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Contamination Tests of New Silicone-Based Detectors for Beta-Alpha Radiation in Water

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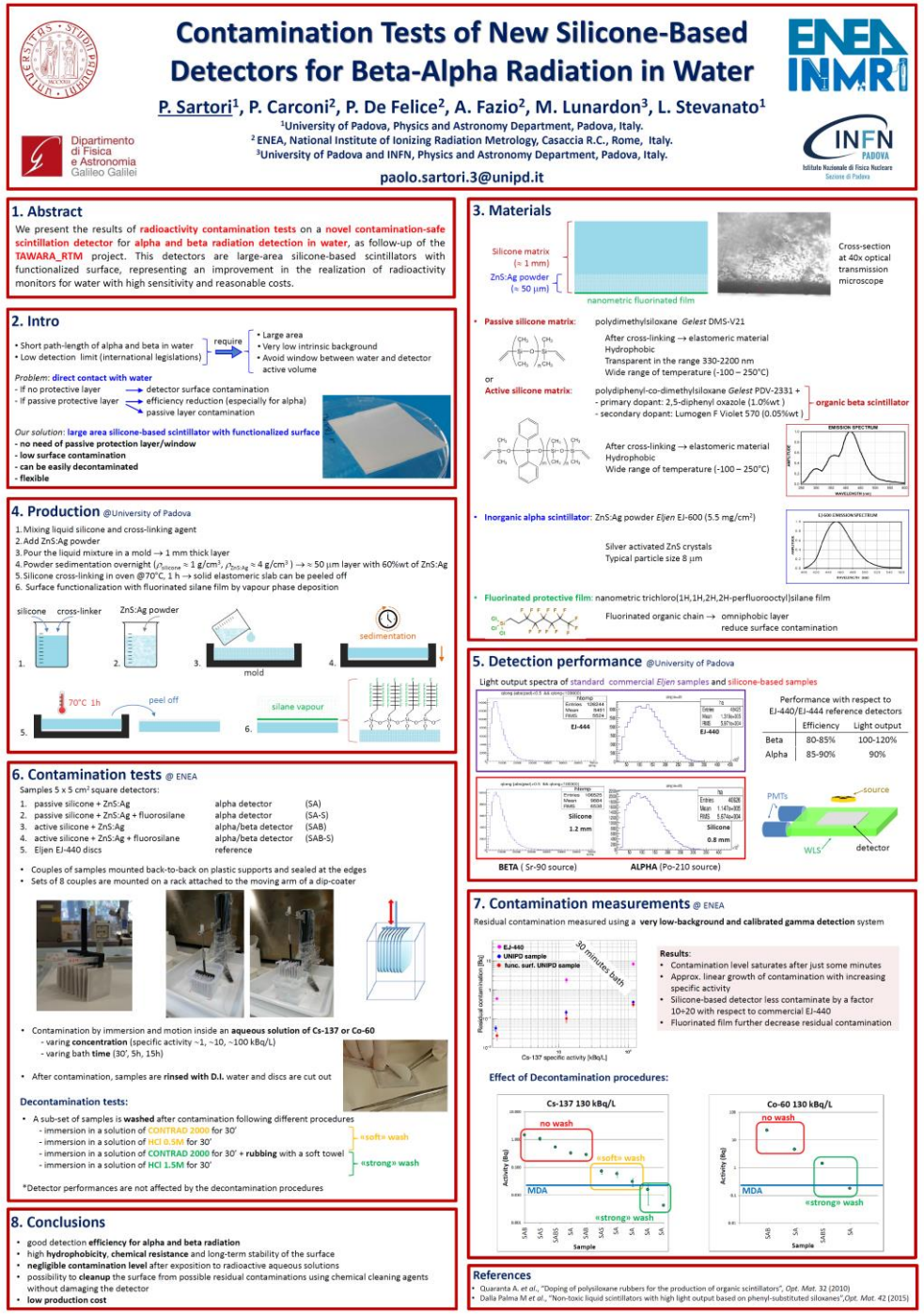


Radioactivity contamination tests on a **novel contamination-safe scintillation detector** for **alpha and beta radiation detection in water**, as follow-up of the **TAWARA_RTM** project.

Detectors are large-area **silicone-based scintillators** with **functionalized surface**, representing an improvement in the realization of radioactivity monitors for water with **high sensitivity and reasonable costs**.

