

Training and Educational Activities in Radiation Protection and Ionizing Radiation: The Italian Experience

- F. Groppi, G La Verde, M Pugliese, M Sisti, M Colucci
on behalf of RadioLab and EyeRAD collaborations

flavia.groppi@unimi.it

Why Radiation Protection Education?

Increasing use of ionizing radiation in key sectors



WORKERS



PATIENTS



PUBLIC

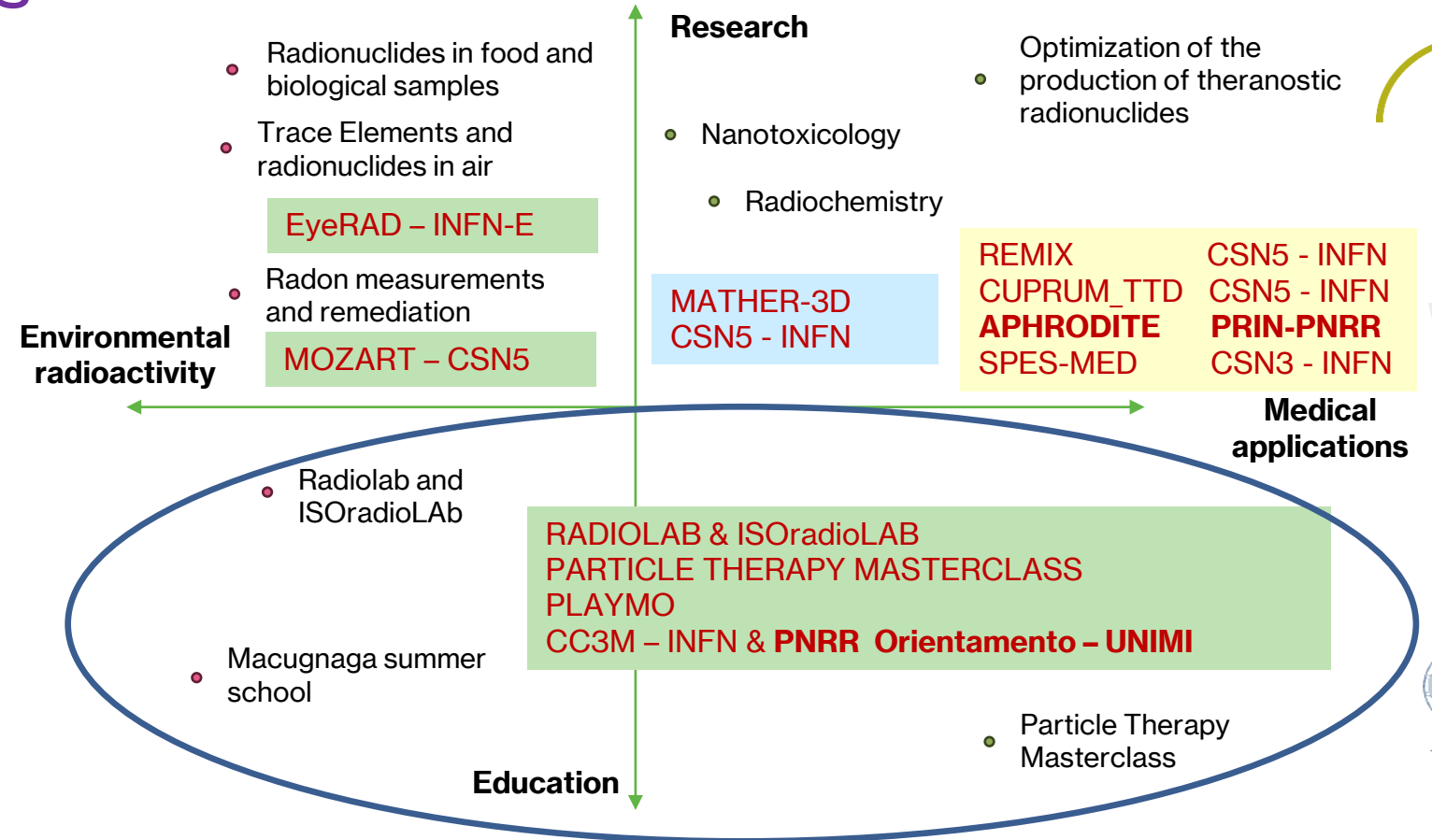


ENVIRONMENT

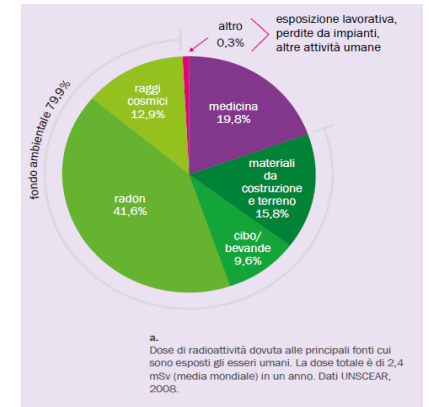
Research Activity at Physics Applied to Health and Radiochemistry Lab. at LASA: the double² face of the health physics



