

# FRIDA

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Responsabile Nazionale: Alessio Sarti

Responsabile Locale: G.A. Pablo Cirrone

**WP1: FLASH effects understanding**

G Forte (CNR-IBFM and LNS), E Scifoni (TIFPA)

Understanding the phenomena at chemical and biological level

**WP2: FLASH beam delivery**

GAP Cirrone (LNS), A Mostacci (RM1)

Implementing new solution to generate flash beam with conventional and laser-driven approaches

**WP3: FLASH beam monitoring and dosimetry**

G Bisogni (INFN-PI), A Vignati (INFN-TO)

Developing new approaches for the absolute dosimetry and the monitoring of these new beams

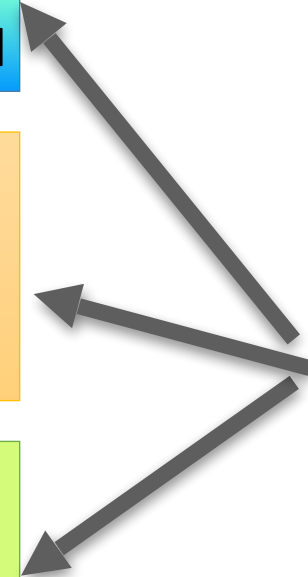
**WP4: FLASH Treatment planning**

A Schiavi (RM1), M Schwarz (TIFPA)

