

# Silicon Carbide (SiC) dosimeter for gamma and conventional radiotherapy

N.S. Martorana

Pillar Health – Spoke 5/WP 4

## SAMOTHRACE 2<sup>nd</sup> Year: Experimental Prototypes Demo Showcase

SAMOTHRACE PROJECT ECS00000022

March 10th 2025



Finanziato  
dall'Unione europea  
NextGenerationEU

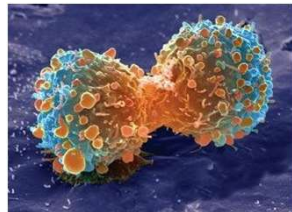


Ministero  
dell'Università  
e della Ricerca

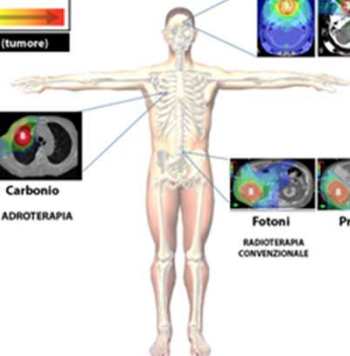
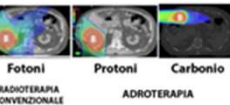
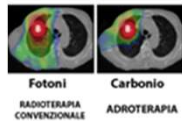
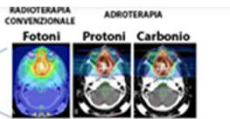
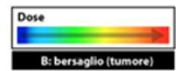


Italiadomani  
PIANO NAZIONALE  
DI RIPRESA E RESILIENZA

## THE PROBLEM TO BE SOLVED



- ✓ Hadrontherapy
- ✓ Diagnostics: dosimetry

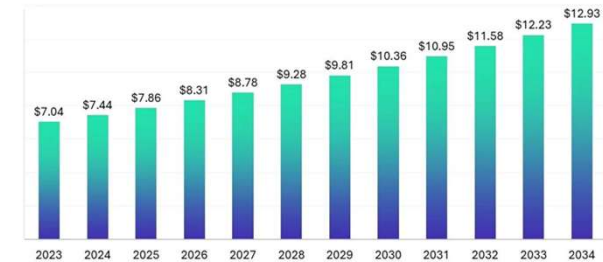


Flash diamond detector



<https://www.ptwdosimetry.com/en/radiation-therapy/categories/detectors>

**Towards Healthcare** Radiation Therapy Market Size 2023 to 2034 (USD Billion)



Source: <https://www.towardshealthcare.com>

- ✓ Tissue equivalence
- ✓ Dose-independence
- ✓ Accuracy and Sensitivity
- ✓ Cheaper solutions
- ✓ Wearable dosimeters

The problem: cancer treatment

Target: from research to patients

Global market and challenges



Finanziato dall'Unione europea  
NextGenerationEU



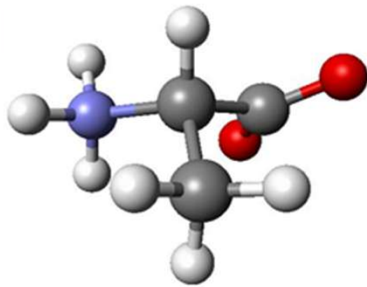
Ministero dell'Università e della Ricerca



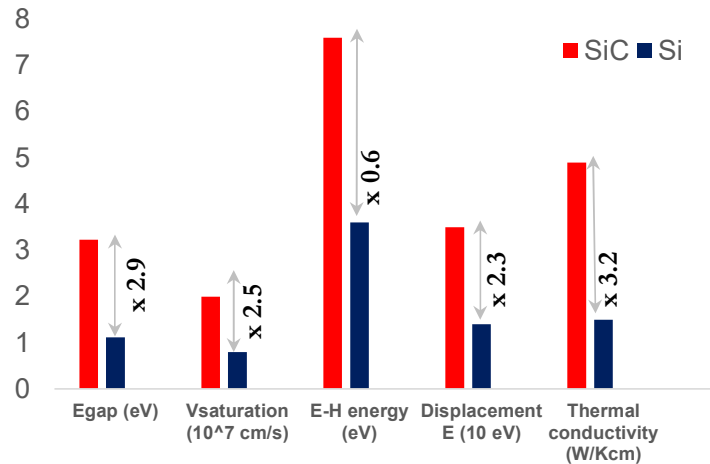
Italiadomani  
PIANO NAZIONALE DI RIPRESA E RESILIENZA

