findings in a **12 minute presentation** before **3 minutes of questions**. You may wish to consider the following:

- What percentage of the UK energy supply is currently made up by nuclear energy? How might this change over the next 30 years?
- How many new build nuclear reactors are planned over the next 30 years? Where will they be located? Other than economic factors, what obstacles might make it difficult to build new reactors in the UK?
- Which reactor designs are being favoured for the new reactors and to which generation of reactors do they belong? Who has designed these reactors? The new build reactors will be financed using a 'strike price' system, how does this work and what strike price has been agreed for the first reactor? Does the nuclear industry offer energy at a competitive cost compared to fossil fuels and renewables?
- In the long term, is there enough uranium to ensure nuclear energy has a sustainable future? Are there any alternatives to uranium as fuel and are these being considered in the UK? What did the UK government have to say about Generation IV reactors and small modular reactors in its Energy Act of 2013?

Team Becquerel

Task 1 – Health & Nuclear Medicine

A variety of radionuclides (also called radiopharmaceuticals) are used in small quantities in medical procedures, for both diagnosis and treatment. This has improved the non-invasive scanning capabilities for organs and tissues that are difficult to image with other techniques, therefore offering unique information and assisting in the early diagnosis of disease. It has also advanced the ability to provide treatment for blood disorders and localised cancer therapy.

We would like you to prepare **a 12 minute presentation before 3 minutes of questions** on nuclear medicine, considering applications in scanning, tracing, and treatment. You may wish to consider the following:

- What radionuclides are commonly used in applications of nuclear medicine? Why are these particular radionuclides used? How are they produced and prepared for use?
- How do the different methods of scanning/tracing using radiopharmaceuticals work? Why can this be more effective or useful than other techniques?
- What are the limitations of current nuclear medicine capabilities?
- Are there any new techniques being developed in the UK to produce new radioisotopes?

Task 2 – Space batteries

Since 1960's radioactive power systems (RPSs) have been used in space travel programmes as main power sources, especially for zones where solar power is not available. Plutonium 238, a human-made isotope, has been the main radioactive source used for space missions. However, Pu-238 belongs to the United States and Russia, which limits the space mission plans for other countries.

We would like you prepare a **12 minute presentation**, to be followed by **3 minutes of audience questions** on how space batteries work and what plans the UK has to support long-distance space travel programmes. You may wish to consider the following:

- How is Pu-238 (and other relevant radioisotopes) produced for space-related applications?
- What characteristics allow these radioactive isotopes to power space travel missions?
- What are the radiological safety considerations taken to choose these isotopes?
- What radioisotopes are being investigated to power long-term, long-distance expeditions?

Team Meitner

Task 1 – Fusion vs Fission

Nuclear fission is used worldwide to provide clean electricity. However, with an increasing global energy demand and an urgent need for carbon neutral energy sources, there is huge pressure for nuclear to provide greater amounts of energy. Various new projects and technologies are being pioneered to improve nuclear fission plants, but some people believe nuclear fusion is the key to our energy future.

We would like you prepare a **12 minute presentation**, to be followed by **3 minutes of audience questions** on nuclear fusion versus nuclear fission. You may wish to consider the following:

- What is nuclear fusion? What is nuclear fission? How do the two differ and how can they each be used to generate energy?
- What feedstocks are required for each process? What are the by-products of each process?
- What are the advantages and disadvantages of each process?
- What is the current status of nuclear fusion technology?
- What is the status of current and future nuclear fission power plants around the world? What new technologies are being developed for nuclear fission plants?
- If you had to advice the UK government on fission vs fusion, what would you recommend they invest in?

Task 2 Nuclear Forensics

The aim of nuclear forensics is to stop the unauthorised use of nuclear and radioactive materials and improve nuclear security practices. As of 31 December 2019, the IAEA recorded 3686 confirmed incidents of trafficking since 1993, including, 189 incidents in 2019.