Implementing solutions for the FLASH-oriented treatment planning



Istituto Nazionale di Fisica Nucleare  
Laboratori Nazionali del Sud



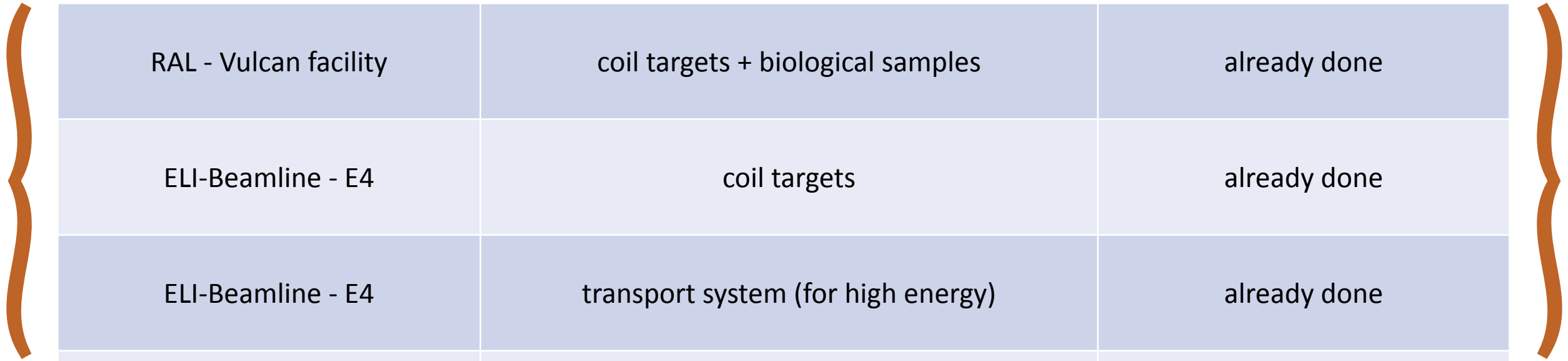
WP2

Laser-plasma acceleration  
&  
Beam delivery

C-band RF Pulse Compressor for the VHEE LINAC

# Attività svolta (LP)

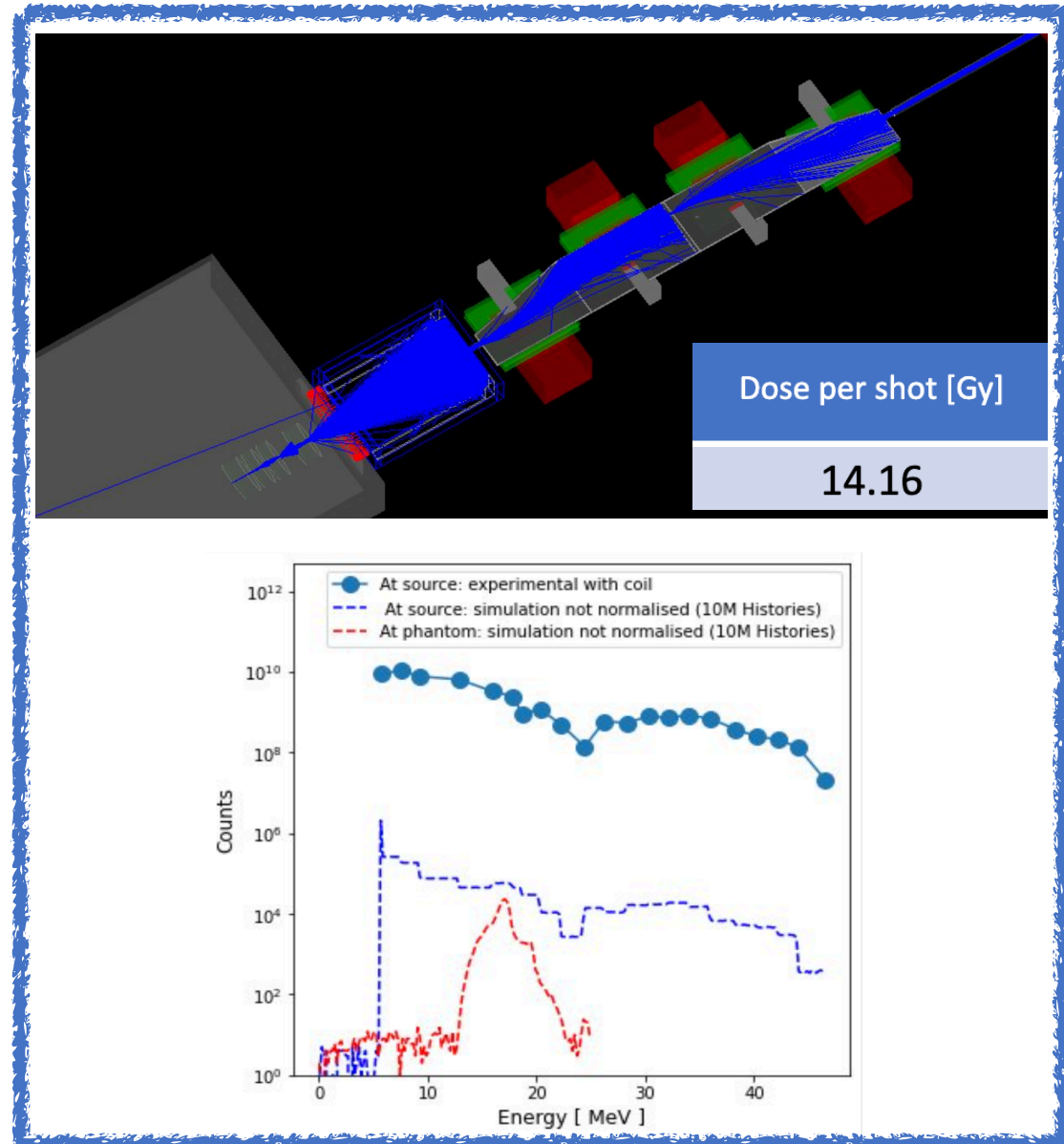
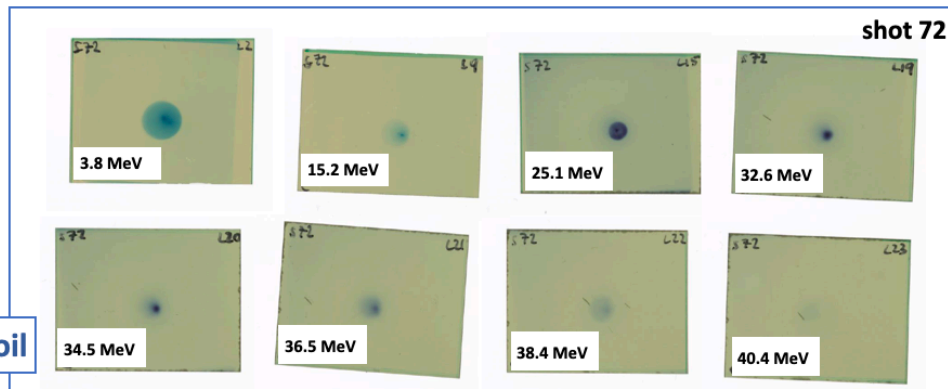
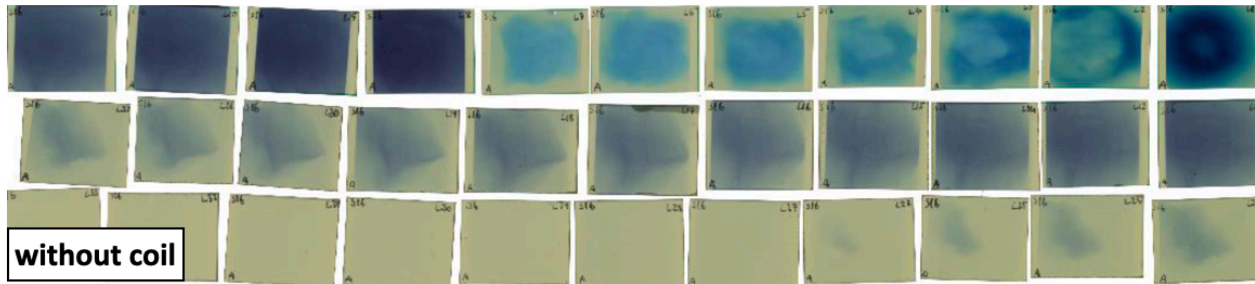
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RAL - Vulcan facility	coil targets + biological samples	already done
ELI-Beamline - E4	coil targets	already done
ELI-Beamline - E4	transport system (for high energy)	already done
ELI-Beamline - E4	coil targets + transport system (for high energy)	in plan
QUB - Taranis	coil targets + transport system (for low energy)	in plan

