

# Development of a mobile radiation detection system based on plastic scintillators with SiPM sensors

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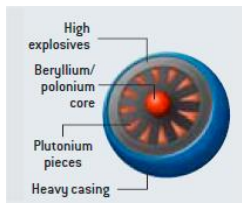
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Prof. Alberto Vale, IPFN

## Problem/motivation:

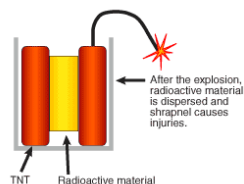
Illicit traffic of Special Nuclear Materials (SNM) and Radioactive materials

Incident and trafficking database (1993-2022):  
**4075** incidents (source: IAEA)

Improvised Nuclear Device  
(plutonium, uranium)



Radiological Dispersal Devices



**Gamma, beta, alpha, and neutron sources**

Radioisotopes used in medicine, industry, research

More than 80% WORLD TRADE IS performed BY SEA  
**Only a SMALL FRACTION** of the cargo IS INSPECTED

**Large and expensive** Radiation Portal Monitors (RPMs)  
Seaports, Land borders and airports - NOT WIDESPREAD

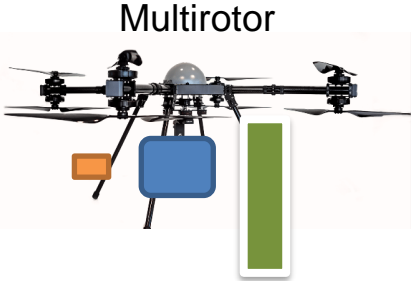


## Goal:

Find an alternative or complement to RPMs and handheld equipment:

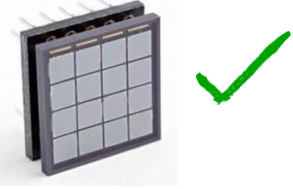
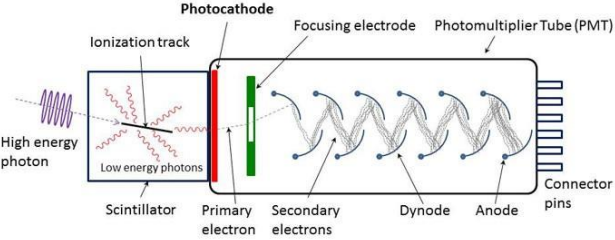
- Low-cost, lightweight, compact, and low power consumption

# Proposed radiation detection system

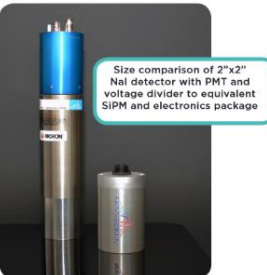


**Semiconductors**  
**Inorganic scintillators**  
**Plastic scintillator** ✓  
**+ Photosensor?**

## Photomultiplier tube (PMT) vs Silicon photomultiplier (SiPM)



Light Sensor	PMT	SiPM
Size	Big	Small
Bias voltage	High	Low
Power consumption	High	Low
Sensitivity to microphonics	No	No
Magnetic field	Yes	No