We would like you prepare a **12 minute presentation**, to be followed by **3 minutes of audience questions** on nuclear forensics. You may wish to consider the following:

- What is nuclear forensics?
- Why is it important?
- What analysis methods are used for identifying and tracking nuclear or radioactive material?
- Give examples of what information radiochemistry can provide on a nuclear material
- Can you find at least one example of when nuclear forensics has helped to identify an unknown source

Appendix 4 Team presentation evaluation criteria

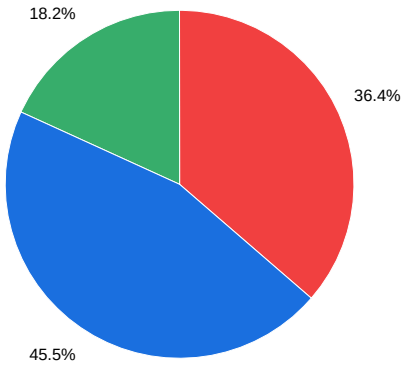
A-CINCH Summer School 2022 Presentation marks.

Score	Information	Structure	Analysis and Interpretation	Use of relevant & accurate Evidence	Presentation skills	Time management	Group Skills (response to questions)
1	Very limited	Muddled, incoherent	Generally superficial	Little/no evidence, irrelevant/inaccurate	Disjointed, difficult to follow	Significantly under/ over, disorganised	Poor
2	Limited	Underdeveloped/ not entirely clear	Fairly superficial	Some mentioned, not integrated/relevant	Not always clear, unengaging	Under/over, stretching/rushed	Uncomfortable
3	Generally relevant, some gaps/ irrelevant points	Moderately clear, minimal development	Little attempt to criticise literature	Some Illustrative, mainly relevant	Conveys meaning, sometimes unclear	Sort of on time, stretching/ rushed	Reasonable
4	Detailed, accurate	Generally clear and logical	Attempts to criticise literature	Most points illustrated with relevant evidence	Generally clear, lively	Close to time, well organised	Attempts to engage with audience
5	Detailed, accurate, key points highlighted	Clear, logical, easy to follow	Clear evidence of critical analysis of literature	Key points supported with relevant/ accurate evidence	Clear, lively, engaging	On time, well organised	Engages well with group, encourages discussion

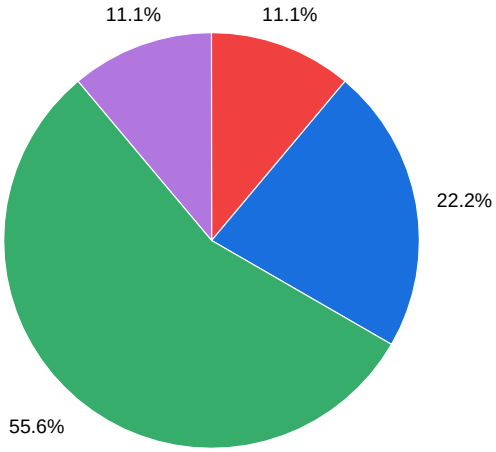
Team	Information	Structure	Analysis and Interpretation	Use of relevant & accurate Evidence	Presentation skills	Time management	Group Skills (response to questions)	Total
Meitner								
Curie								
Bequerel								
Rutherford								

