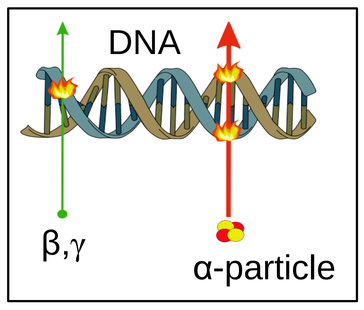
SRT-v09: Remote and real-time optical detection of alpha-emitting radionuclides in the environment

Need

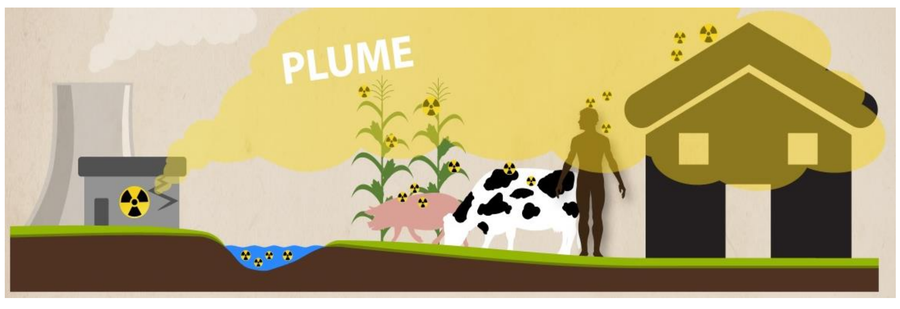
Quick and effective management of radiological emergencies

- Preparedness and response
- On-site incident management
- Creation of evacuation routes
- Guide emergency teams
- Support **Council Directive 2013/59/EURATOM**



Cellular damage from alpha particles: irreparable DNA double-strand breaks.

Detonation of a radiological dispersion device.



Radiological accident: contamination of people, buildings, food, water and livestock [After http://emergency.cdc.gov/radiation].

Current State of the Art

Image from: https://www.argonelectronics.com/blog/the-value-of-applied-learning-for-radiation-safety-training

Conventional detectors for alpha particles, in contrast to those for beta particles and gamma rays, must be positioned within a few centimeters of the source due to the short range of alpha particles in air.

Drawbacks

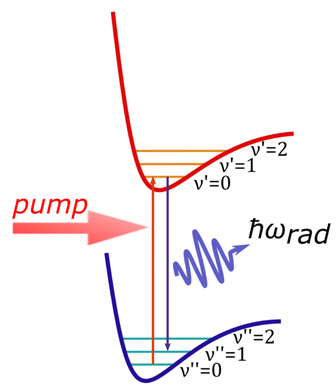
- Personnel exposed to hazards and risks;
- It is time consuming and tedious to scan large contaminated areas;
- Difficult to scan complex terrain geometries;
- Detectors may become contaminated;
- Real time and automated mapping of the contamination is very difficult, if not impossible.

Work package objectives

WP1	To develop a new method and instrumentation for the optical detection of alpha particle emitters in the environment by air radioluminescence
WP2	To develop and establish a calibration system for the novel-type radioluminescence detector systems
WP3	To extend the optical detection system to an imaging functionality for mapping of alpha contaminations in the environment
WP4	To prepare and run a feasibility study for a laser-induced fluorescence spectroscopic method for the detection of alpha emitters
WP5	**Impact:** To facilitate the take up of the results by stakeholders and provide input to relevant standardization bodies and radiation protection authorities

WP6: Coordination

Novel Techniques

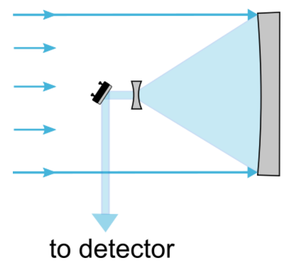


Spontaneous and laser-induced radioluminescence

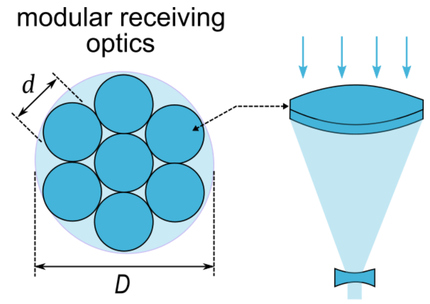
UV-AB (310-400 nm)
UVC (220-290 nm)

