



UNIVERSITÀ
DEGLI STUDI
DI MILANO



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

The ISOradioLab project devoted to students of High Schools of minor Italian islands: the radon measurements to introduce them to STEM subjects

GROPPI F. (1, 2), AMBROSINO F (3, 4), LA VERDE G. (3, 4), PUGLIESE MG. (3, 4), COLUCCI M. (1, 2)

(1) Università degli Studi di Milano – UNIMI, Dipartimento di Fisica, LASA, Italy

(2) Istituto Nazionale di Fisica Nucleare – INFN, Sezione di Milano, LASA, Italy

(3) Università di Napoli Federico II, Dipartimento di Fisica, Italy

(4) Istituto Nazionale di Fisica Nucleare , Sezione di Napoli, Italy



The AIM of the Projects

- × The **subjective perception (sensation)** of the risk doesn't correspond very often to the **objective and real risk** of a human activity, and natural events as well.
- × The **radioactivity** theme is misleading because it is almost unknown and the public links this concept only to nuclear weapons and to its usage in unsafe way to produce energy in the nuclear power plants, NPPs.



Dissemination of scientific culture

a correct knowledge and information about this subject, permits a discussion and debate in a more objective way and to build up a personal understanding through the population:

STARTING from students at High Schools bring them closer to subjects of Physics applied to human health, thanking the presence and use of ionizing radiation.

HOW

showing the double face of radioactivity

1. limiting the effect of exposition
thanking to radioprotection

2. application of IR in
medicine



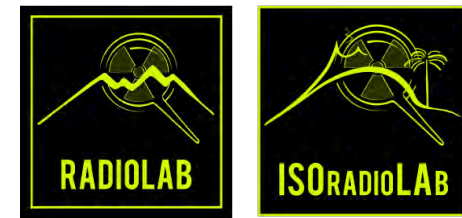
RADIOLAB &
ISOradioLAB
Project



Particle Therapy
Master Class
Project

Let the students become researchers for a period, with the opportunity to share their experience with many other national and international students

RADIOLAB (since ... 2004) & ISOradioLAB (2021)



The aim of the Project

This process is applied to the measurement of the radioactivity starting from the natural component as a part of our environment:

- a) **the measurement of the ^{222}Rn concentration** is particularly suited and, nowadays, is up-to-date;
- b) **there are different types of radiations**, and ionizing radiations are just a particular type of radiation;
- c) ionizing radiations can be measured;
- d) to prove the fun a student can derive from discovery and detection of ionizing radiation.

Points of strength of the project

- *Real **experimental*** approach but also a **Citizen science approach...**
- It is a **not an occasional** experiment: it requires **2-3 years**, giving the possibility to the students to gain a deeper thinking over and acquisition of these items.
- It allows the **study of the environment** outside the school too.
- The high **multidisciplinary approach** of this matter, permits to **link** the knowledge of different subjects: **radioactivity, environment, biology, medicine, health, communications, risk prevention, legislation, ...**
- The development of the **communication ability** and debate between students and their relatives on these topics.
- A final spin-off is the **training and refreshment** for the teachers.
- Gender and STEM

RADIOLAB & ISOradioLAB



How the Project ...

The High School students have to develop an experiment along all its phases:

- × the research theme,
- × the build up of their own laboratory at their school,
- × to understand the modality of how to do the measurements,
- × the choice of the instrumentation more suitable, depending on the type of measurements chosen,
- × data analysis,
- × presentation and discussion of the results.

THE LAB

*not just a physical place but a METHOD of
"KNOW" through the "KNOW-HOW"*

17/05/2023

CIIP - ANPEQ

The idea is that ...

×An "assembly box": school receives a kit with instructions (given by teachers or university experts)

×*"I construct the instrumentation ..."*

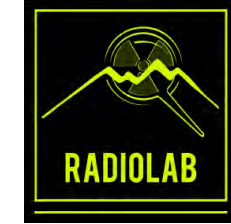
×*"I build up my laboratory ..."*



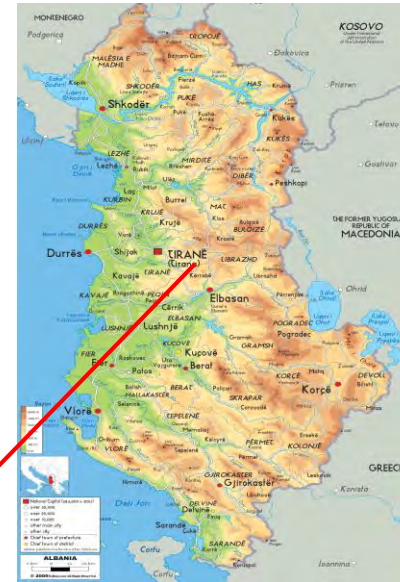
- dosimeters - CR39 or electretes
- plastic box - diffusion chamber
- fryer - as thermostatic bath
- a cheap optical microscope
- a simple webcam



RADIOLAB & ISOradioLAB



Many Italian Regions and Minor Islands involved together with Albania, Ecuador and ...