Appendix 5 Feedback
Key

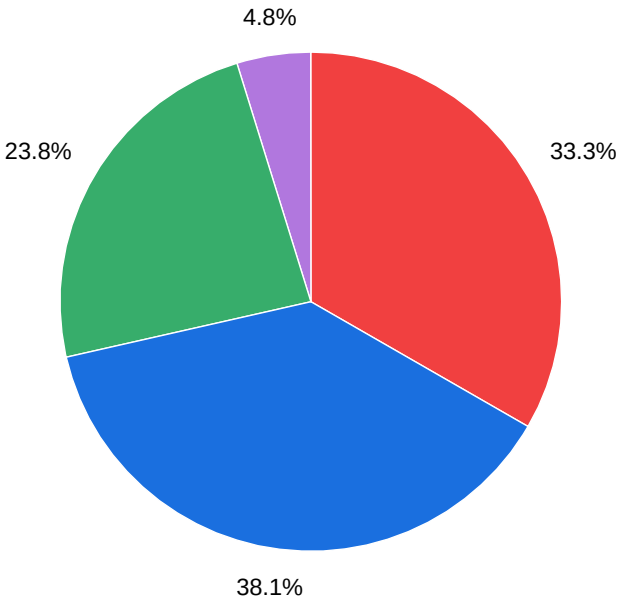
1.1. Introduction to NRC



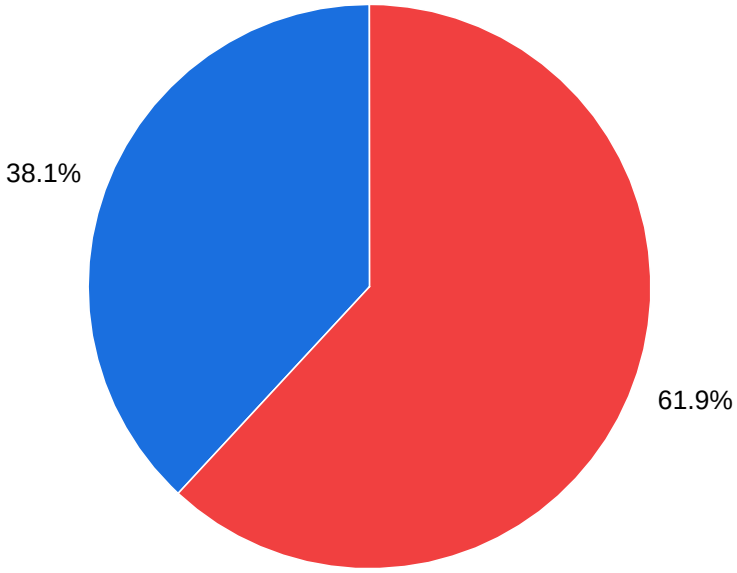
1.2. Icebreaker – Nuclear forensics game



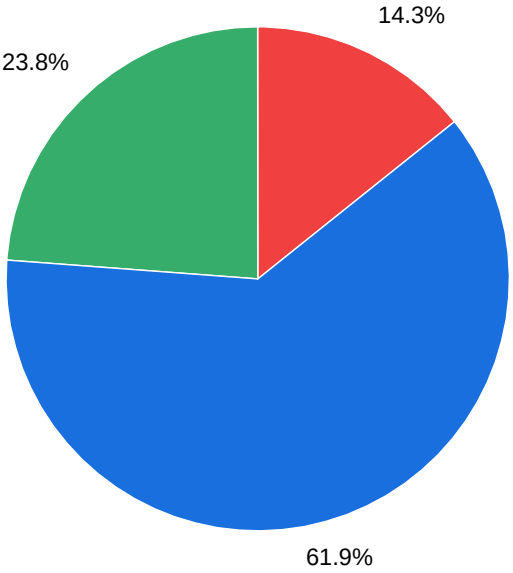
1.3. The NuclearVerse (Virtual Reality town)