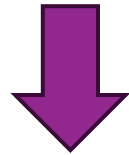
The Four Seasons, Arcimboldo 1563-1573



Natural and artificial radioactivity



- Primary source of human exposure to IRs remains natural radioactivity followed by the medical use;
- In Italy, there exists a cultural taboo surrounding all things "nuclear," leading to a lack of information;



- Dissemination of scientific culture through educational initiatives for disseminating knowledge and fostering awareness among students and the public.

HOW

- showing the double face of radioactivity
 1. Measuring the natural and artificial radioactivity, limiting the effect of exposition thanking to radioprotection
 2. application of IR in medicine



RADIOLAB & ISOradioLab
EyeRAD



Particle Therapy
Masterclass

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

RADIOLAB (since ... 2004) & ISOradioLab



Students 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 kind of measurements,

data analysis,

presentation and discussion of the results.

• The idea is:

×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



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

The aim and the point of strength

From the measurement of natural radioactivity it is clear that:

- there are different types of radiations, and IR are just a particular type of radiation;
- IR can be measured;
- to prove the fun a student can derive from discovery and detection of IR;
- real experimental approach but also a Citizen science approach;
- it is not an occasional experiment;
- it allows the study of the environment outside the school/university;
- the high multidisciplinary approach of this matter, allows 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;
- Gender and STEM;
- it is also a way for the teachers to be trained and have a refreshment on these topics.

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



High School in Korce & Scutari



Ecuadorian High Schools, Riobamba

NEW Entry (2023):
Miroslav Vanek in Slovakia



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



ISOradioLab



Lampedusa & Linosa



Pantelleria



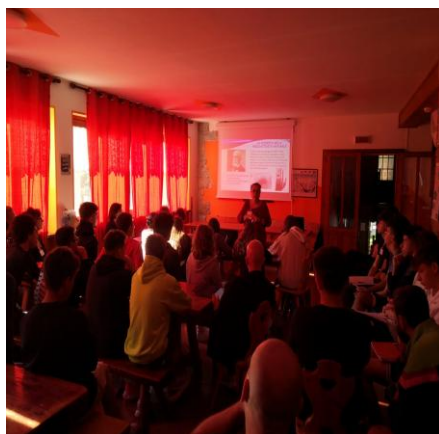
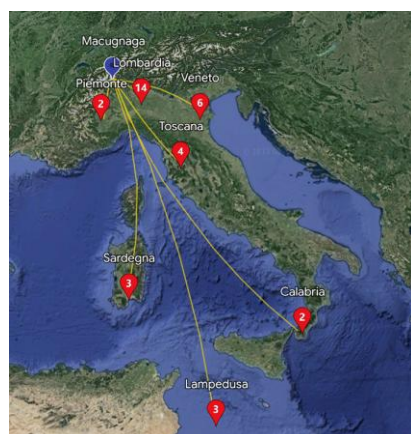
The Summer School: a scientific retreat at the base of the east wall of Monte Rosa



The topics will be general on radioactivity, environmental radioactivity, radioactivity and society, nuclear energy.

Lessons in the morning
Laboratory with experimental measurements in the afternoon.

The size of the village allows the entire mountain community that hears about these issues to be involved.



07/09/2026

EUTERP - PSI

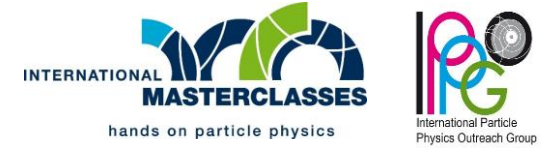
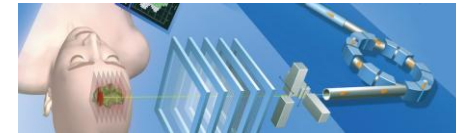
10

Table card game “Guess the radionuclide”

invented to bring the population closer to the issues related to natural and artificial radioactivity.



