

19ENV02 RemoteALPHA

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

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19ENV02 RemoteALPHA denotes the EMPIR project reference.



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

RemoteALPHA: 01.09.2020 - 31.08.2023

EMPIR =
European
Metrology
Programme for
Innovation and
Research

Partners



BUDAPEST FŐVÁROS
KORMÁNYHIVATALA



Alfa Rift Oy



Motivation: Emergency Response Plans

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

Article 97

Emergency Management System

Article 98

Emergency Preparedness

Article 99

International Cooperation

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RemoteALPHA fills the gap

Alpha Particles. Close Proximity Detection

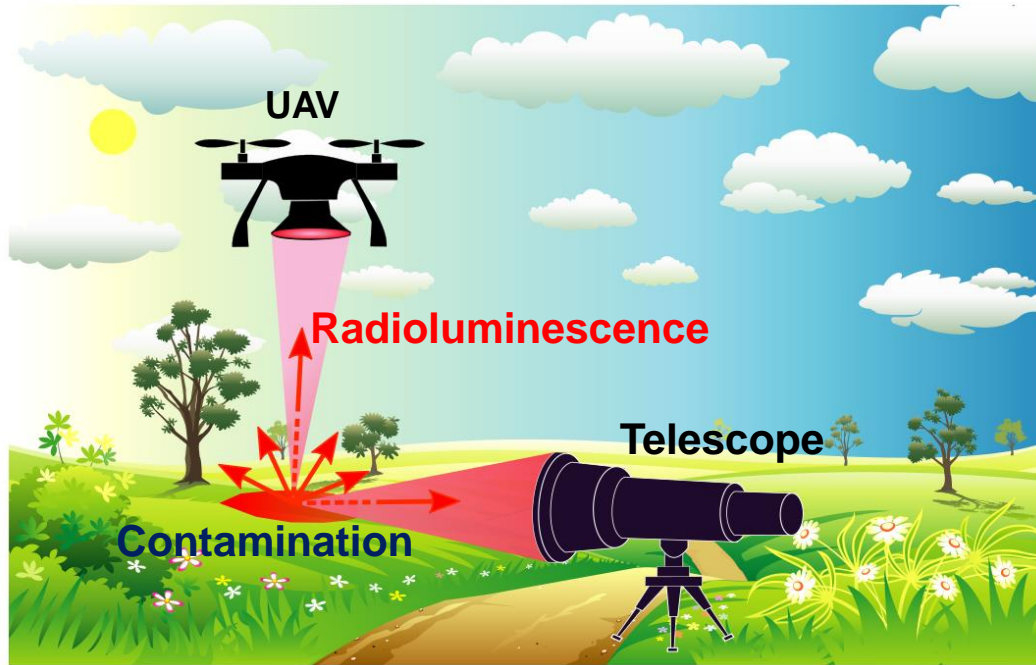


<http://www.argonelectronics.com/blog/the-value-of-applied-learning-for-radiation-safety-training>

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.).**

Motivation: Remote detection of alpha particles



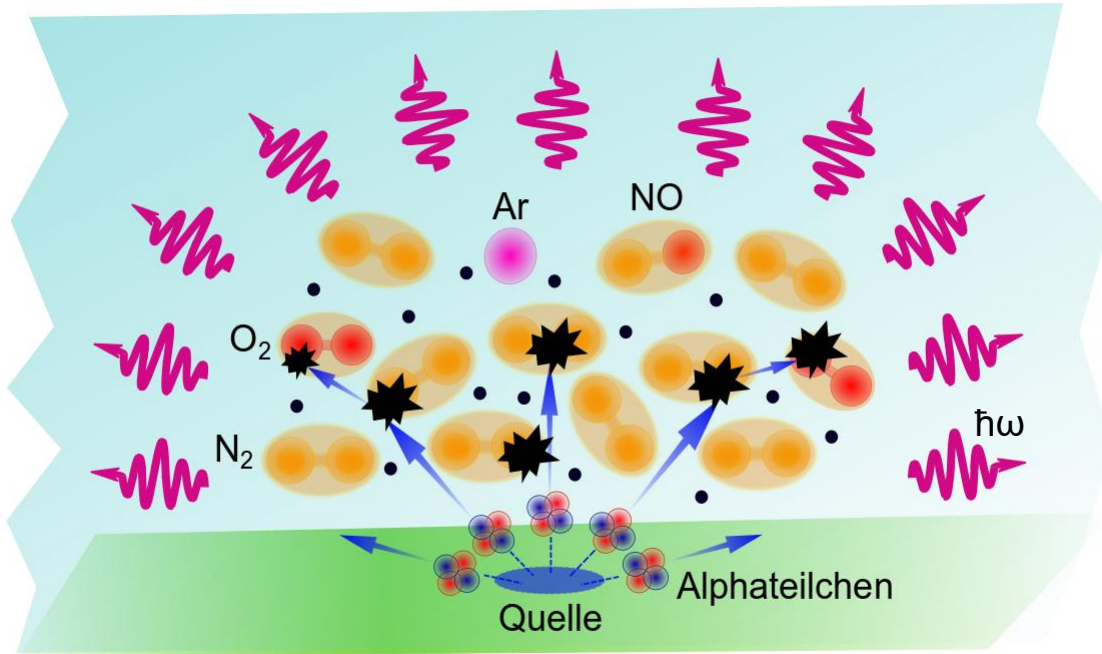
Concept of remote detection of alpha particles.