## The solution → SiC as dosimeter

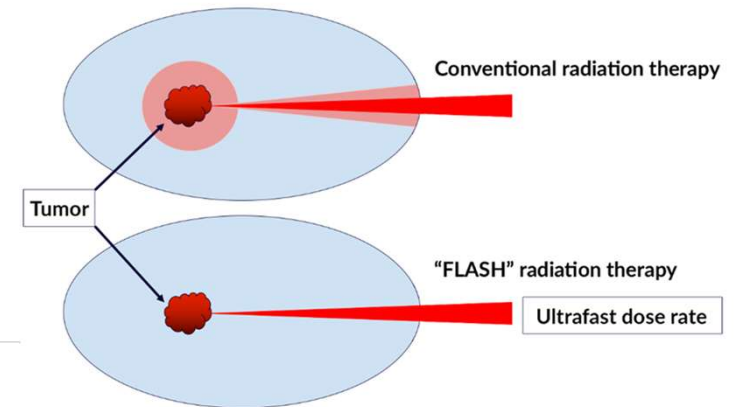
Active detector → provide real time dose measurement much faster and sure than alanine passive detectors



Advantages with respect to Diamond and Silicon dosimeter



FLASH radiotherapy: a promising cancer treatment modality under development



Finanziato dall'Unione europea  
NextGenerationEU

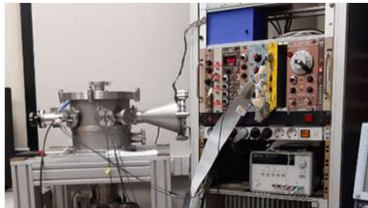


Ministero dell'Università e della Ricerca



Italiadomani  
PIANO NAZIONALE DI RIPRESA E RESILIENZA

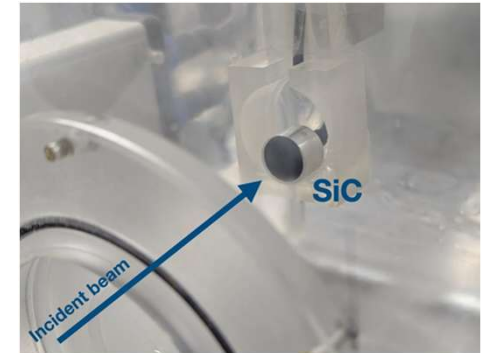
## DEVELOPMENT PLAN UNDER SAMOTHRACE ECOSYSTEM: 3 different partners in synergy: INFN (CT, LNS), UNICT, UNIPA



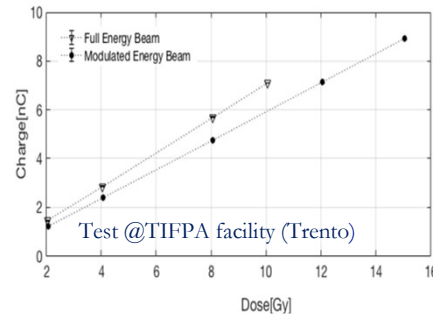
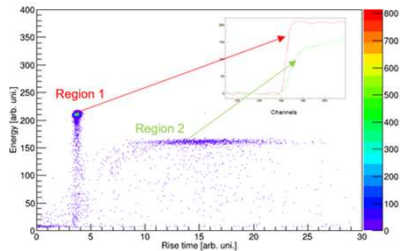
The SiC 25 mm<sup>2</sup>-10 μm prototype