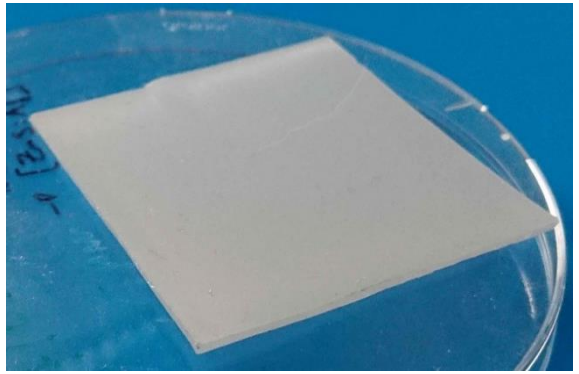
- Short path-length of alpha and beta in water
- Low detection limit (international legislations)

require →

- Large area
- Very low intrinsic background
- Avoid window between water and detector active volume

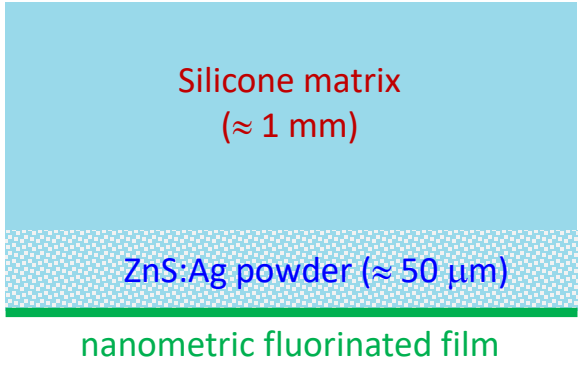
Problem: **direct contact with water**

- If no protective layer/window → detector surface contamination
- If passive protective layer/window → efficiency reduction (especially for alpha)
  passive layer contamination



Our solution: **silicone-based scintillator with functionalized surface**

- **no need of passive protection layer/window**
- **low surface contamination**
- **can be easily decontaminated**
- flexible **elastomeric** material
- good **detection performances**
- **resonable cost**



Silicone rubber matrix: Polydimethylsiloxane (passive)
Polydiphenil-dimethylsiloxane (beta scintillator)

ZnS:Ag powder: 50 μm layer of alpha scintillator powder mixed with silicone (alpha scintillator)

Fluorosilane layer: nanometric protective fluorinated layer - hydrophobic

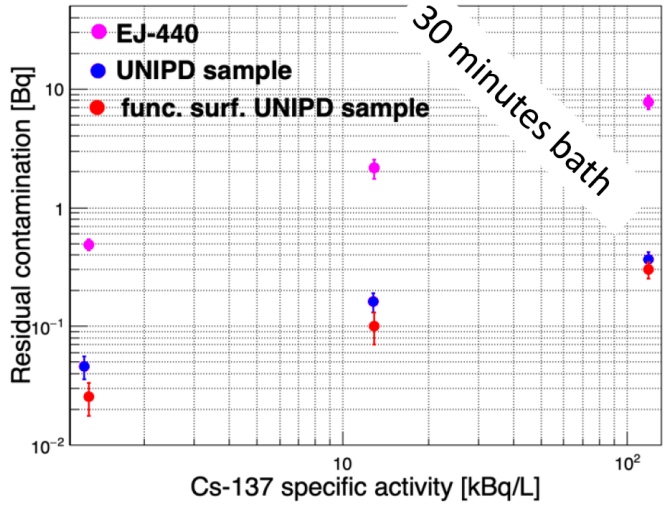
Silicone-based detectors **performance** with respect to **EJ-440/EJ-444 reference** detectors

	Efficiency	Light output
Beta	80-85%	100-120%
Alpha	85-90%	90%

Contamination tests

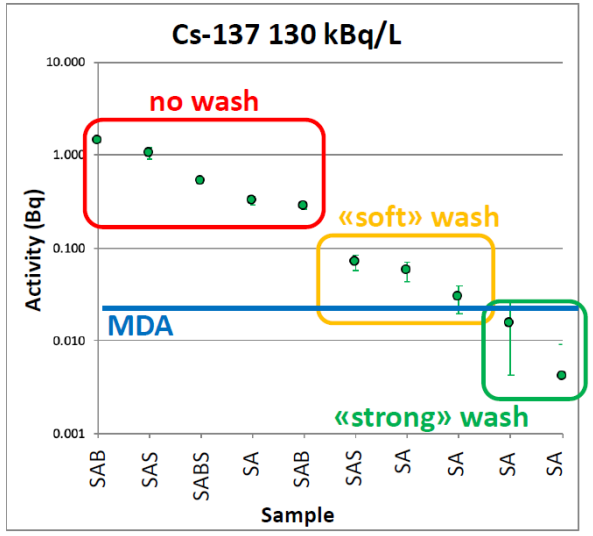
immersion in aqueous solution of Cs-137 or Co-60
- varying concentration
- varying immersion time

Silicone-based detectors are ~10 times **less contaminated**
Surf. functionalization **further reduces contamination**



Decontamination tests

washing after contamination following different procedures:
- solution of **CONTRAD 2000** for 30'
- solution of **HCl 0.5M** for 30'
- solution of **CONTRAD 2000** for 30' + **rubbing**
- immersion in a solution of **HCl 1.5M** for 30'



Residual activity can be **reduced** by **washing** procedure with **no loss in performance**