# Attività del 2024 (LP)

## Experimental test with coil targets @ELI-E4



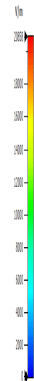
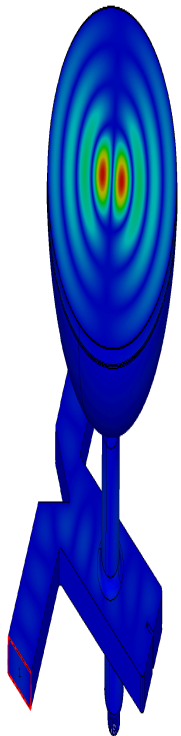
# Attività 2024 (BD)

SLED – modello finale completato

2024: disegno meccanico esecutivo completato

## Simulazioni RF

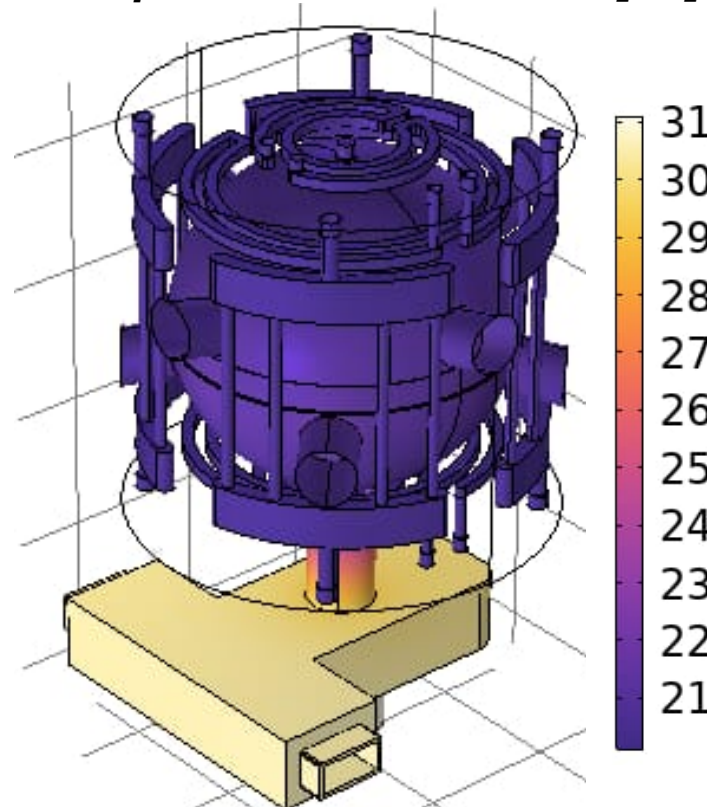
Created using  
SIMULIA CST Studio Suite®



Model (5-2024) 1  
Origin: Cube  
Component: Axis  
Frequency: 570 GHz  
Phase: 0°  
Excitation: A  
Copper: 1  
Copper: 1  
Material: Copper  
Material: Copper