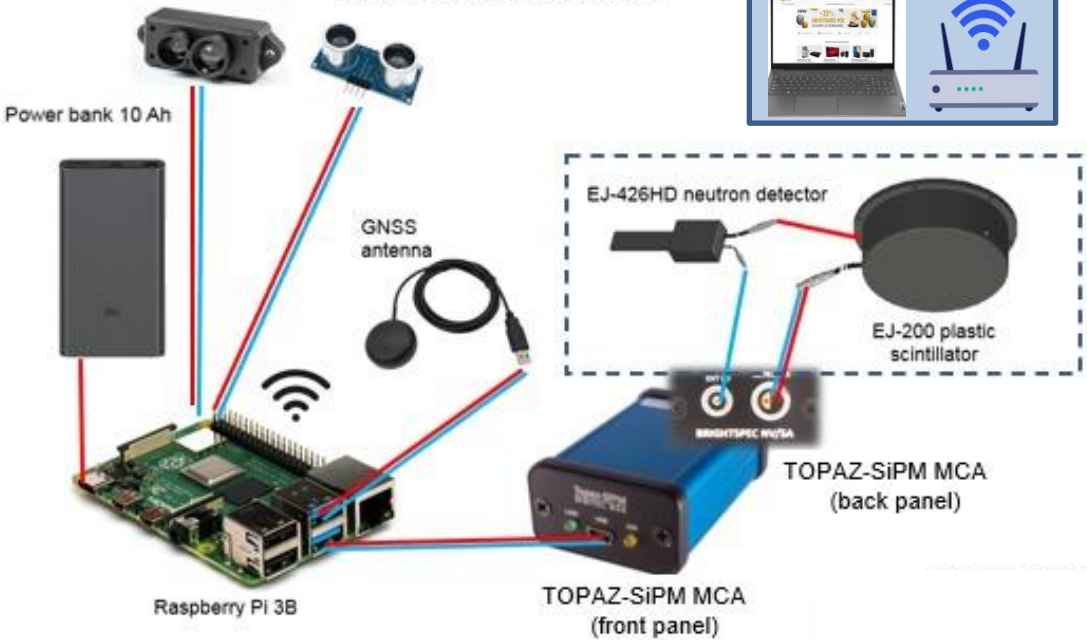
Source: Saint Gobain



TFmini-S LiDAR

HC-SR04 sensor ultra sons

Remote access

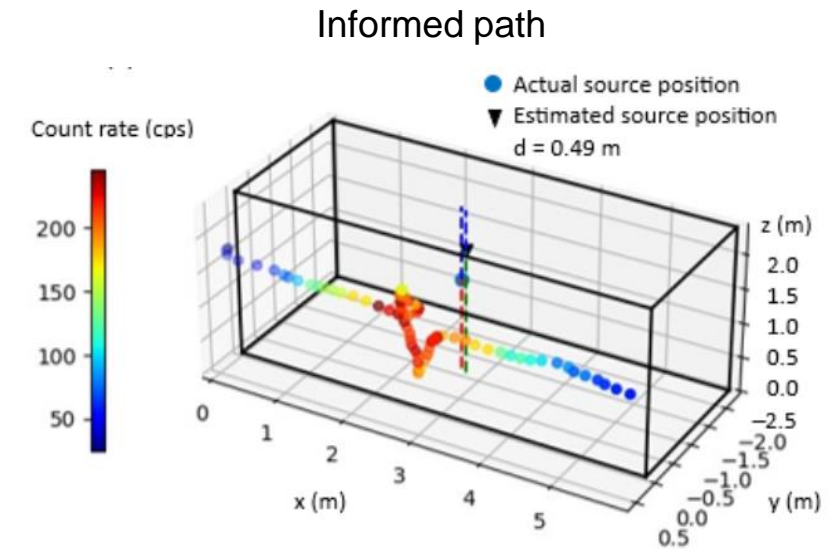
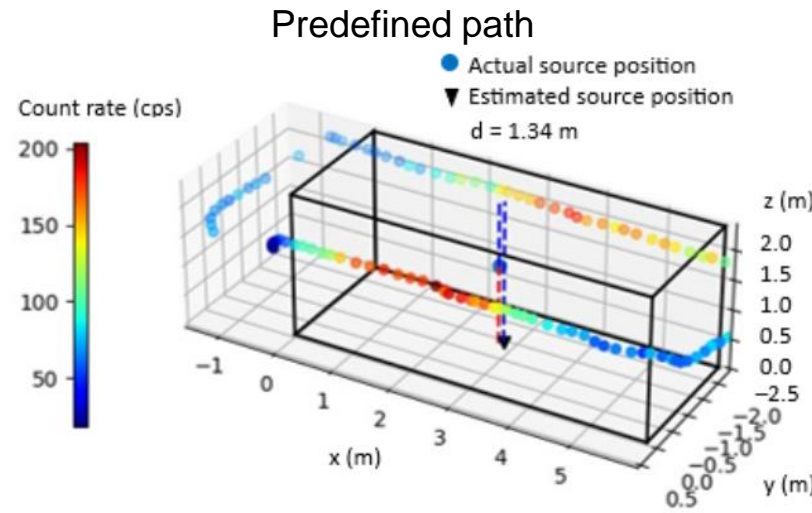


# Results / Conclusion:

- Developed mobile radiation detection system:
  - Best efficiency per weight
  - Low cos, lightweight and compact
  - Low power consumption
  - **Easy replication (e.g. fleet of drones)****Autonomous inspections/monitoring**



- **Accurate source localization**
  - **Real-time measurements**
  - Iterative maximum likelihood algorithm
  - **Source position estimation at each second**
- **Application:**
  - ✓ **Security and Safety** scenarios (e.g. nuclear facilities inspection and radiological and nuclear emergencies)



**Thank you for your attention!**