Radioluminescence → atmosphere (air) is used as a scintillating medium

Advantages:

- Operators are kept out of the radiation field,
- Efficient scanning of large areas.

Radioluminescence at a glance



Schematic representation of air ionization by α -particles and radioluminescence.

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

Range in air:

α -particles	→	0,04 m
UV light	→	500 m

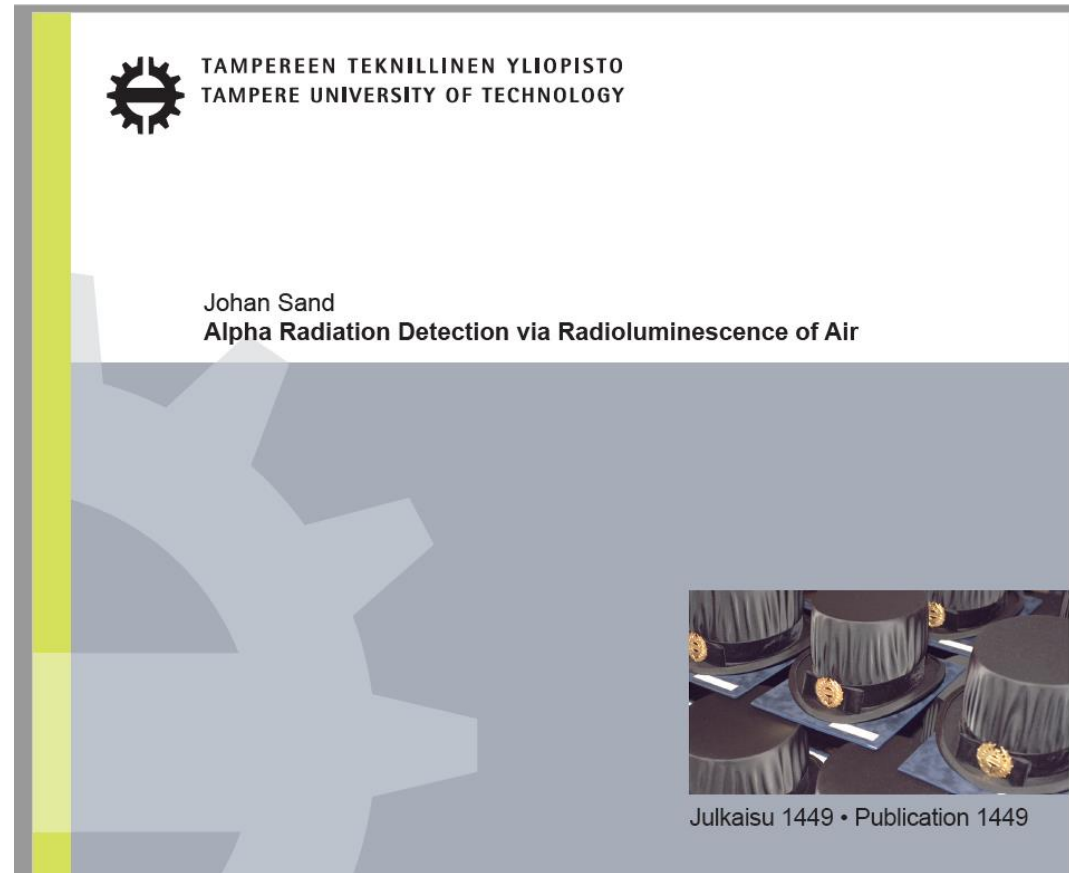
Optical detection of alpha particles

Johan Sand (2016)