Optical systems

Newtonian-like telescope

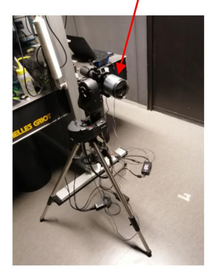


modular receiving optics

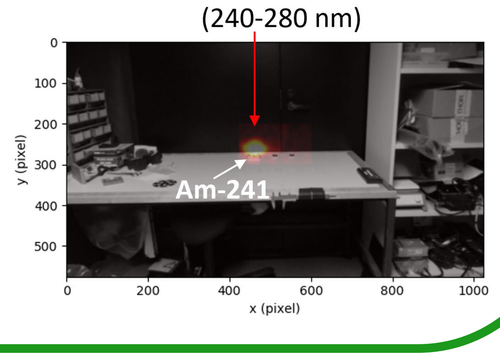


Preliminary tests

Galilean telescope

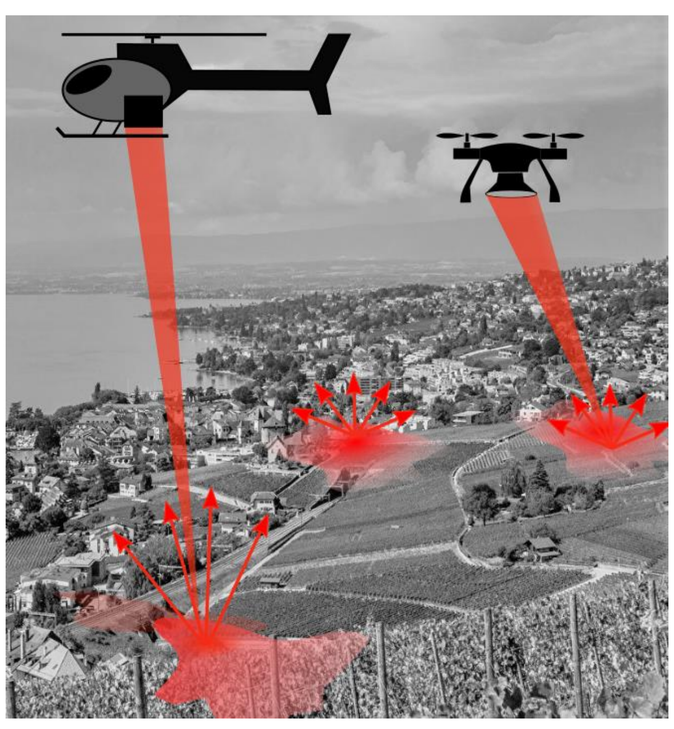


Radioluminescence signal (240-280 nm)



Progress Beyond the State of the Art

The scenario of a large-scale contamination of the environment with alpha emitters will become effectively manageable for the first time.



Environmental Impact

Real-time information on the location of the contamination source and its morphology;

Adequate countermeasures which lead to a better protection of both living beings and environment;

Dynamic reviewing of the response.

Socio-Economic Impact

Help authorities take immediate targeted action for the public protection;

Increase credibility and acceptance of reported radiological data by the public;

Reduce risks of exaggerated actions and preventable follow-up costs;

Minimize losses associated with the reputational damage.

Scientific, Metrological and Technological Excellence

- Development of novel instrumentation and measurement techniques
- Establish SI traceable calibration procedures, new and specific calibration schemes and novel portable calibration standards
- Creation of new metrological infrastructure
- Develop unmanned airborne monitoring systems (UAMS) that enable automated scanning and imaging of large contaminated areas
- Active laser probing of the contaminated area--Feasibility of a LIDAR type detection system

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Collaborators: Australian Nuclear Science and Technology Organisation (ANSTO), Sofia University "St. Kliment Ohridski"