



Istituto Nazionale di Fisica Nucleare

## Piano Triennale

2024 | 2026

Trieste

Stazione Marittima

27 | 28 giugno 2023

# INFN Life Science

Gaia Pupillo, LNL

Dolomiti e Baita Segantini, Passo Rolle

# Panoramica delle (tante!) iniziative

Intelligenza  
Artificiale

Rivelatori

Diagnosi

Terapia

Acronimi  
Tecnicismi  
Inglesismi..



.. anyway



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# Cosa vi descriverò..

- INFN for Life Science
- Attività INFN sulle Scienze della Vita finanziate da CSN5, CSN3 e PNRR:
  - ✓ Terapia
  - ✓ Diagnostica
  - ✓ Radionuclidi e radiofarmaci
  - ✓ Rivelatori per dosimetria ed imaging
  - ✓ Intelligenza artificiale per analisi immagini



Progetto PNRR:

SPOKE

PILOT

WP



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## INFN4LS INFN for Life Science

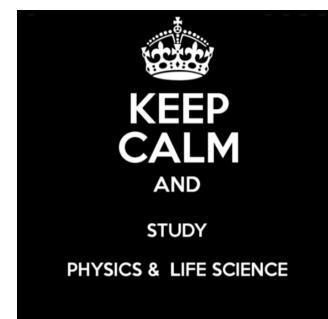


- **Ruolo importante di coordinamento per PNRR**
- **Creare una comunità INFN trasversale alle CSN e con forti connessioni cliniche**
- Promuovere attività e seminari (es. *Quantum Biology*, Silvia Pisano LNF)



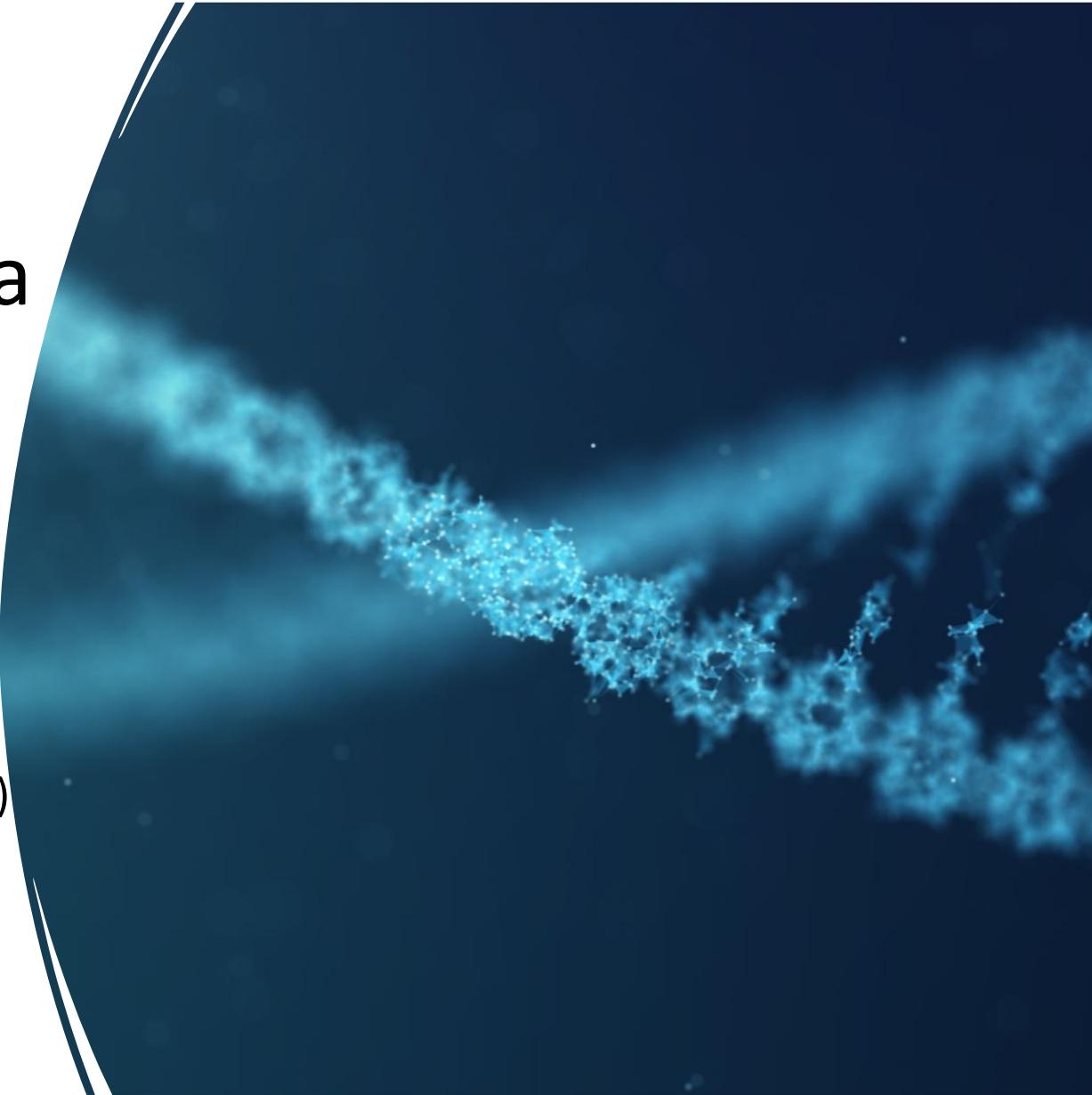
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Website: <http://web.infn.it/INFN4LS/>