Themistokli
Germenji High
School in Korçë



Ecuadorian High
Schools, Riobamba

NEW Entry (2023):
Miroslav Vanek in Slovakia



CIIP - ANPEQ

alamy

alamy

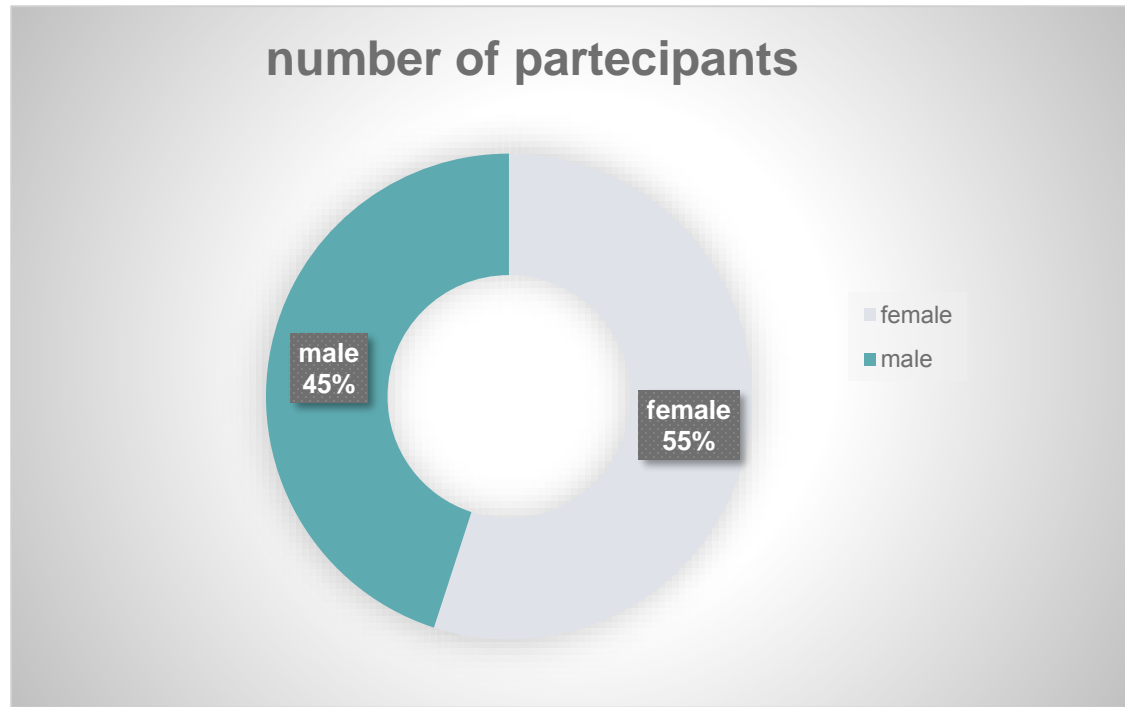
Why ISOradioLab



- to pay particular attention to male and female students from the **smaller Italian islands**;
- to give them the **same opportunities** for participation, exchange and involvement in the implementation of projects proposed by universities and research centers that their peers who live on the Italian peninsula have;
- to provide them with the possibility **of overcoming the natural difficulties** associated with the different geographical location.
- They have shown themselves **eager** to integrate into the project demonstrating a great desire driven by the curiosity that pervades them for subjects that are not commonly treated at school.



What we did – case study Lampedusa & Linosa



20 high school students from «Istituto Omnicomprensivo Luigi Pirandello» of Lampedusa and Linosa

- 9 male
 - 11 female
- and 4 teachers**

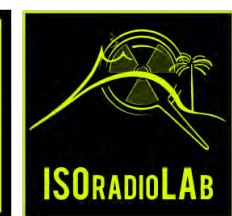
As collaborative citizen science project, the students are the main actors:

- they aware the characteristic of their territory;
- they know the structure of their schools and public buildings



after some lessons about radioactivity and the origin of radon they participate actively in the determination of the locations where the measurements took place; performed measurement process, data analysis and dissemination of their results to the population.

What we did – case study Lampedusa & Linosa



Some results



Comparison between the results obtained with CR-39 and electrets

Island	position	floor	CR39 (Bq/m ³)	Electretes (Bq/m ³)
Lampedusa	classroom	first	116 ± 6	121 ± 12
Lampedusa	classroom	first	99 ± 11	77 ± 24
Lampedusa	classroom	first	78 ± 14	95 ± 11
Lampedusa	administration office	ground	43 ± 13	60 ± 9
Lampedusa	administration office	ground	16 ± 6	19 ± 4
Linosa	classroom	ground	22 ± 8	26 ± 10
Linosa	library	ground	58 ± 12	91 ± 9
Linosa	classroom	ground	87 ± 14	85 ± 11

over the results, the students get during this activity is learning how to perform a real scientific experiment with all the connected difficulties, such as dealing with the measurements and their uncertainties, performing the experiments in a rigorous way and adopting the safe behaviours that are mandatory in a scientific laboratory.

Some results

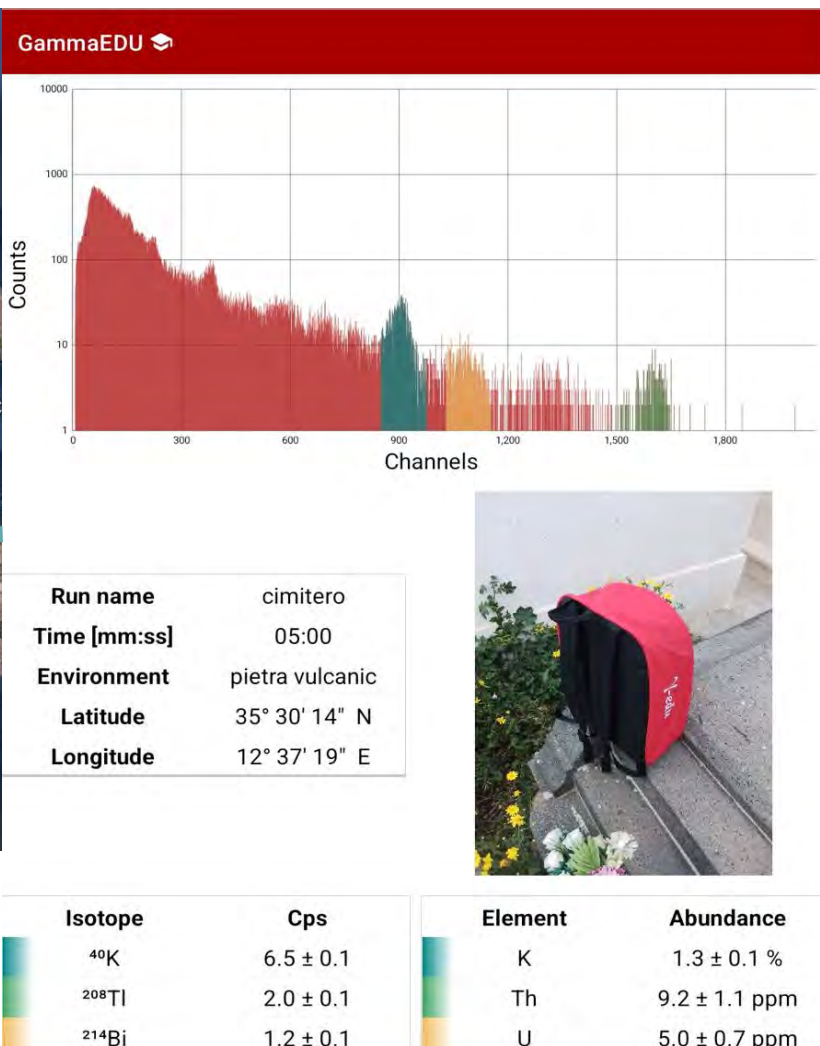
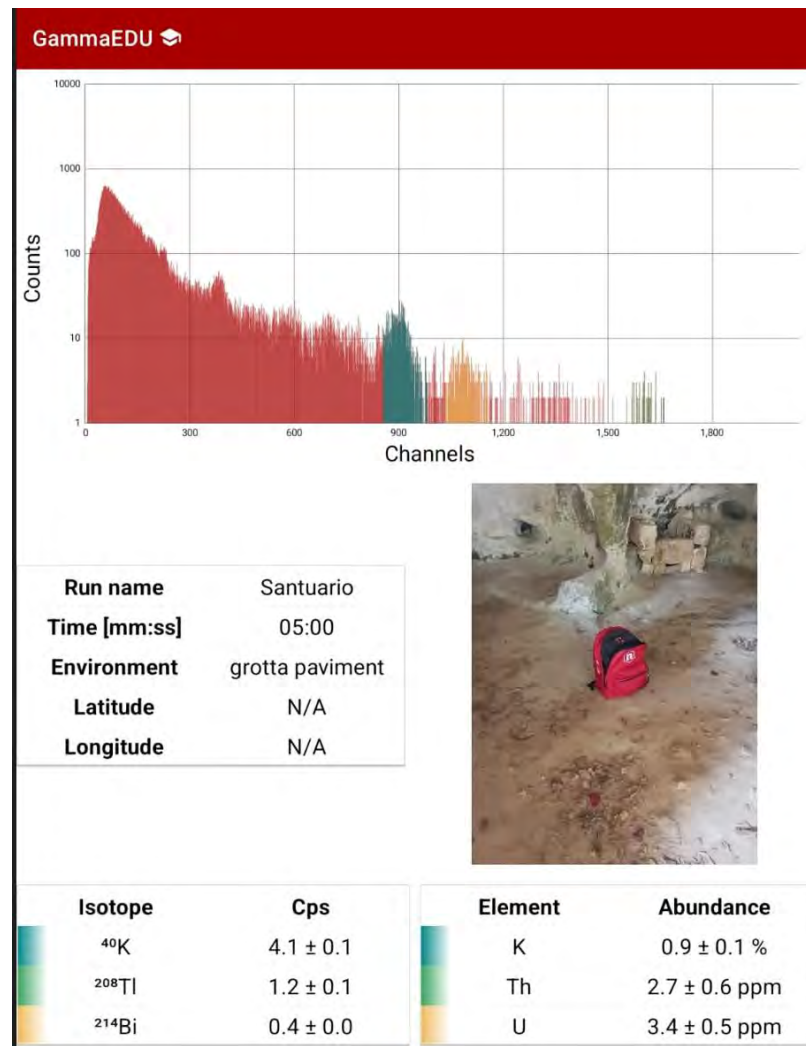