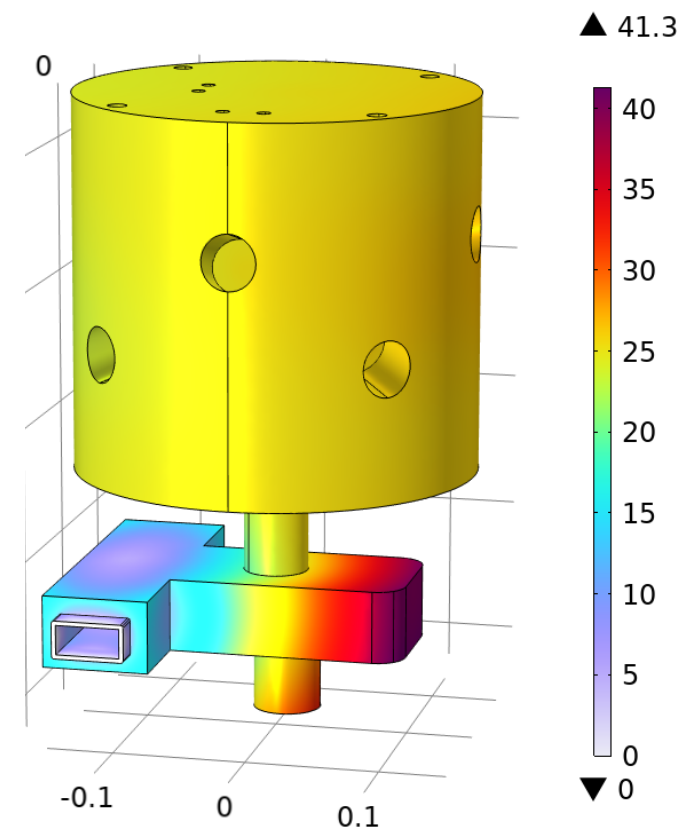
## Termiche

*temperature distribution [°C]*



## Strutturali

Volume: Displacement magnitude (μm)



# output scientifico (BD)

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**Deliverable: RF simulation Report  
(D18) [IPAC Proc. 2023]**

14th International Particle Accelerator Conference, Venice, Italy JACoW Publishing  
ISBN: 978-3-95450-231-8 ISSN: 2673-5490 doi: 10.18429/JACoW-IPAC2023-WEPA124

**RF DESIGN OF A COMPACT C-BAND RF PULSE COMPRESSOR FOR A  
VHEE LINAC FOR FLASH RADIOTHERAPY**

G. Torrissi<sup>\*</sup>, G. S. Mauro, G. Sorbello<sup>2</sup>, INFN-LNS, Catania, Italy  
L. Faillace, B. Spataro, INFN Laboratori Nazionali di Frascati, Italy  
L. Giuliano<sup>5</sup>, M. Migliorati<sup>5</sup>, A. Mostacci<sup>5</sup>, L. Palumbo<sup>5</sup>, SBAI, Sapienza University of Rome, Italy  
<sup>2</sup>also at University of Catania, Catania, Italy  
<sup>5</sup>also at INFN-Sezione di Roma, Italy

**LINAC2024 - 32nd Linear Accelerator Conference**

25–30 Aug 2024  
Hilton Chicago  
America/Chicago timezone

**Design and optimization of a C-band RF Pulse Compressor  
for a VHEE LINAC for FLASH Radiotherapy #418**

**Accepted** Giuseppe Torrissi submitted this abstract and it was finally accepted for track

*G. Torrissi, L. Faillace, L. Giuliano, G. S. Mauro, A. Mostacci, L. Palumbo, G. Sorbello, B. Spataro*

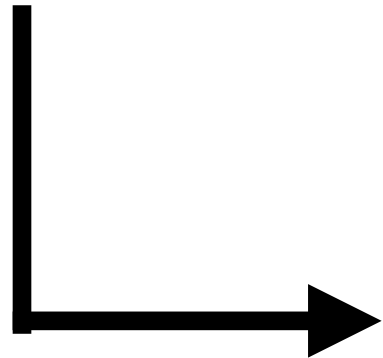
Potenziabile output scientifico

Articolo su Rivista (dopo manufacturing and test)

# Richiesta di prolungamento (LP)

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Milestones			
2024	M2.3.1.3	Experimental test in laser facilities and beam characterisation in this new laser-matter interaction scheme (M36)	30%



we have to perform the experimental run in the final configuration, including transport and selection system (in both high and low energy configuration)

**L'estensione di un anno di progetto consentirebbe di completare i test sperimentali in programma nelle due configurazioni high energy e low energy**



# Richiesta di prolungamento (BD)

D2.1.2	RF accelerating structure design	Design of the high gradient accelerating structure prototype	18
D2.2.1	RF compr. design	Design of the SLED RF pulse compressor.	18
D2.1.3	RF accel. structure manufacturing	Manufacturing high gradient accelerating prototype	24
D2.2.2	RF compressor manufacturing	Manufacturing of the pulse compressor prototype	24
D2.1.4	RF accelerating structure test	Low power RF tests of accelerating prototype	36
D2.2.3	RF compr. test	Low power RF tests of the SLED prototype	36