Particle Therapy International Masterclass - Physics applied to human health



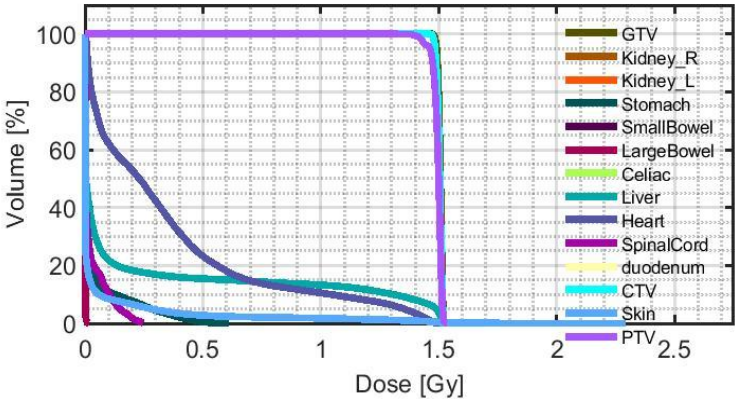
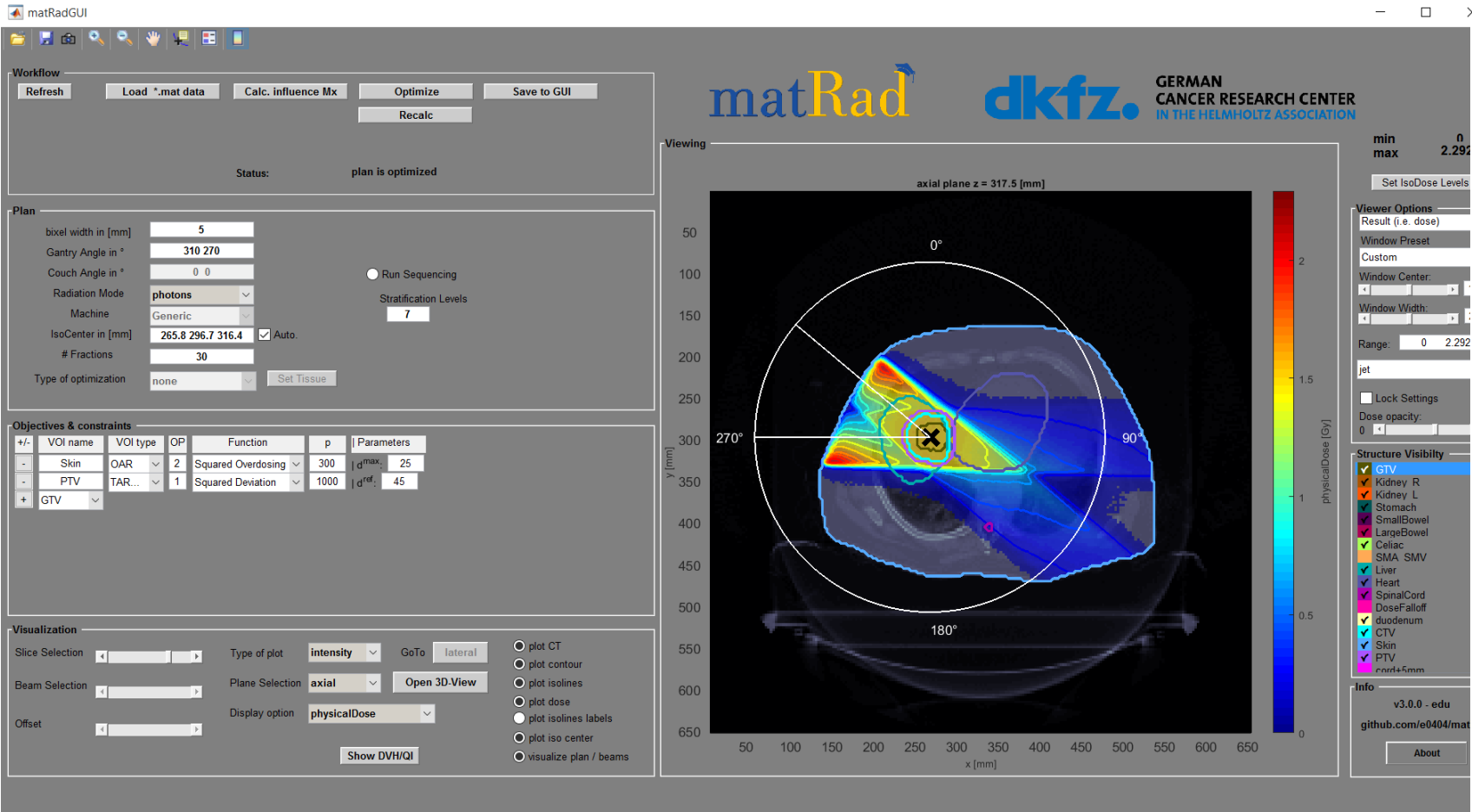
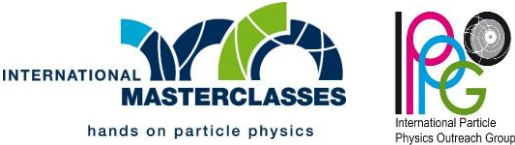
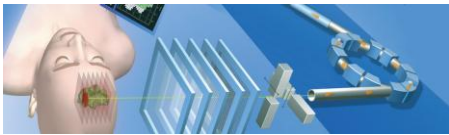
Main goals:

- Introduce students to the physics applied to human health, in particular to conventional and non-conventional radiation therapy;
- Demonstrate the role and the importance of the fundamental research for the society, with particular regard to human health.

matRad software:

- Participants created real treatment plan for radiation therapy by using a simplified version of the software **matRad** developed by the **dkfz**.

matRad – dkfz, Germany Cancer Research Centre

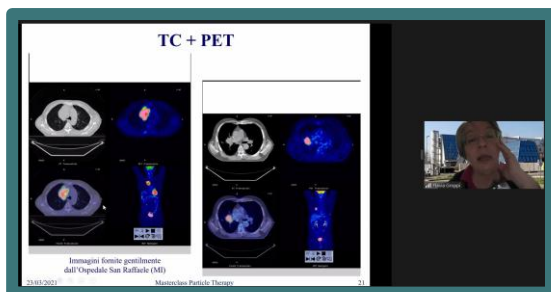


	max	min	mean	std
GTV	1.5262	1.4786	1.5061	0.0085
Kidney_R	0	0	0	0
Kidney_L	0	0	0	0
Stomach	0.6104	0	0.0382	0.0959
SmallBowel	0	0	0	0
LargeBowel	0.0174	0	1.7647e-04	0.0011
Celiac	0	0	0	0
Liver	1.7871	0	0.2248	0.4765
Heart	1.5029	8.6299e-04	0.3500	0.3967
SpinalCord	0.2495	0	0.0261	0.0510
duodenum	0	0	0	0
CTV	1.5315	1.4684	1.5027	0.0102

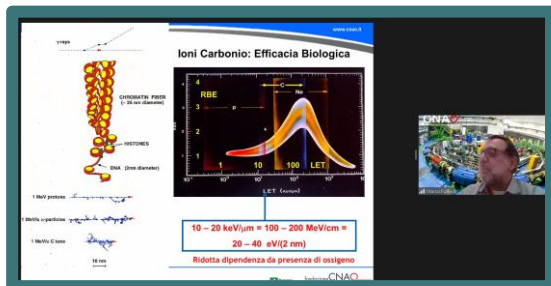
Timetable

• Morning session

Physics applied to medicine



CNAO – Virtual visit to the centre and examples of treatment plan



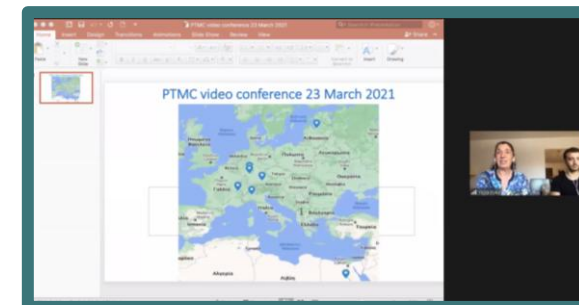
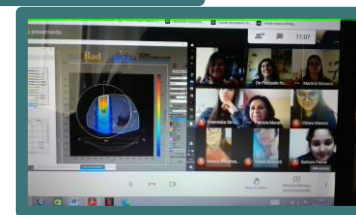
07/09/2026