Natural radionuclides in the soils – determination using the **γ -edu CAEN backpack**



Some results

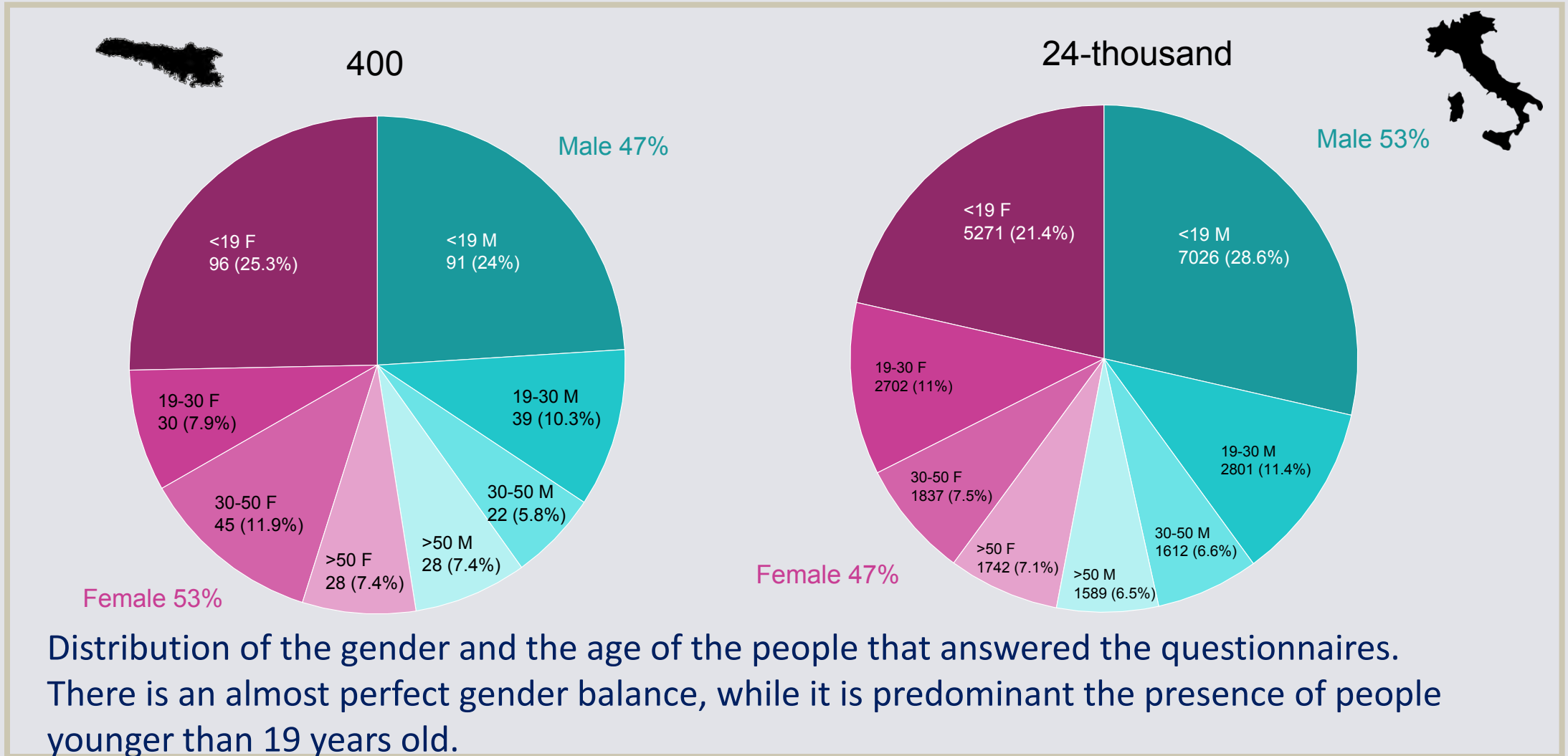
Natural radionuclides in the soils – determination using the γ -edu CAEN backpack