COMPLETE

Ordine avviato

inizio 2025

WP1

Flash effect understanding

# Richiesta di prolungamento

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## 2024- D.2.4 Radio consolidation and insight (24-36): current achievement 70%

The project extension is required for the following reasons:

### *Activities planned using the CPFR facility in PISA*

- Performing a second round of in vitro experiment on **MCF10A** and **MDA-MB-231** under *conv.* vs FLASH RT, to consolidate the survival curves (data analysis in progress).
- To finalize the gene expression profiling analysis of response induced by FLASH-RT vs conv irradiation (data elaboration in progress);
- To deepen the oxidative stress response induced by FLASH-RT vs conv irradiation (experimental set up performed and next experiment to be planned);

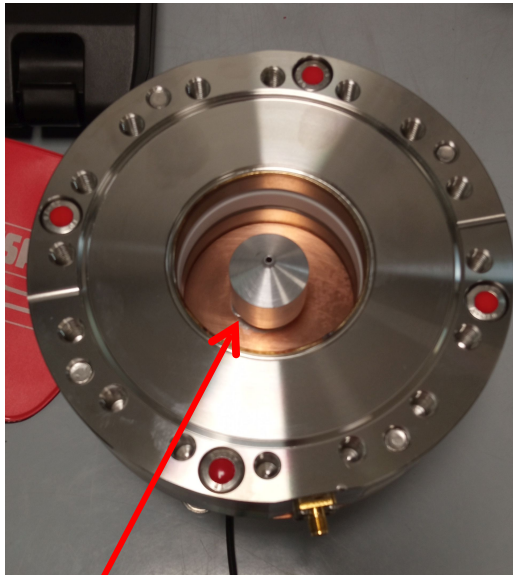
### *Activities planned using the PROTON FLASH facility in Trento*

- Performing a second round of Zebrafish embryos irradiation under FLASH-RT vs conv dose rate in combination with hypoxia to corroborate the results already collected and to perform gene expression analysis.

WP3

Flash beam monitoring and  
dosimetry

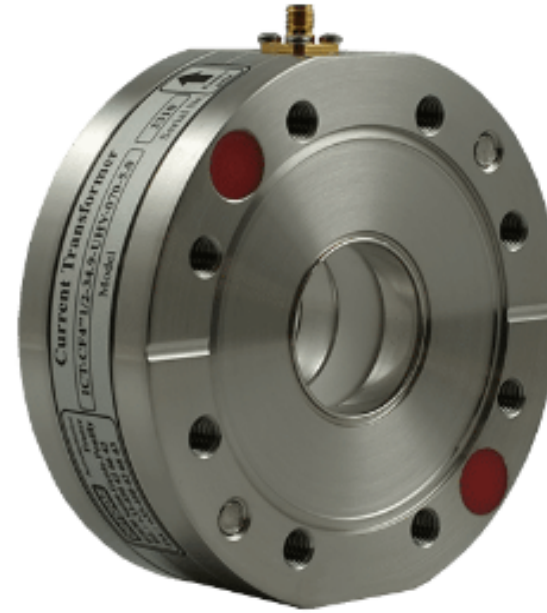
# Integreting Current Transformer



Capacitor to test the ICT with a pulser generator.



Configuration setup to test the ICT with the pulser



## ICT Bergoz CF6» 60.4-40-UHV-070-50-LD

ICT Integrating Current Transformer is a passive transformer designed to measure the charge of very short pulses with accuracy.

It is capable of integrating pulses with with a rise time down to femtoseconds with no significant loss.

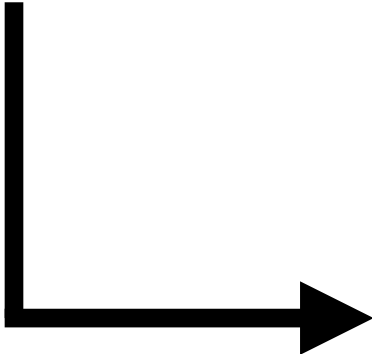
## Milestones

2024

D3.3.2

Beam monitoring and dosimetric systems prototypes  
commissionint

40%

- 
- We already performed the first experimental test with the complete dosimetric chain
  - The data analysis is currently ongoing
  - The next experimental test will be in November @ELI-Beamlines

**L'estensione di un anno di progetto consentirebbe di completare il task di  
intercomparison tra detectors**

Richieste

# Budget

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- 2 k€ missioni @LNF per misure SLED
- 6 k€ missioni @ELI-Beamlines per misure con coil target e sistema di trasporto high energy
- 2 k€ missioni @TARANIS per misure con coil target e sistema di trasporto low energy
- 5k€ missioni di radiobiologia a Pisa e Trento