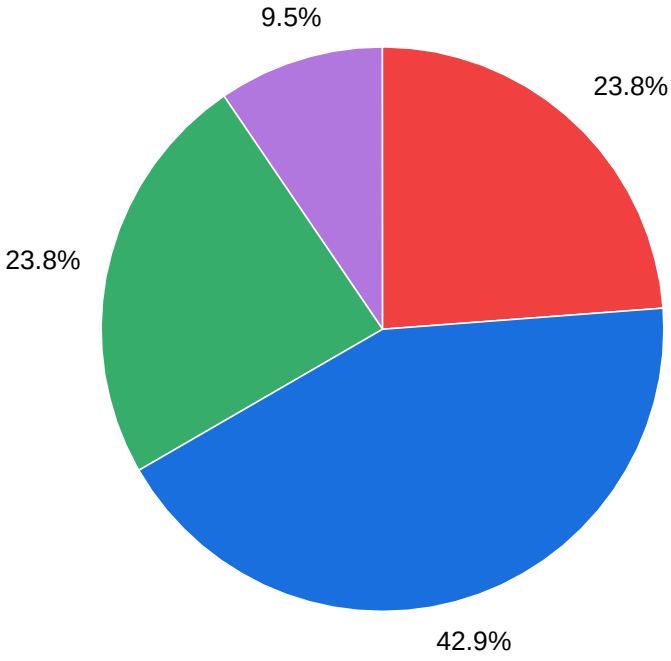
1.4. Separation of lanthanides



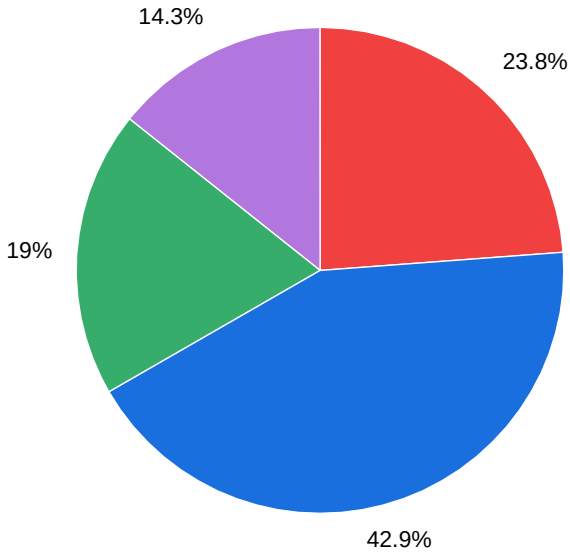
1.5. NNL PC based activity



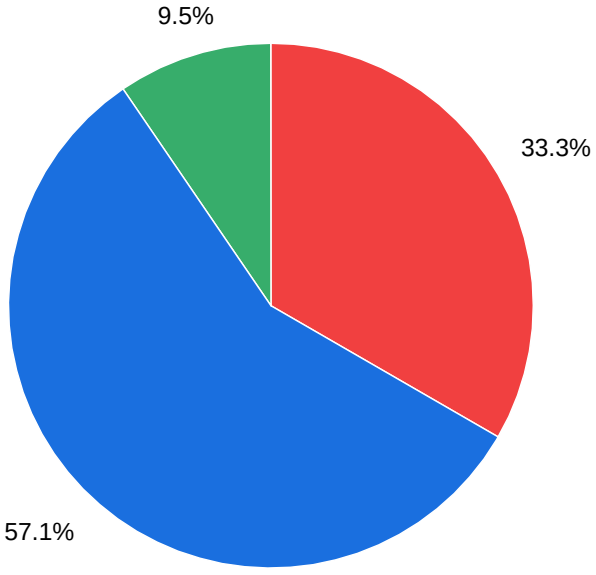
1.6. Active lab tour



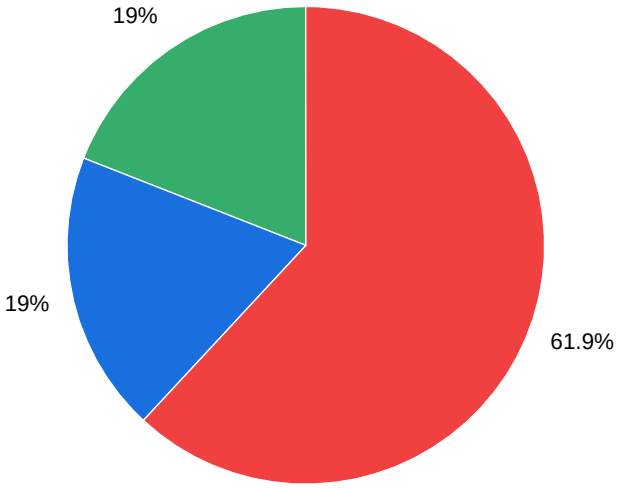
1.7. Working on assignments