NUMBER OF QUESTIONNAIRES (SINCE THE

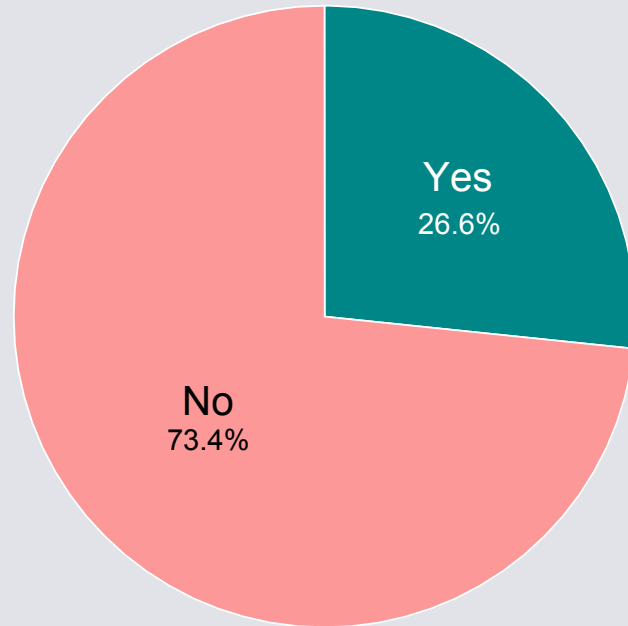


END 2022)

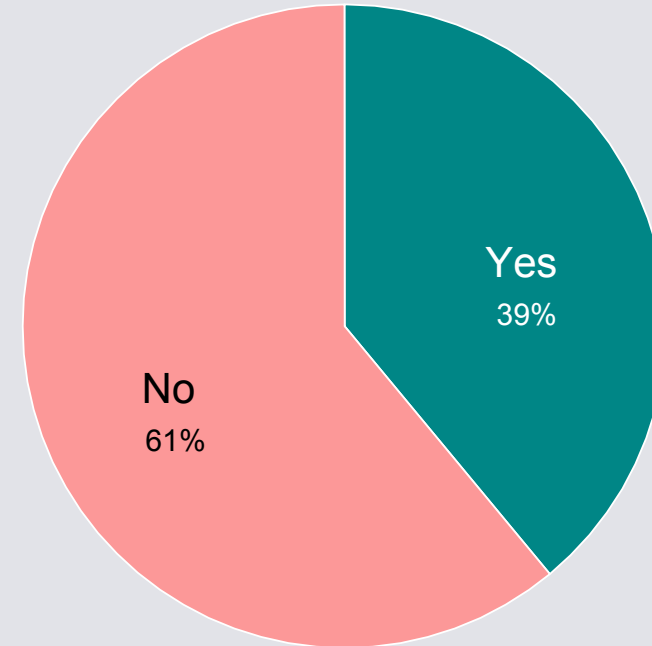




DO YOU KNOW WHAT RADON IS?



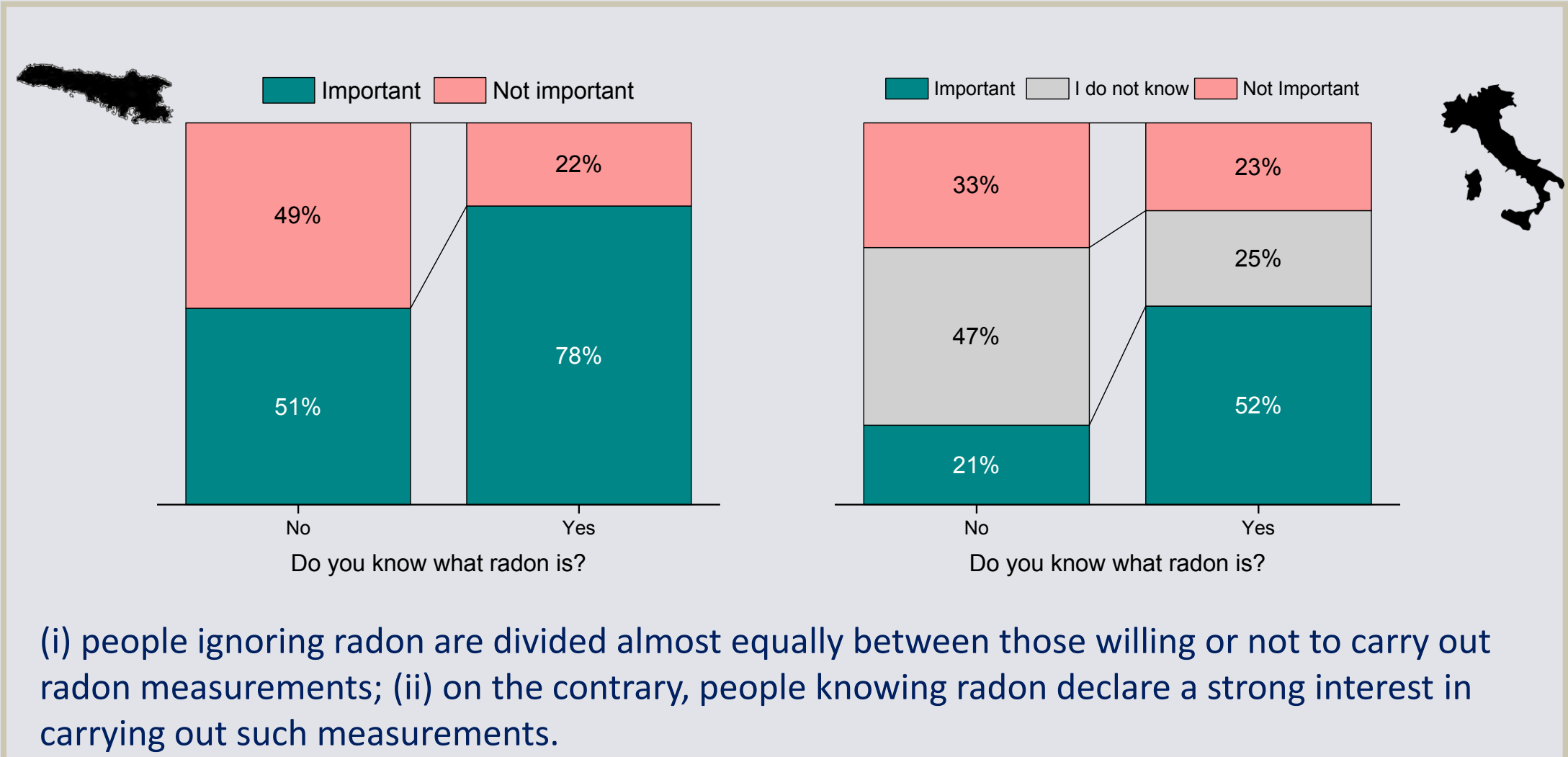
For the islands only the 26% of people declare the radon knowledge.



For Italy the percentage change a little but remain a majority of people that doesn't know the radon.



