



19ENV02 RemoteALPHA

## Remote and real-time optical detection of alpha-emitting radionuclides in the environment

Coordinator: Faton S. Krasniqi, PTB

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19ENV02 RemoteALPHA denotes the EMPIR project reference.





### **Motivation: Emergency Response**



Safety standards for the protection against the dangers arising from the ionising radiation: The European Directive 2013/59/EURATOM

#### RemoteALPHA supports...

**Emergency actions** and strategies for radiological emergencies involving accidental or deliberate dispersion of alpha emitting radionuclides in the environment.

Measures required by the European Directive 2013/59/EURATOM

#### **Emergency Management System**

-Member states should ensure that account is taken of the fact that emergencies may occur in their territory... -The emergency management system shall provide for the establishment of emergency response plans...

#### **Emergency Preparedness**

-Member States shall ensure that emergency response plans are established in advance for the various types of emergencies... -Member States shall ensure that emergency response plans are tested and revised at regular intervals...

#### **International Cooperation**

Member States shall cooperate with other Member States and with third countries in addressing possible emergencies on its territory which may affect other Member States or third countries...





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Article 97

Article 98

Article 99

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### **Detection of alpha particles**





http://www.argonelectronics.com/blog/the-value-of-applied-learningfor-radiation-safety-training

Traditional detection methods (proportional counter, scintillator counter, PIPS detectors) are:

- time consuming and tedious,
- involve scanning very close to the surface of the contaminated area,
- require the use personal protective equipment,
- Expose the personel to other hazards and risks (other types of radiation, fire, etc.).





### **Detection of alpha particles**





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### **Radioluminescence at a glance**



Schematic representation of air ionization by  $\alpha$ -particles and radioluminescence.

Air molecules emit fluorescent light (radioluminescence) in the UV range between 200 nm and 400 nm.

Range in air:		
x-particles	$\rightarrow$	0,04 m
JV light	$\rightarrow$	500 m





Alpha



### **Technical Workpackages**

#### RemoteALPHA: 01.09.2020 - 31.08.2023





## Optical systems for remote detection of alpha-emitting radionuclides





UV Grade Fused Silica lens system Objective lens diameter: 240 mm; focal length: 600 mm Spectral window: UV-A, UV-C



Fresnel lens systems Objective lens diameter(s): 257.6 mm (452.9 mm); Focal length(s): 244.5 mm (424.5 mm) Spectral window: UV-A, UV-C



Modular-mirror systems 6 x UV-Enhanced Al-Coated Concave Mirrors, Mirror diameter: 75 mm Focal length: 500 mm (or 200 mm). Spectral window: UV-A, UV-C

PTB: M. Luchkov, V. Dangendorf, U. Giesen, K. Tittelmeier, F. Langner, and F. Krasniqi















Testing of optical detection systems: experiments at the PTB Ion Accelerator Facility (PIAF)





Alpha particles with a rate from  $50 \times 10^3$  to  $15 \times 10^6$  particles/s have been accelerated to energies up to 8.3 MeV by means of a tandem accelerator and a compact cyclotron.

PTB: M. Luchkov, V. Dangendorf, U. Giesen, K. Tittelmeier, F. Langner, and F. Krasniqi IFIN-HH: C. Olaru





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#### Testing of optical detection systems with extended Am-241 sources





Am-241 source (980 kBq, active area: 20 mm x 100 mm) designed and provided by IFIN-HH.

UV-transmissive box to comply with radiation protection protocols in EU designed by PTB, UPC, LUH and IFIN-HH, built by PTB.



Experiments at the PTB: M. Luchkov and V. Dangendorf







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#### Testing of optical detection systems with extended Am-241 sources





#### PTB: M. Luchkov and V. Dangendorf









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#### Testing of optical detection systems with extended Am-241 sources





#### PTB: M. Luchkov and V. Dangendorf





F. Krasniqi, EURAMET TC-IR AM 2022, 27.01.2022

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## **RemoteALPHA** Calibration system for the novel-type radioluminescence detector systems







A new dedicated, characterized and calibrated optical UV radiance standard for calibration of UV-A and UV-C radioluminescence detection systems.

PTB: Anna Förster, Philipp Tesch, Richard Dieter Taubert













## **RemoteALPHA** Calibration systems for the novel-type radioluminescence detector systems



Extensively characterized <sup>210</sup>Po source for the determination of the radioluminescence yield

#### PTB: Florian Mertes, Anja Honig, Stefan Röttger



Preparation of the Po-210 source, from left to right:

- Silver target in PMMA holder,
- Silver target in holder in the Po-210 solution,
- Po-210 source on silver target.



## Alpha emission spectra measured with a silicon surface barrier detector





#### **Environmental samples**

...for studying detection limits of the optical detection setup(s)



**EURAME** 



Preparation for measurement campaign using UAVs and laboratory scale systems for low-activity sample characterization







## Laboratory scale systems for low-activity sample characterization



Laboratory scale radioluminescence detector based on a 3 UV-PMT coincidence technique system developed by IFIN-HH, LMRI

Provide metrology services to third parties such as: measuring low active alpha samples and in the production process of specific radioactive alpha standard sources (traceability purposes).

IFIN-HH: Andrei Antohe, Mastaneh Zadehrafi, Mihail-Razvan Ioan







## **RemoteALPHA workshop** 16. February 2022, online

#### Registration

https://forms.gle/HyiyoWwGsWNYqPo58

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Thank you! on behalf of RemoteALPHA consortium.

BUDAPEST FOVAROS

KORMÁNYHIVATALA

EURAME RemoteALPHA online workshop on 16 February 2022 Registration form In Google anmelden, um den Fortschritt zu speichern. Weitere Informationer \* Erforderlich First Name Meine Antwort Last Name Meine Antwort Email <sup>1</sup> Meine Antwort Organisation Meine Antwort Phone Number Meine Antwort Address Meine Antwort SZENT ISTVÁN UNIVERSITAT POLITÈCNICA UNIVERSITY **DE CATALUNYA** Tampere University

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F. Krasniqi, EURAMET TC-IR AM 2022, 27.01.2022

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