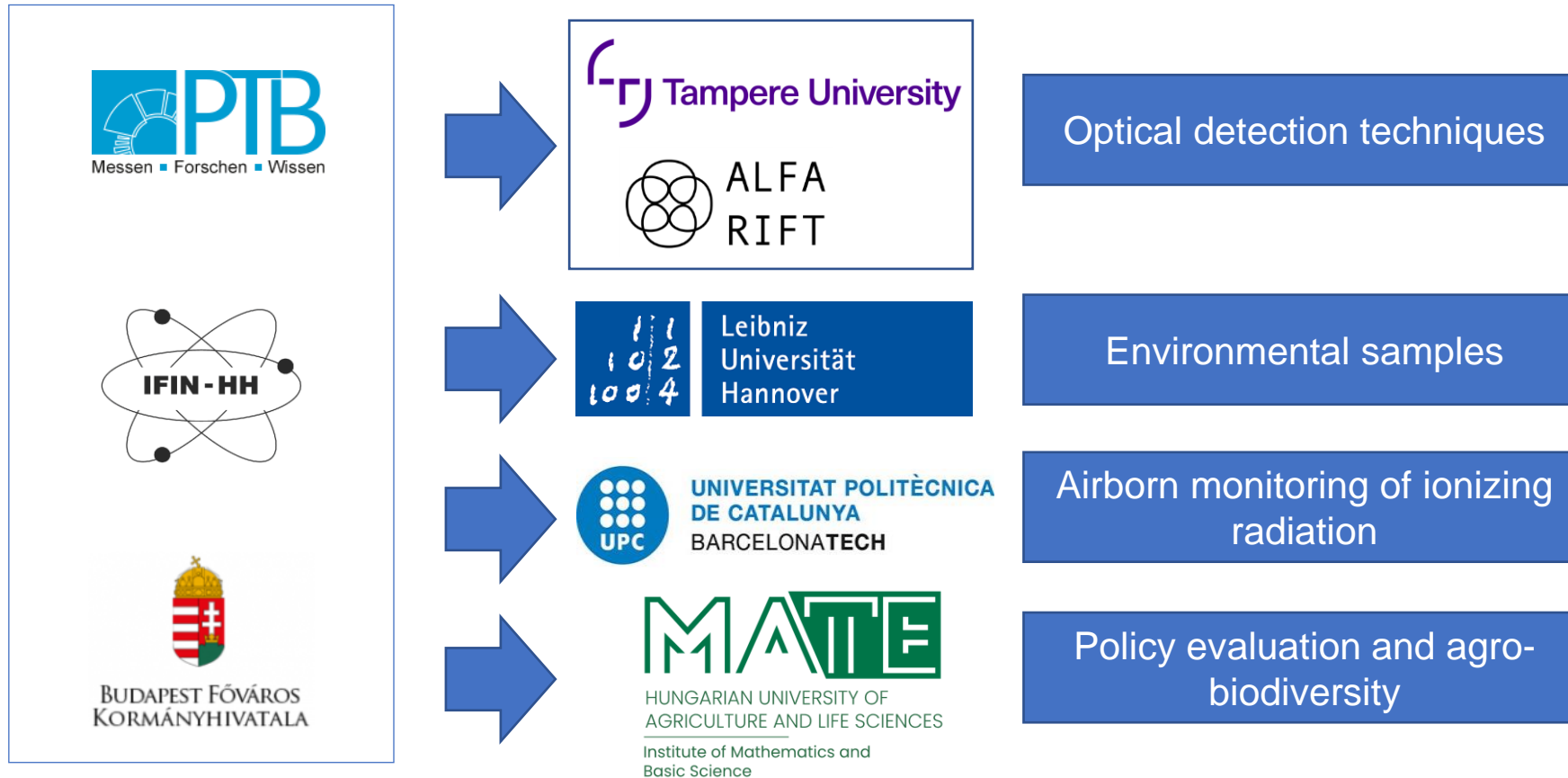
PhD Thesis

Alpha Radiation Detection via
Radioluminescence of Air

<https://trepo.tuni.fi//handle/10024/114881>



Setting up RemoteALPHA



WP1

New instruments for the optical detection of alpha emitters in the environment



UV fused silica lens system (UVFS)