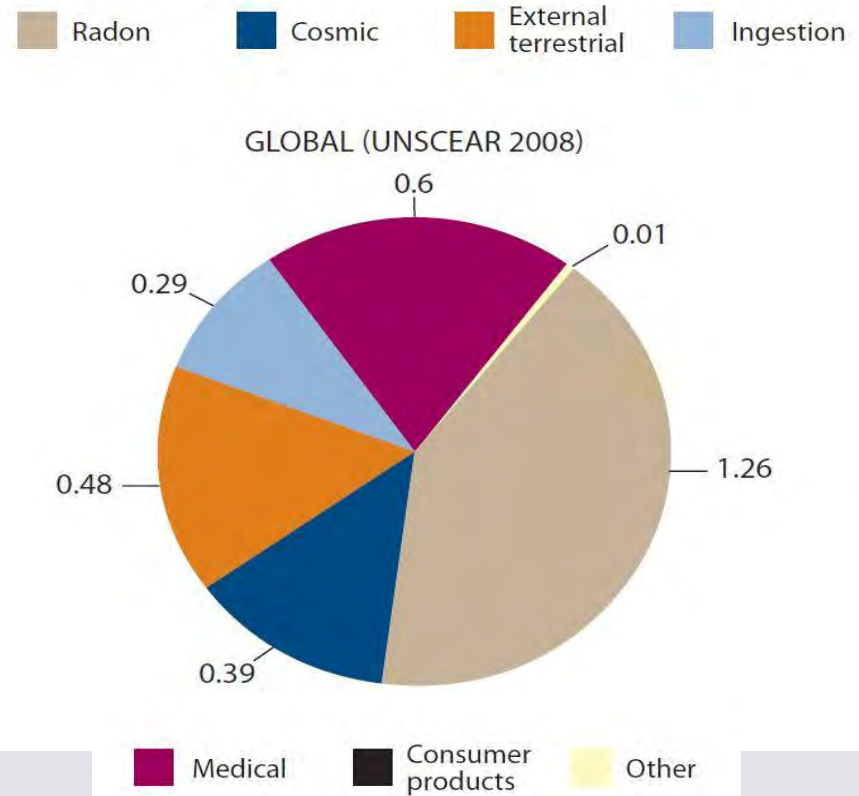
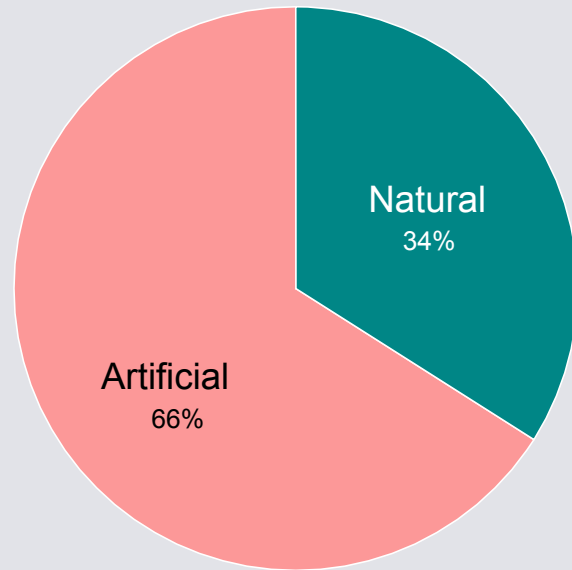
CONCENTRATION MEASUREMENT IN YOUR HOME/WORKPLACE IS?



(i) people ignoring radon are divided almost equally between those willing or not to carry out radon measurements; (ii) on the contrary, people knowing radon declare a strong interest in carrying out such measurements.



PRIMARY SOURCE OF EXPOSURE



Were asked whether the main source of exposure to ionizing radiation was of natural or man-made origin. The results were compared to the real danger classification by (UNSCEAR, 2008): the answers confirm that risk perception is the result of a personal and subjective perception of the real risks, regardless of real knowledge of the nature of the risk itself.

There is still a need to talk about ionizing radiation and radon, the associated risks and methods of measurement and prevention



Conclusions

- this kind of activities upper excites a strong interest and the desire to understand more deeply a subject that in general is unusual,
- the **beginning from the measurement of natural radioactivity** is a good way for the students to approach the nuclear theme on a more rationale basis,
- an **experimental activity** is a good way to provide for an adequate scientific background,
- through this project also the teachers carry out a training or refresher course on these subjects,
- the measurements are made in accordance with radioprotection law,
- the **presentation of the results is done by the students** involved to other students, but also to authorities, family and/or the population in general, according to the methodology of scientific congresses,
- this aspect allows **to amplify the diffusion** of these topics,
- it gives the possibility to students to learn **how to expose complex concepts in a scientific and rigorous language**, but such as to be **understood even by people not in the field**,
- this project has shown how powerful is its value for the scientific disciplines it involves.

But it is also a tool for creating a network and international relationships between young people around the world.

So, the consolidated result of this experience encourages us to present, to share and to export it to other realities to make the project richer and richer.

Iniziativa for 2023



- ▶ **Summer School 10 – 15 settembre (5 nights)** – presso Casa Alpina De Filippi, Macugnaga – Monte Rosa
- ▶ It is planned to recruit 30 male and female students from the schools linked to the nine sections to add 1 teacher per group and university and INFN researchers as teachers and tutors of the initiative.
- ▶ The topics will be general on radioactivity, environmental radioactivity, radioactivity and society, nuclear energy, ...



Thank you for your kind attention

INFO & DOCUMENTATION

[RadioLab – RadioLab – Radioactivity Laboratory \(inf.n.it\)](http://RadioLab – RadioLab – Radioactivity Laboratory (inf.n.it))

CONTACTS

flavia.groppi@unimi.it
mariagabriella.pugliese@unina.it
michele.colucci@unimi.it
fiorella.cagnetta@mi.infn.it
pier.maggioli@esteri.it
jenny-orbe@hotmail.com

Thank you for your kind attention!