From particle physics to application in medicine

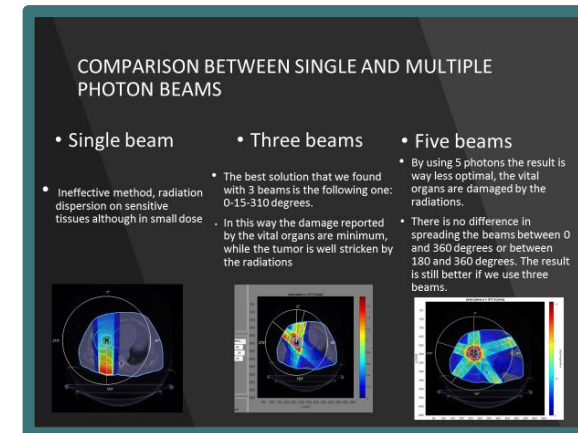


• Afternoon session

Introduction to matRad



Hands-on session

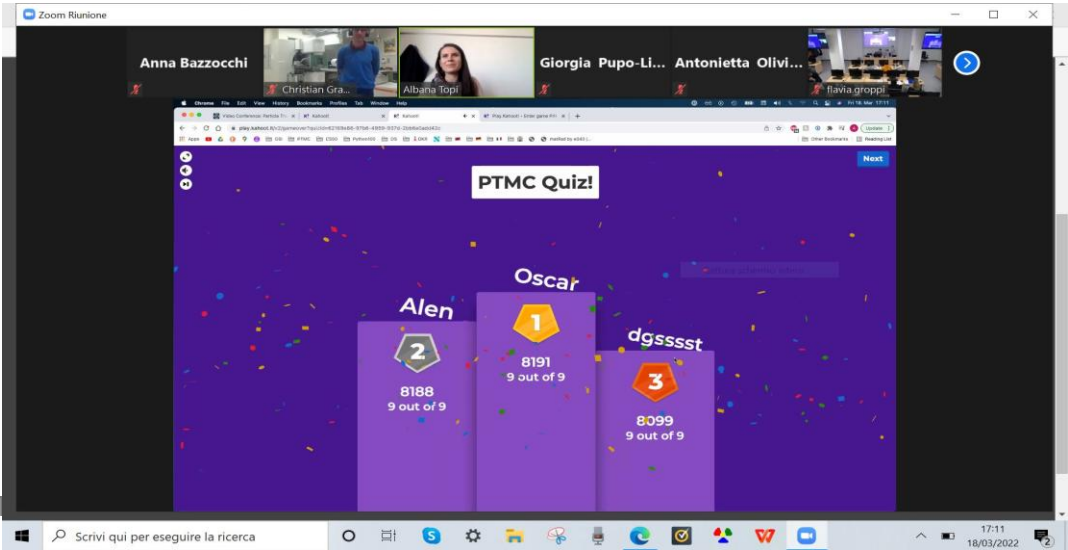
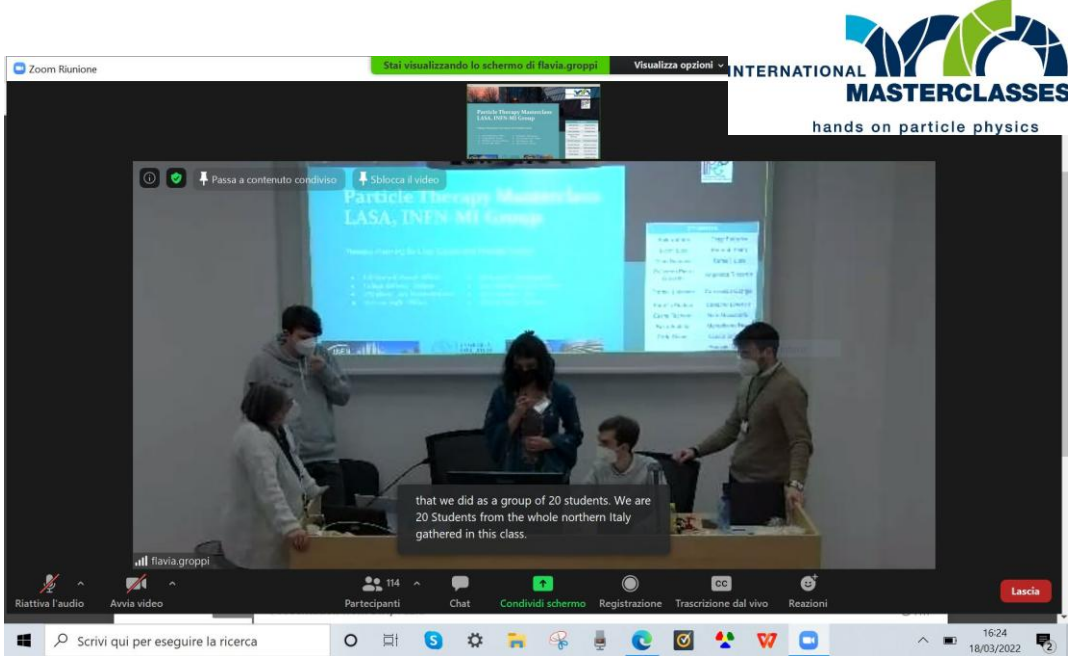
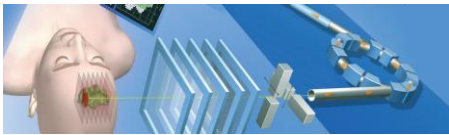


- *Videoconference at CERN with all participant institutes*
- *Results presentation;*
- *Final quiz*

EUTERP - PSI

14

Some pictures from different ed.