Fresnel lens system

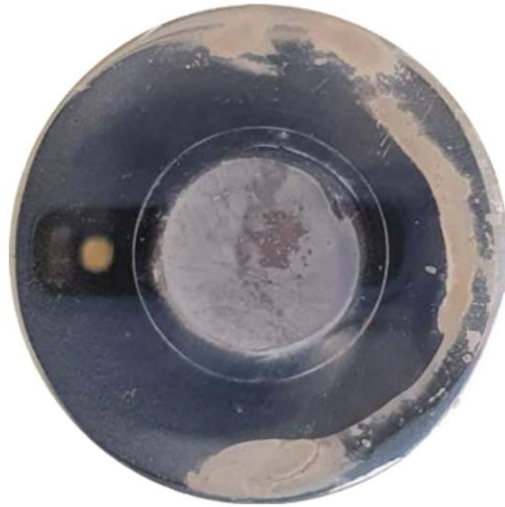


Modular mirror system

M. Luchkov *et al.*, Nucl. Instr. Meth. Phys. Res. A **1047**, 167895 (2023)

WP2

Calibration system for the novel radioluminescence detector systems

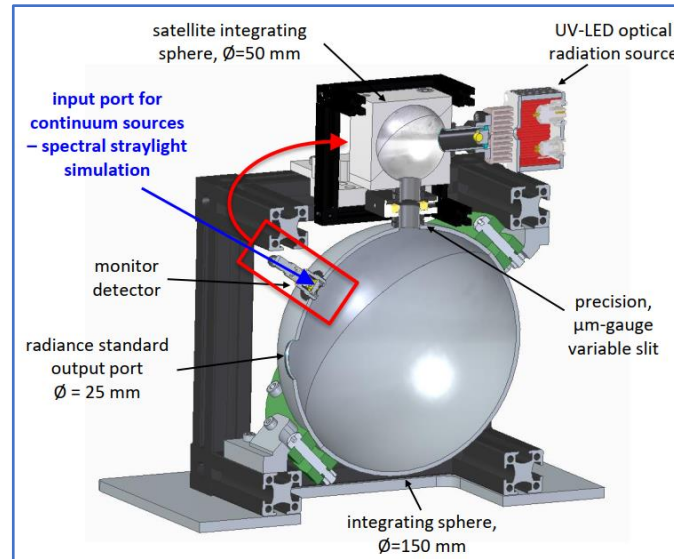


^{210}Po

Alpha activity standard

Traceable to national standard

Stefan Röttger @ PTB



Novel radiant standard

for radiometric characterization and SI-traceable calibration of optical detection systems

Dieter Taubert @ PTB

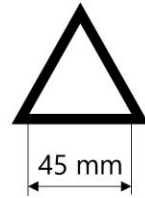
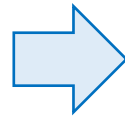
Determination of a traceable relationship between radioluminescence signal and alpha activity.

WP2

Calibration system for the novel radioluminescence detector systems

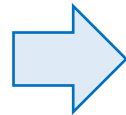
Americium-spiked environmental samples (leaves, sand, and soil)

Claudia Olaru @ IFIN-HH



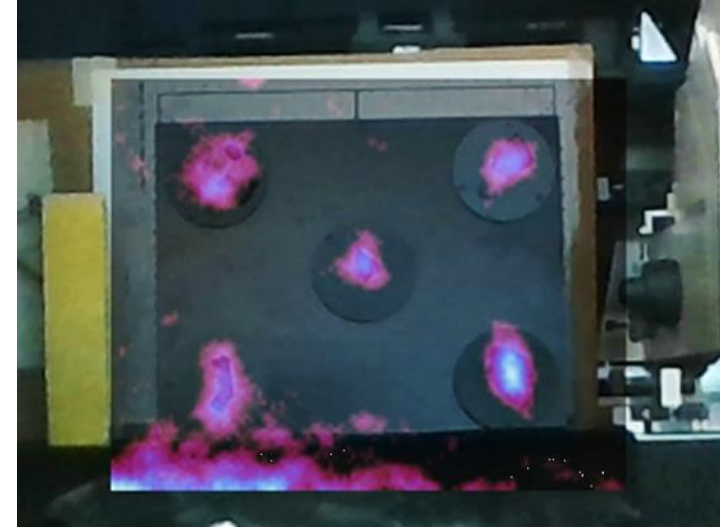
Americium-spiked concrete samples

Annika Klose @ LUH



Environmental standards
Pitchblende minerals

Annika Klose @ LUH



A. Klose *et al.*, J. Radioanal. Nucl. Chem. 331, 5401 (2022)

WP3

Mapping alpha contamination in the environment using UAVs

Extension of the optical detection system to allow imaging of alpha contamination in the environment.

UPC: Development of an unmanned airborne monitoring system (UAMS)

PTB: Fresnel-lens based radioluminescence detection system



Impact

- Novel technologies for government-led emergency management teams
- New calibration services for alpha-radioluminescence detection systems that to serve industry, especially nuclear safety sector
- Instrumentation and procedures to support national and international authorities to prevent illegal movement of alpha emitting materials for terroristic, political or illegal profit (illicit trafficking)

Thank You!

On behalf of RemoteALPHA consortium

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