CONTACTS

flavia.gropi@unimi.it

mariagabriella.pugliese@unina.it

michele.colucci@unimi.it

fiorella.cagnetta@mi.infn.it

pier.maggioli@esteri.it

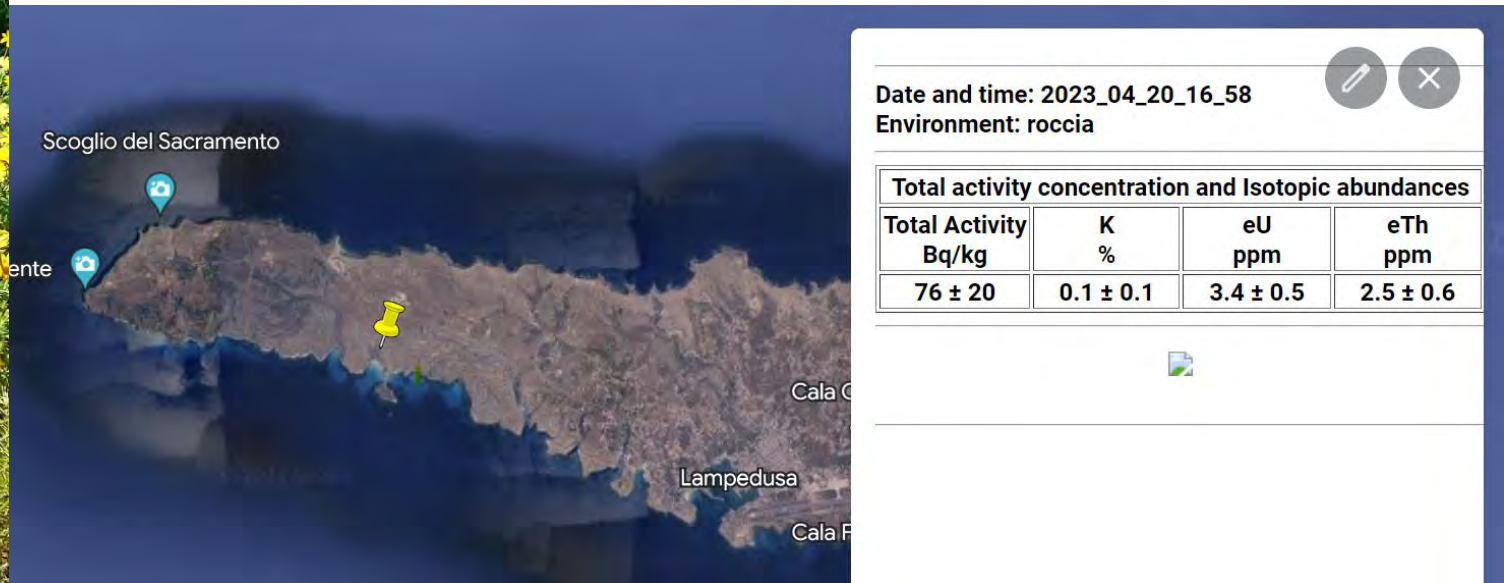
jenny-orbe@hotmail.com

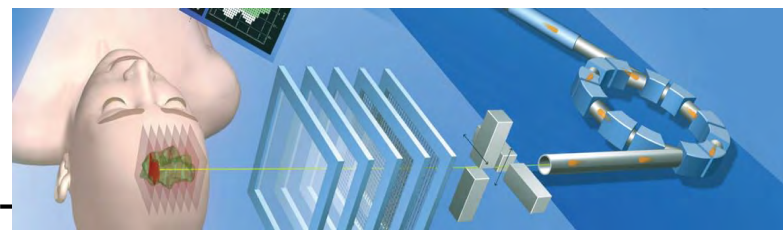
INFO & DOCUMENTATION

[RadioLab – RadioLab – Radioactivity Laboratory \(infn.it\)](http://www.infn.it)

Some results

Natural radionuclides in the soils – determination using the γ -edu CAEN backpack





Particle Therapy International Masterclass

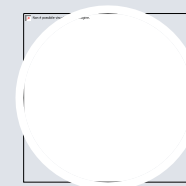
Physics applied to human health



23 Marzo 2021

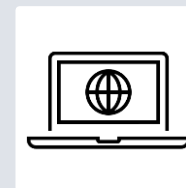


Online



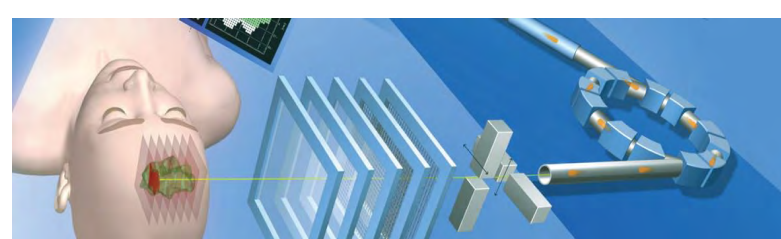
Planning and preliminary work

- International meetings with the organizers (Groppi F. e Capua M.);
- Meeting with teachers and tutors;
- Preparation and optimization of the exercises to be solved by the students;
- Remote guide to the software installation.



Web site

<https://agenda.infn.it/event/25762/>



Exercises



ESERCIZI MASTERCLASS – PARTICLE THERAPY

Gruppo 1

- 1) Caricare il **fegato** (LIVER.mat)
Suggerimento. Deselezionare i seguenti organi: Kidney_L, Kidney_R, SmallBowel, LargeBowel, Celiac, Duodenum.
- a) Confrontare i piani di trattamento ottenuti con **fotoni** e **protoni** con **un singolo fascio** (un solo angolo per volta), provando a variare l'angolo per valutare quale sia ottimale.
Nota: l'angolo che è più adatto per il trattamento con fotoni è diverso da quello per il trattamento con protoni.
- b) Ripetere a) impostando manualmente il piano di trattamento con protoni e provare a calcolare nuovamente la dose usando il tasto "Calcola". Qual è la distribuzione di dose?

ESERCIZI MASTERCLASS – PARTICLE THERAPY

Gruppo 2

- 2) Caricare il **fegato** (LIVER.mat)
Suggerimento. Deselezionare i seguenti organi: Kidney_L, Kidney_R, SmallBowel, LargeBowel, Celiac, Duodenum.
- a) Ottimizzare un piano di trattamento con **3 fasci di fotoni** provando a sperimentare diverse posizioni degli angoli in modo da trovare una configurazione efficace.
- b) Ripetere ottimizzando un piano di trattamento con **5 fasci di fotoni**. (*Suggerimento:* prova con 5 fasci equi-spaziati sui 360° e con 5 fasci equi-spaziati tra 180° e 360°) Cosa è cambiato nella distribuzione di dose?

ESERCIZI MASTERCLASS – PARTICLE THERAPY

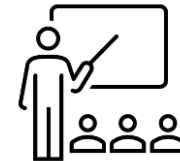
Gruppo 5

- 5) Caricare la prostata (PROSTATE.mat)
Suggerimento. Deselezionare i seguenti organi: Penile_bulb, Lymph_Nodes, prostate_bed
- a) Studiare l'**andamento della dose** media al PTV, alla vescica e al retto al variare dell'angolo, irraggiando con un singolo fascio di fotoni. Riempire una tabella con questa struttura completando l'angolo giro:

	Dose media		
	PTV	Bladder	Rectum
0°			
30°			
60°			
...			