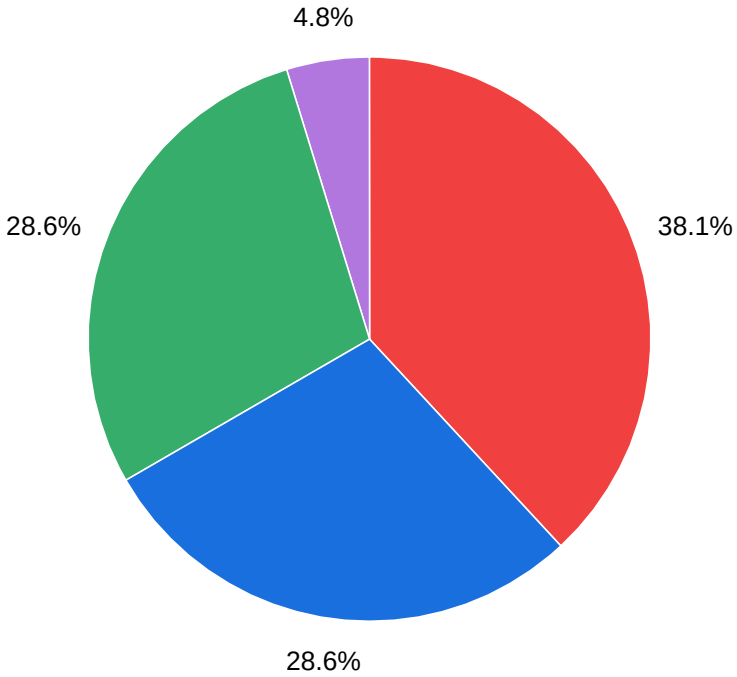
1.8. Geo chronology



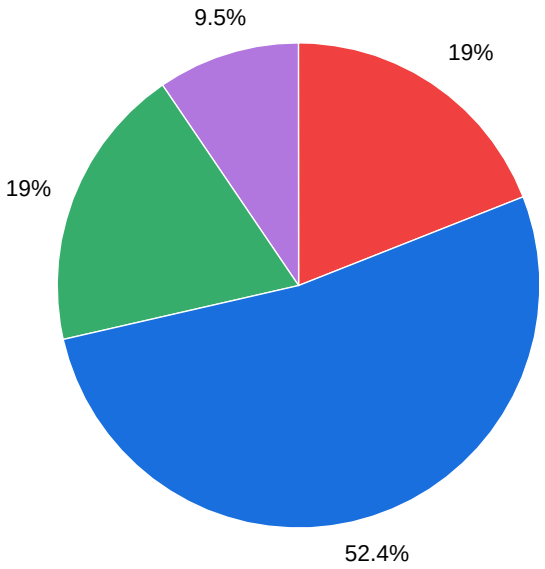
1.9. Radio pharmaceuticals



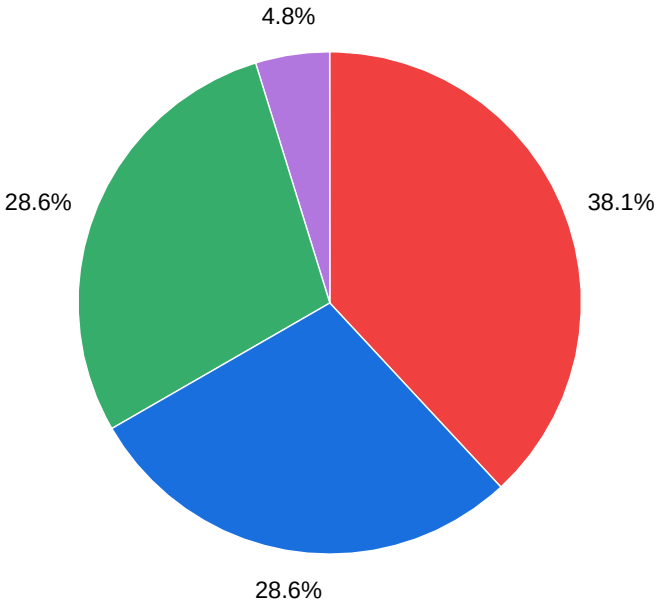
1.17. Panel discussion



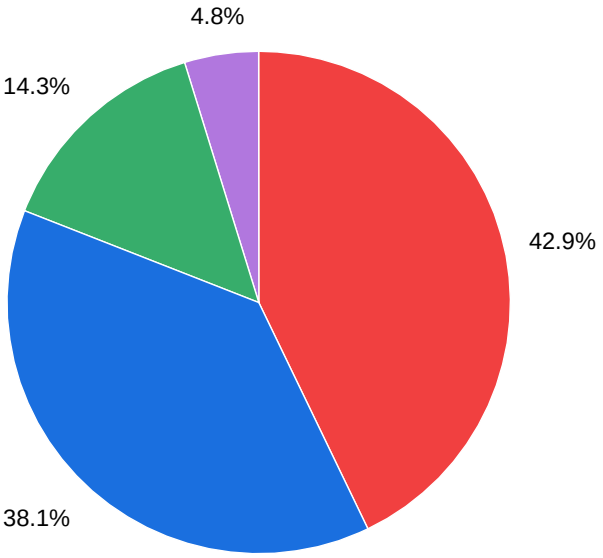
1.10. Presentations (overall)