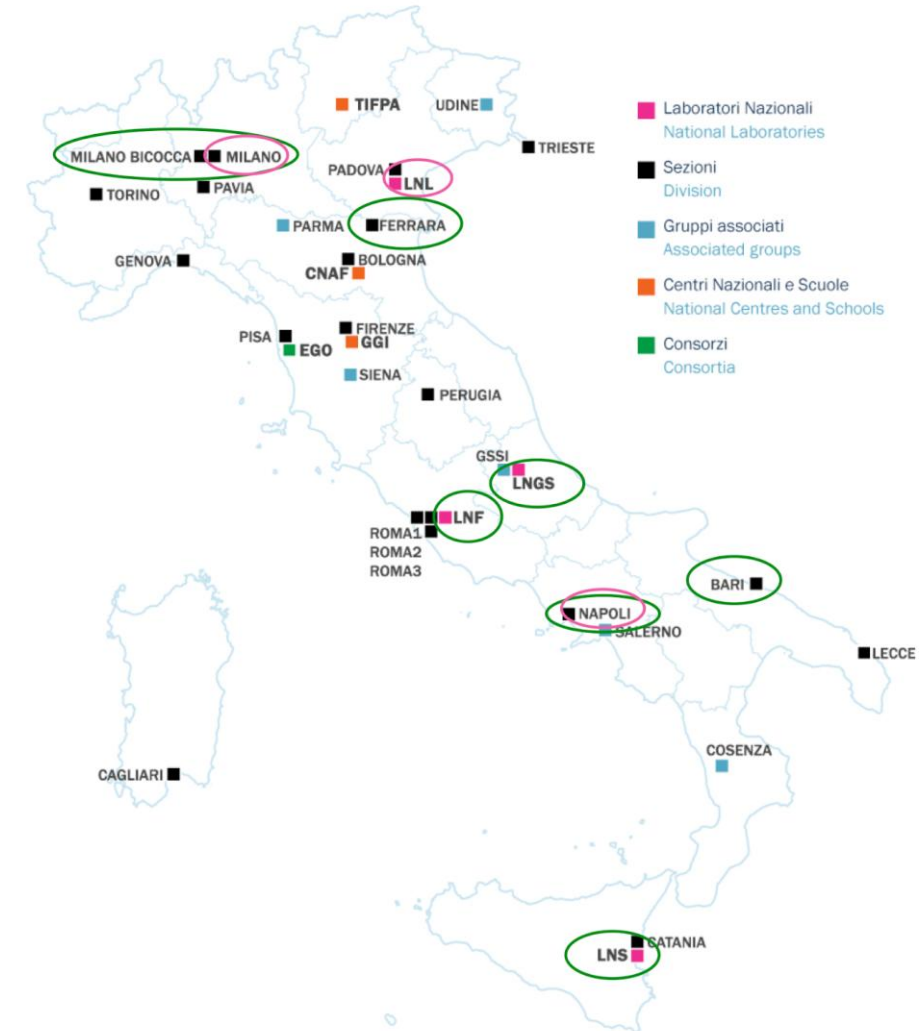


EyeRAD Project

- Project born from the awareness that the research activity within the INFN in the field of nuclear measurements is of the highest level and constitutes unique potential capable of offering a service to society in environmental measurements.
- In the detection of artificial radioactivity issued following occasional anomalous events, in parallel with the regional and national agencies and bodies that already deal with them for an institutional duty.

Goal

- environmental radioactivity monitoring network focusing on measuring the concentration of radionuclides present in atmospheric particulate matter;
- inclusion of any other initiatives regarding environmental monitoring and radiation protection in Italy;
- dissemination of these information to the population.



EyeRAD Project

TSP High Volume Particulate Sampler

draft protocols to standardize the entire data collection and analysis procedure in order to have comparable results

Sampling glass fiber filters

AMS (ITA)

HVS up to 60 CFM

designed and manufactured in full compliance with EPA Protocol requirements

Italy

Brushless system

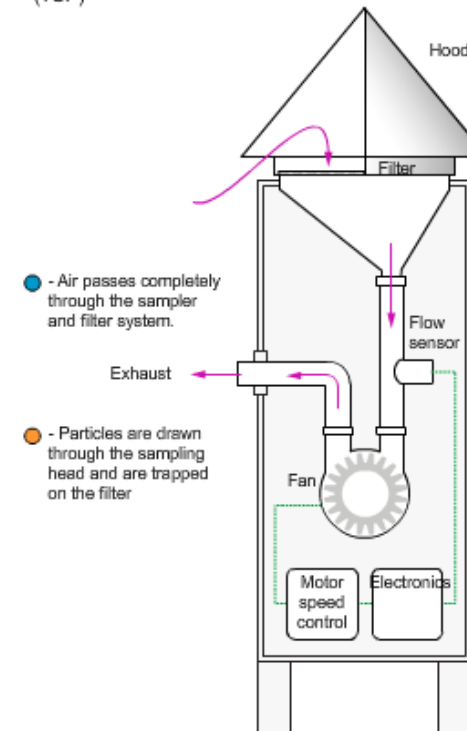
Programmable up to 7 segments of measurements distributed at selectable intervals and durations