# FTE

- G. Torrisi (0%\*)
- G. S. Mauro (5%)
- G: Sorbello (5%)
- M. Calvaruso (50%)
- F. Cammarata (10%)
- G. Forte (70%)
- L. Minafra (10%)
- V. Bravatà (50%)

\*valutare sinergia con PNRR

SEDE	NOMINATIVO	TIPO	CONTRATTO	QUALIFICA	RICERCATORI	TECNOLOGI	NOTE	
LNS	Bravatà Valentina	ASSOC	Scientifica Dipendenti altri...	Ricercatore Confer...	100			
	<b>Cagni Beatrice Maria</b>	⚠ ASSOC SCAD fino al 2023-01-01			20			
	Calvaruso Marco	▲ ASSOC	Scientifica Dipendenti altri...	Ricercatore A Temp...	30		scadenza contratto 2024-08-31	
	Cammarata Francesco Paolo	ASSOC	Scientifica Dipendenti altri...	Ricercatore Confer...	10			
	Catalano Roberto	DIP	Tecnologo	Tecnologo			% attiva dal 2024-03-01 ins. corso d'anno (2024-03-19)	
	Cirrone Giuseppe	DIP	Ricercatore	Primo D				
	Cuttone Giacomo	DIP	Ricercatore					
	<b>Falciglia Pietro Paolo</b>	⚠ ASSOC SCAD fino al 2023-12-31						
	Fattori Serena	DIP	Tec			0		
	<b>Ficarra Milene</b>	⚠ ASSOC			100			
	Forte Giusi Irma				70			
	Giuffrida Lorenzo			di Ricerca	30			
	Mauro Giorgio Sebastiano	DI		tecnologo		0		
	Mele Stefania	AS	altri...	Dirigente di Ricerca	50			
	Patti Iolanda Valeria	ASS	Altri Enti (laur...	Dirigente di Ricerca	50			
	Petringa Giada	DIP	tecnologo	Tecnologo		0		
	Rifuggiato Danilo	DIP	Tecnologo	Dirigente Tecnologo		10		
	Russo Giorgio	ASSOC	Scientifica Dipendenti altri...	Ricercatore Confer...	20			
	Sabini Maria Gabriella	ASSOC	Scientifica Dipendenti altri...	Dirigente di Ricerca	50			
	<b>Salamone Vincenzo</b>	⚠ ASSOC SCAD fino al 2023-12-31			10			
	Sorbello Gino	ASSOC	Incarico di Ricerca tecnolog...	Prof. Associato	10			
LNS (21 PERSONE - 6.16 FTE)					5.85 fte	16 pers.	0.31 fte	5 pers.
					6.16 fte / 21 pers. (media 0.29)			

To be defined

L'idea è di garantire circa 5 FTE

# DIODE

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Responsabile Nazionale: Claudio Verona