Irradiation field: 5mm in diameter  
Energy: 250 MeV proton beam  
Monochromatic beam  
Beam Current: 10<sup>6</sup>-10<sup>8</sup> p/cm<sup>2</sup>



The encapsulated dosimeter positioned inside the water phantom enables accurate dose distribution measurements



Starting point: TRL 2  
Characterization, simulations, tests

Current point: TRL 4  
Engineering work for the encapsulation and resin coating of the prototype

Next future: TRL 6  
assess the dosimeter's performance in clinical approach



Finanziato dall'Unione europea  
NextGenerationEU



Ministero dell'Università e della Ricerca

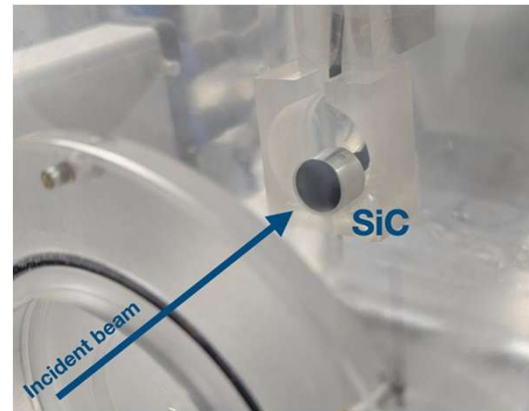


Italiadomani  
PIANO NAZIONALE DI RIPRESA E RESILIENZA

## NEXT STEP UNDER SAMOTHRACE ECOSYSTEM

### Next future: the dosimeter assessment performance

- ✓ Dose measurements with X ray
- ✓ Dose measurements with charged particles
- ✓ Comparison with standard alanine detector



TRL@ $t_0$	Current TRL	Final TRL
2	4	6



Finanziato dall'Unione europea  
NextGenerationEU



Ministero dell'Università e della Ricerca



Italiadomani  
PIANO NAZIONALE DI RIPRESA E RESILIENZA



[www.samothrace.eu](http://www.samothrace.eu)



# THANK YOU

## VISIT OUR DEMO AT BOOTH N. 36

**SiC dosimeter for gamma and conventional radiotherapy**

INFN-CT - SPOKE 5 INFN  
 INFN-LNS - SPOKE 5 INFN  
 INFN-LNS - SPOKE 5 INFN

**INTRODUCTION**

The development of a **silicon Carbide (SiC) dosimeter** represents a significant advancement in radiation monitoring, offering superior performance, high radiation hardness, and high thermal stability, making it ideal for reliable and accurate dose measurements. These characteristics ensure accurate performance even with emerging radiation therapy techniques, such as **FLASH therapy**. SiC-based dosimeters are particularly well-suited for **hadrontherapy** as advanced sensors measure the ion-charged particles like protons and carbon ions. Hadron therapy allows for precise dose distribution, reducing damage to surrounding healthy tissues compared to conventional radiotherapy with gamma rays. A wearable SiC dosimeter provides precise dose delivery, enhancing treatment effectiveness and improving patient safety.

**CONCLUSIONS**

The Silicon Carbide (SiC) dosimeter has been successfully implemented and integrated in a dedicated support, work on the device creating an ongoing research initiative during the dose measurements. The implementation enhances durability and enables accurate measurements over various experimental and medical settings, making it a viable solution for real-time radiation monitoring. Future work will focus on miniaturization, integration with wireless systems, and validation through clinical trials. The next step involves testing with **charged particle beams** and steps to assess the dosimeter's performance under different radiation types. Additionally, a thorough comparison with **standard dosimeter** devices will be conducted to benchmark its accuracy and reliability against existing standards. Successful validation will confirm the potential of the SiC dosimeter for advanced cancer treatment techniques, such as **hadrontherapy**, where precise dose monitoring is critical for optimizing therapeutic outcomes and enhancing patient safety.



Finanziato dall'Unione europea  
NextGenerationEU



Ministero dell'Università e della Ricerca



Italiadomani  
PIANO NAZIONALE DI RIPRESA E RESILIENZA