Downloadable data and measurement parameter reports

Internet Communication



High volume sampler for Total Suspended Particulates (TSP)

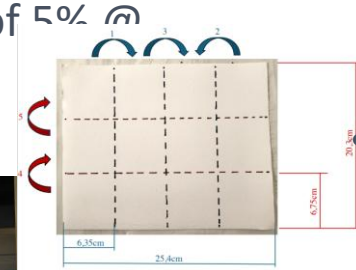
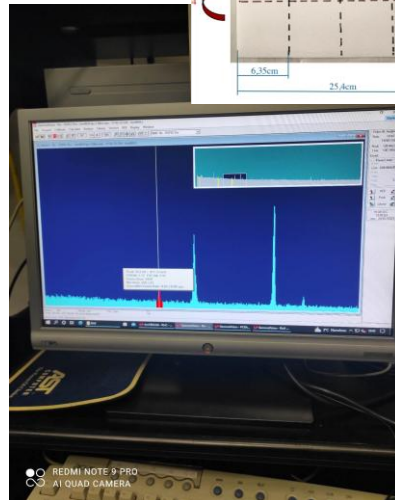


- depth filters with a retention rate of 99.8% at 1 μm , 99% efficiency for particles as small as 0.3 μm and moderately effective for particles as small as 0.05 μm ;
- excellent retention efficiency/low pressure drop in the suction line;
- lower sensitivity to electrostatic charge buildup during storage and weighing procedures.

EyeRAD Project

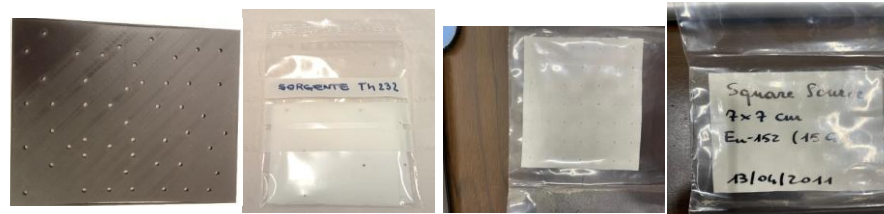
Gamma spectrometry measurements

- P-type HPGe detector
- The LNF Section uses 3" NaI(Tl) detectors with a resolution of 5% ^{137}Cs and high efficiency.
- Background subtraction



Sources for efficiency calibration

- Filter-sized template with 49 holes. Deposition of 30 μL of liquid ^{232}Th standard in each hole.
- Total: 1470 μL ; Certified concentration: 10 mg/mL (10,000 ppm)
- Expected total activity: ~ 60 Bq
- Certified ^{152}Eu source 49 points
- Activity (1/1/1995): 896.4 Bq - error 2.35%



EyeRAD gamma spectra analysis protocol

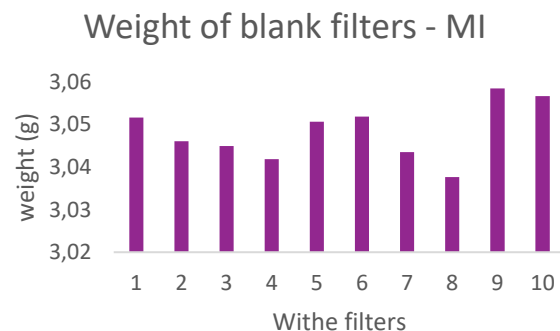
Quantitative spectral analysis to evaluate activities (in Bq m^{-3}) - with the associated error - or sensitivities (MDA) for the following radionuclides:

- ^{210}Pb (natural, indicative of resuspension from the soil)
- ^7Be (cosmogenic from spallation - indicator of the "goodness of (measurement according to Recommendation 2000/473/Euratom)
- ^{131}I (relevant RNs released during nuclear accidents)
- ^{137}Cs (most important tracer of nuclear accidents: reference indicator for environmental radioactive contamination)