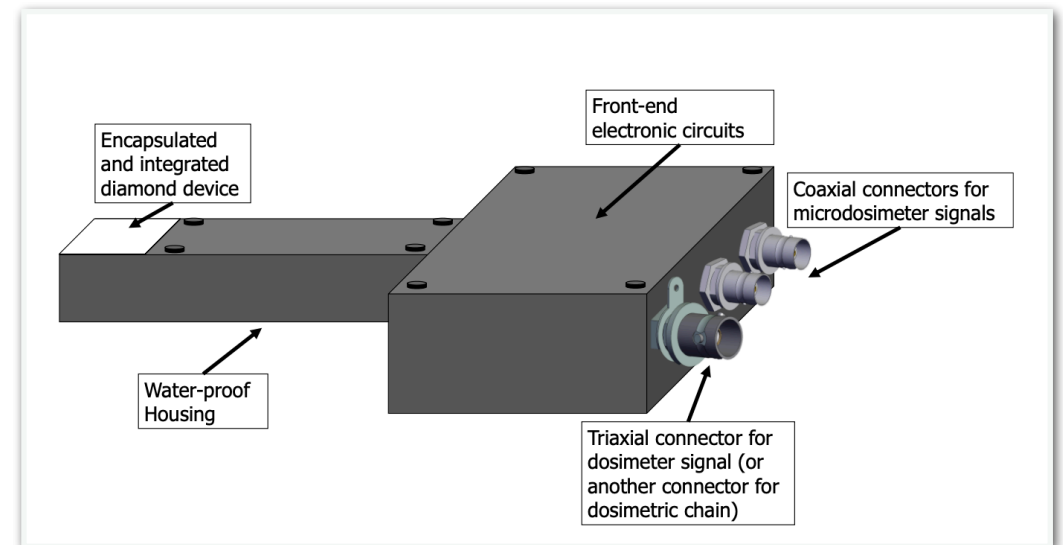
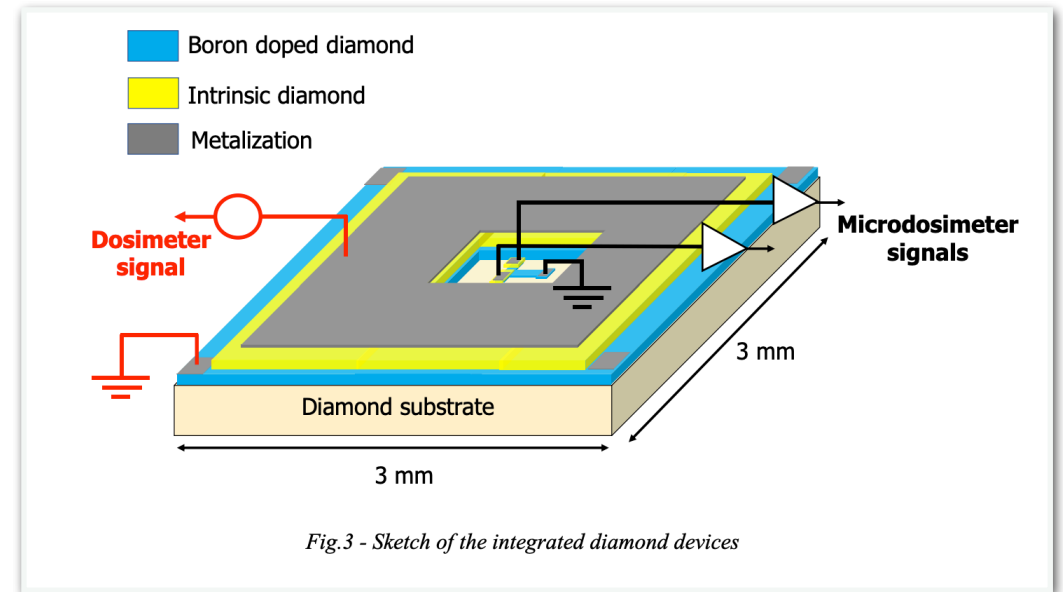
Responsabile Locale: Roberto Catalano