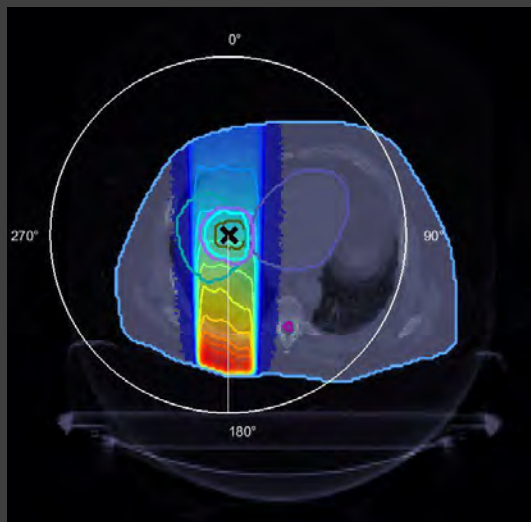
- b) Fare un grafico con gli **angoli** sull'asse **x** e **dose al PTV** sull'asse **y**. Nella stessa figura fare un grafico con gli **angoli** sull'asse **x** e **somma di dose alla vescica e dose al retto** sull'asse **y**.

COMPARISON BETWEEN SINGLE PHOTON AND SINGLE PROTON BEAM FOR LIVER



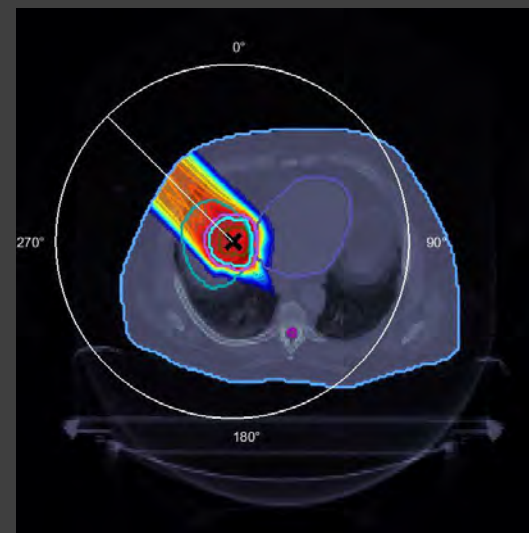
• Photon therapy

- Best angle for photon therapy (180°), single beam, minimum effects on OARs (heart - spinal cord - skin)
- More amount of radiation for heart



• Proton therapy

- Best angle for proton therapy (315°), single beam, minimum effects on OARs (heart - spinal cord - skin)
- Less amount of radiation for heart

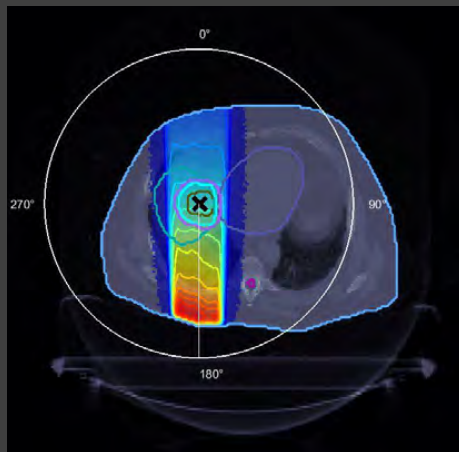


COMPARISON BETWEEN SINGLE AND MULTIPLE PHOTON BEAMS



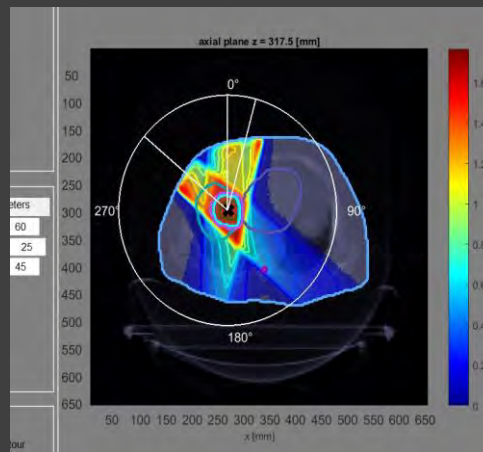
• Single beam

- Ineffective method, radiation dispersion on sensitive tissues although in small dose



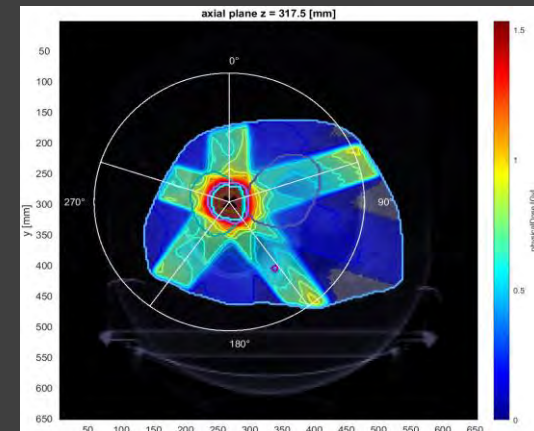
• Three beams

- The best solution that we found with 3 beams is the following one: 0-15-310 degrees.
- In this way the damage reported by the vital organs are minimum, while the tumor is well stricken by the radiations



• Five beams

- By using 5 photons the result is way less optimal, the vital organs are damaged by the radiations.
- There is no difference in spreading the beams between 0 and 360 degrees or between 180 and 360 degrees. The result is still better if we use three beams.



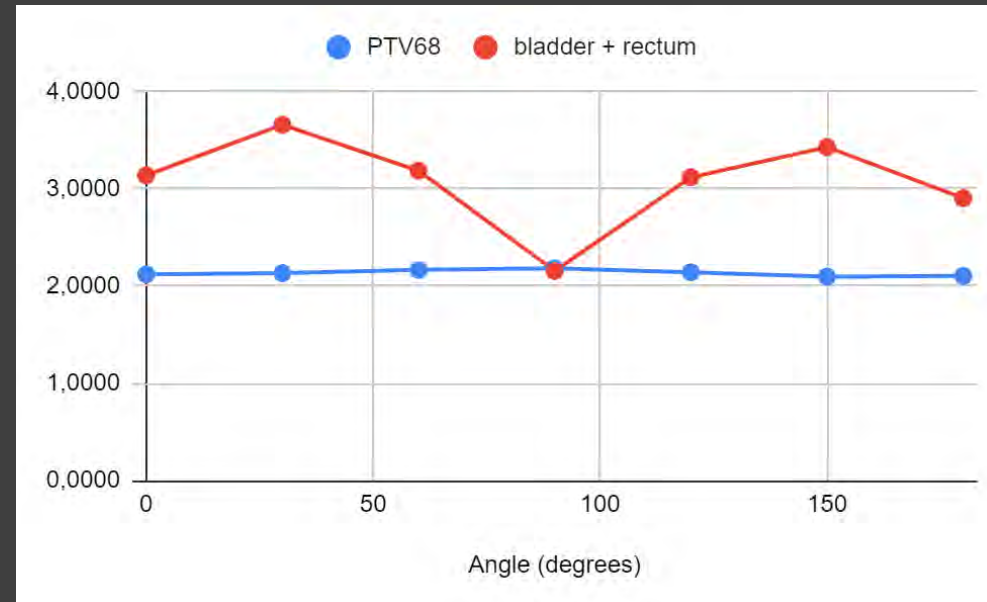
DOSE DELIVERY TO THE OARs AS A FUNCTION OF THE ANGLE FOR A SINGLE PHOTON BEAM FOR PROSTATE