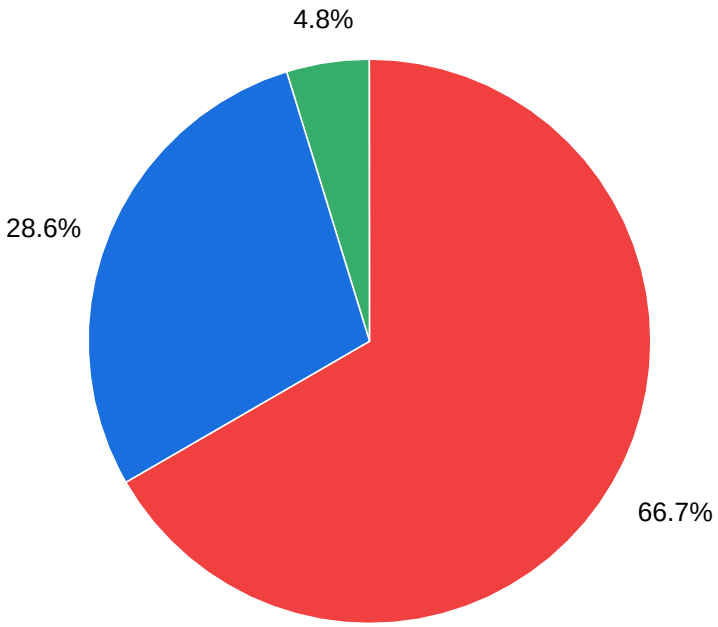
1.17. Panel discussion

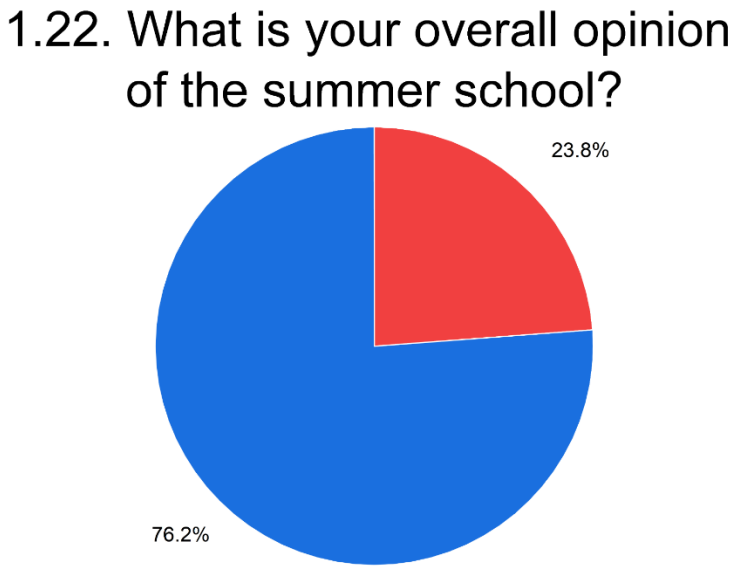


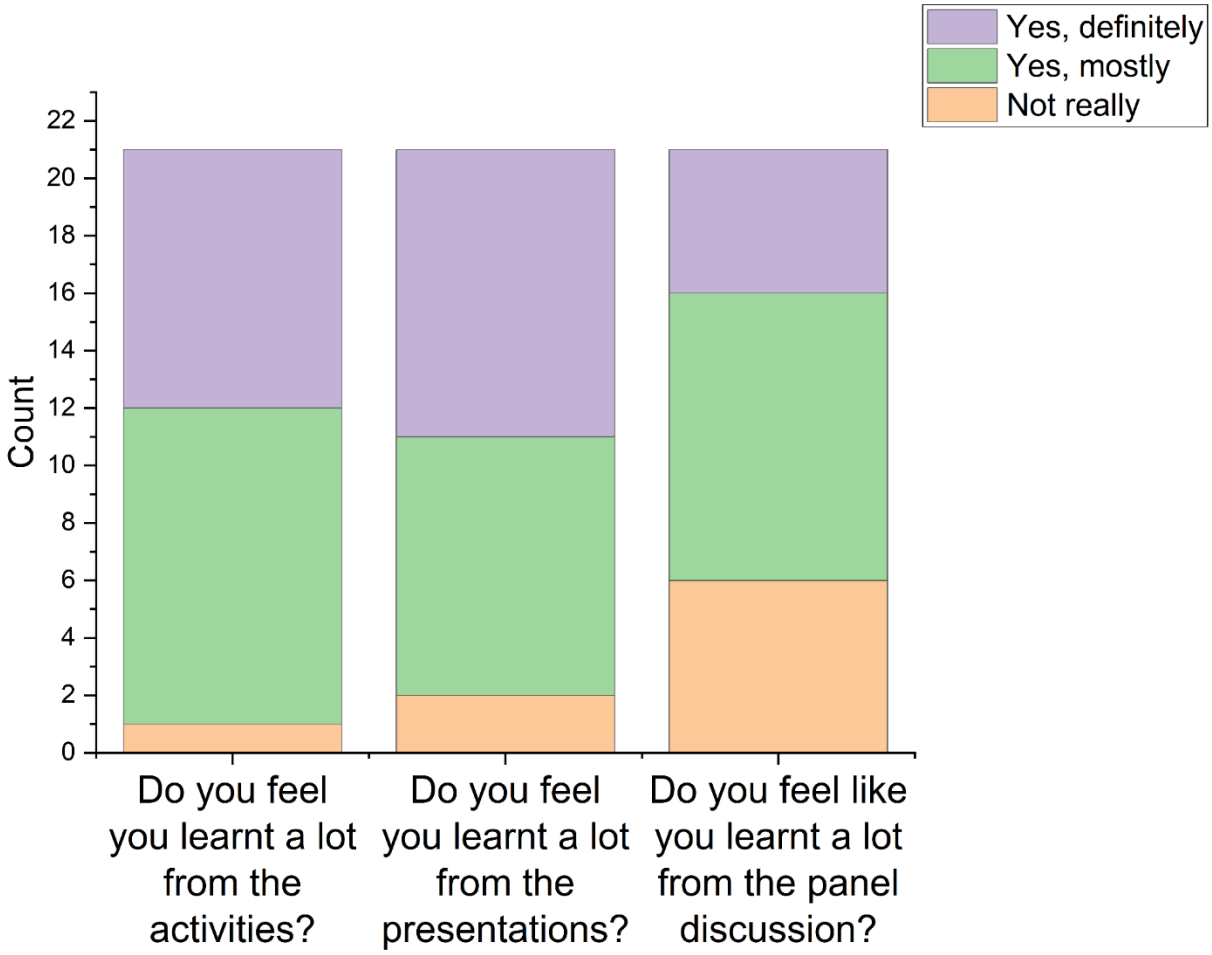
1.18. Site visit - Oxide fuel complex (Westinghouse)



1.19. Site visit - NNL labs




1.22. What is your overall opinion of the summer school?
23.8%
76.2%


Yes, definitely
Yes, mostly
Not really
Count
0
2
4
6
8
10
12
14
16
18
20
22
Do you feel you learnt a lot from the activities?
Do you feel you learnt a lot from the presentations?
Do you feel like you learnt a lot from the panel discussion?