# Obiettivi generali

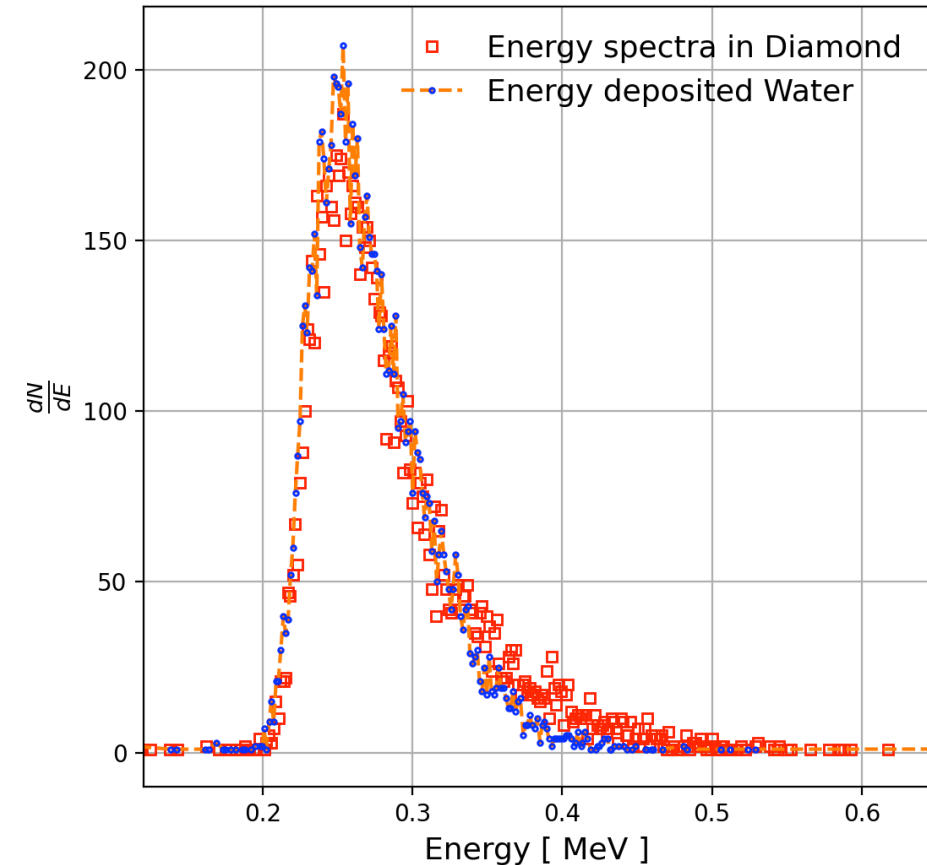
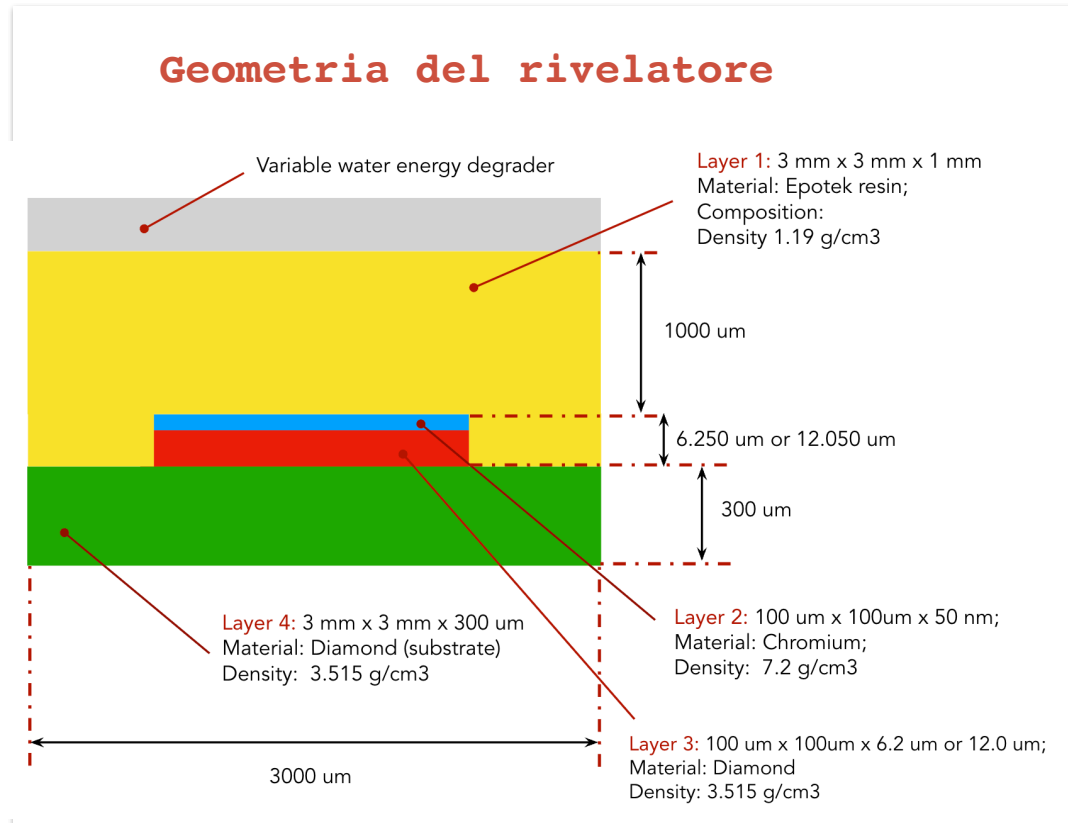
Development of methods to realize **different monolithic devices**, i.e. diamond dosimeter and few diamond microdosimeters, **on the same diamond substrate**, combining chemical vapour deposition and photolithography techniques.

Development of a novel, practical and compact detector and its **integrated electronic chain**, system based on synthetic single crystal diamond able **to perform simultaneously hadron therapy dosimetry and microdosimetry**

Development of dedicated **Monte Carlo simulations** to study the **microdosimetric response** under different conditions and to evaluate the effects of the secondaries.



# Attività



Turno sperimentale a Trento - fine Luglio 2024

- primo test con protoni sia per la parte dosimetrica che per quella microdosimetrica

# Attività

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**D.5 – Month 24:** Simulation of the beamline adopted for the experimental tests. The application will be included the LET calculation also. **40%**

**La geometria della beamline incluso l'algoritmo per il calcolo del LET è già esistente. Bisogna simulare l'esatta configurazione sperimentale che verrà adottata a Luglio (energie, distanze del detector dal punto di uscita del fascio in aria, etc..)**