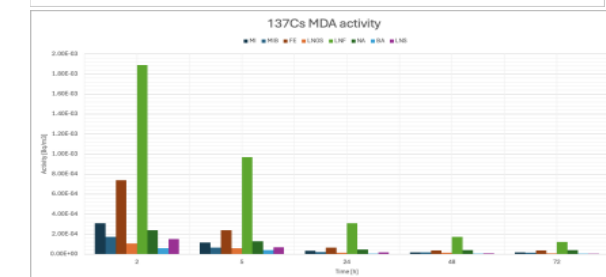
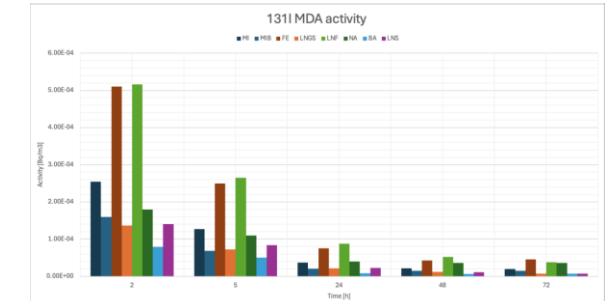
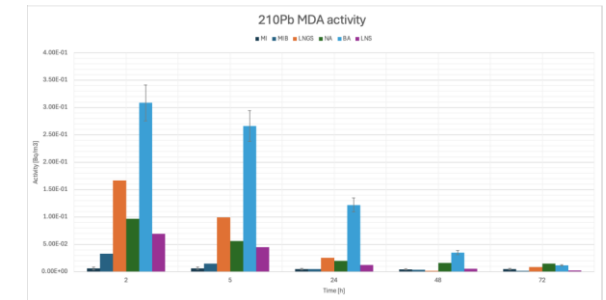
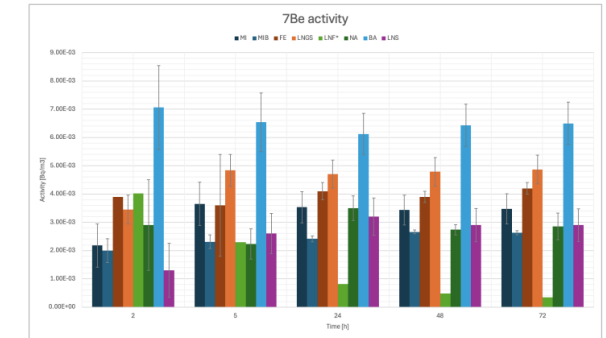
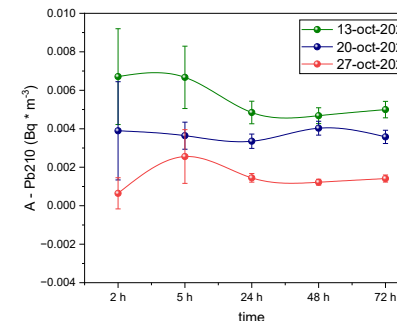
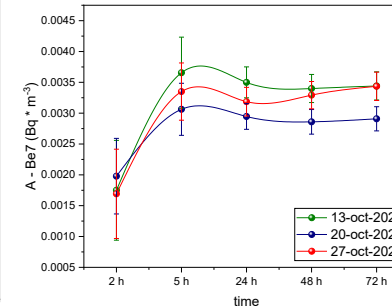
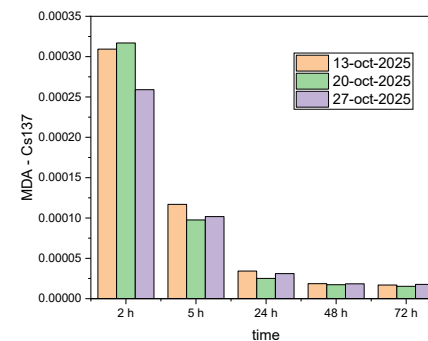
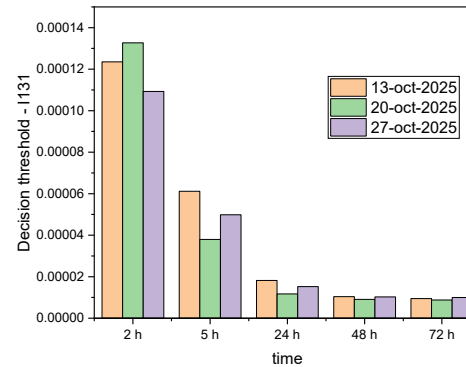
EyeRAD Project

Shared protocol for the measurement and analysis

- 23-hour aspiration cycle, followed by a gamma measurement
- with subsequent acquisitions,
- Flow value : 1000 L/min
- Flow regulation parameter set: "Standard conditions", Fc,N, i.e., the flow detected by the measurement system and normalized to standard conditions.



Some preliminary results - Milano



Impact

Main Outcomes of INFN Educational Initiatives



Conclusions

- Education is essential for strengthening radiation protection culture.
- Our educational activities on environmental and artificial radioactivity reflect a holistic approach to scientific literacy and engagement.
- By combining interdisciplinary perspectives, practical experiences, and community outreach, these initiatives aim to empower individuals to navigate and contribute to the complexities of contemporary scientific challenges.
- Beyond mere dissemination of information, our efforts seek to inspire curiosity, critical inquiry, and active participation in shaping a safer and healthier future for all.
- Investing in education means investing in the next generation of radiation protection professionals.

Thank you for your kind attention