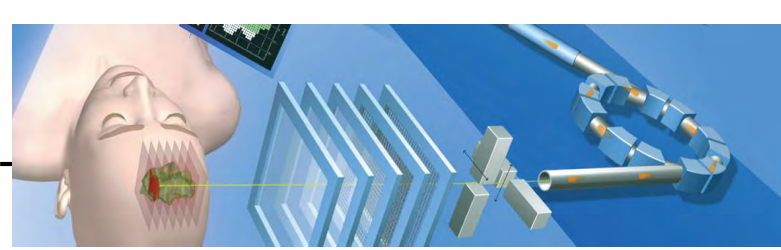


We compared PTV68, bladder and rectum mean doses for various angles (multiples of 30°), and graphed the results. In the graph, we notice that the best angle for the treatment is 90° (minimum dose delivery to the OARs and maximum to the PTV).



Angle (deg)	Mean Dose		
	PTV68	Bladder	Rectum
0	2,1216	1,8692	1,2706
30	2,1338	2,1799	1,4792
60	2,1680	1,7563	1,4315
90	2,1845	0,9996	1,1566
120	2,1433	1,3691	1,7507
150	2,0980	1,4923	1,9375
180	2,1060	1,2659	1,6385



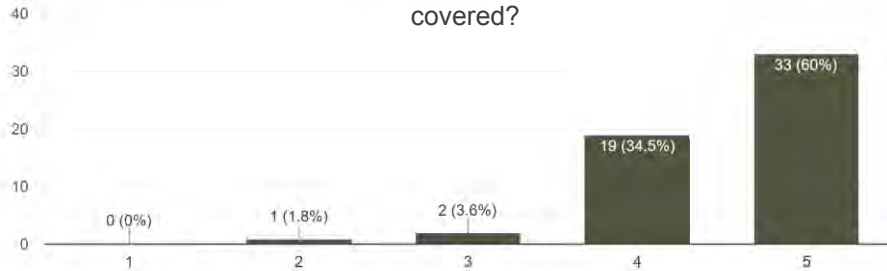


satisfaction questionnaire

Quanto hai trovato interessanti gli argomenti presentati?

55 responses

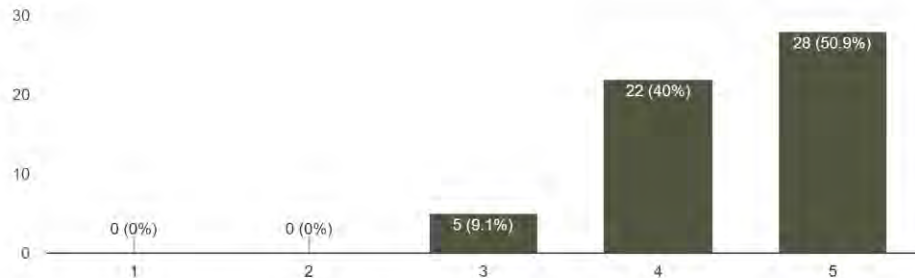
how interesting did you find the topics covered?



Le tue aspettative sono state soddisfatte?

55 responses

Have your expectations been met?

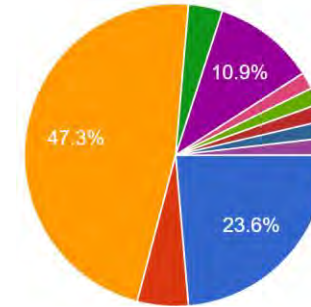


17/05/2023

Quale parte della masterclass ti è piaciuta di più?

55 responses

which part of the masterclass did you like the most?



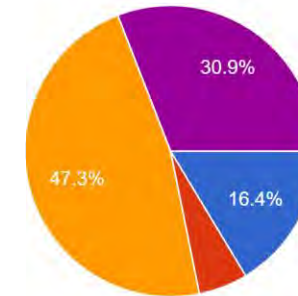
- Presentazioni introduttive della mattina
- CNAO tour
- Presentazione pomeridiana sulla piani...
- Discussione dei risultati
- Videoconferenza CERN
- Nulla
- Lavoro sul software
- Simulazione della pianificazione del tr...

▲ 1/2 ▼

Come cambieresti l'organizzazione delle MasterClasses?

55 responses

how would you change the organization of the masterclass?

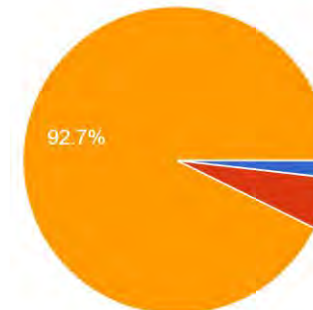


- Più seminari e più attività di analisi dati
- Più seminari e meno attività di analisi dati
- Meno seminari e più attività di analisi dati
- Meno seminari e meno attività di analisi dati
- Nessun cambiamento

In che modo la masterclass ha influenzato il tuo interesse?

55 responses

how did the masterclass influence your interest?



- Ora sono meno interessata/interessato
- Non ha avuto effetto
- Ora sono più interessata/interessato

Particle Therapy International Masterclass: The First Italian Experience



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UNIVERSITÀ
DELLA CALABRIA



GROPPI F. (1)(2), CAPUA M. (3)(4), MANENTI S. (1)(2), TUCCI R. (3)(6), CAGNETTA M.F. (2)(5), COLUCCI M. (1)(2)

(1) Università degli Studi di Milano – UNIMI, Dipartimento di Fisica, LASA

(2) Istituto Nazionale di Fisica Nucleare – INFN, Sezione di Milano, LASA

(3) Dipartimento di Fisica dell'università della Calabria

(4) Istituto Nazionale di Fisica Nucleare , Gruppo Collegato di Cosenza

(5) Liceo Scientifico Donatelli, Milano

(6) Liceo Scientifico E. Fermi, Cosenza