# Applicazioni in terapia

- BNCT
- Flash therapy
- Hadrontherapy
- Infrastrutture di ricerca (TIFPA, CNAO)





Ministero  
dell'Università  
e della Ricerca



Italiadomani  
PIANO NAZIONALE  
DI RIPRESA E RESILIENZA

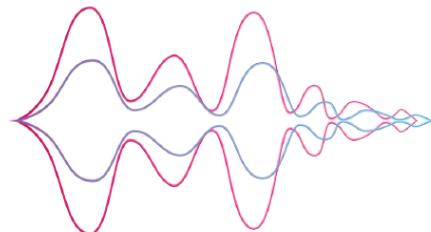


PNC

Piano nazionale per gli investimenti  
complementari al PNRR  
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## Research initiatives for technologies and innovative trajectories in the health and care sectors



# Anthem

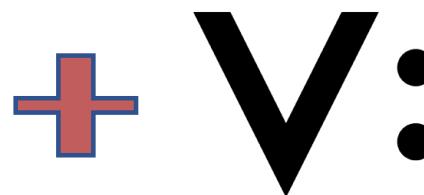
AdvaNced Technologies for Human-centEred Medicine

## INFN: LNL, NA, PV, TO

Accelerating system with unique performances,  
optimal neutron beam, radiobiology studies integrated  
with Treatment Planning, new boron carriers

HUB Leader Mi-Bicocca  
123 Meuro, 12.5 Meuro INFN  
Spoke 4 (Leader UniCT)  
*Innovative radiotherapy techniques and imaging  
(Flash therapy & BNCT)*  
INFN Units: CT, LNL, LNS, NA, PV, TO

**Pilot 4.9: Realisation of a boron neutron capture  
therapy (BNCT) facility in Caserta**



Università  
degli Studi  
della Campania  
*Luigi Vanvitelli*



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Courtesy of V. Vercesi



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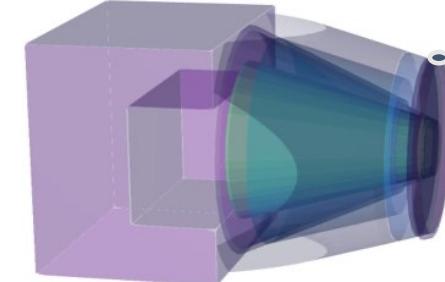
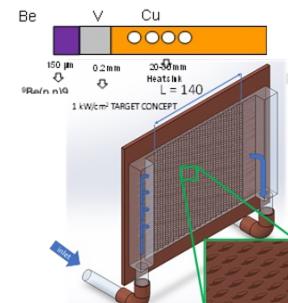
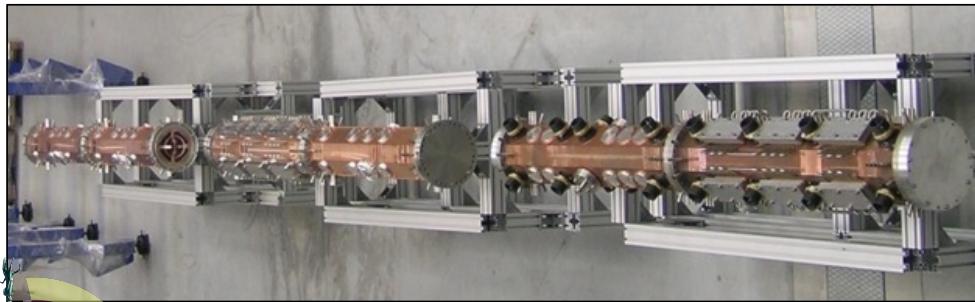
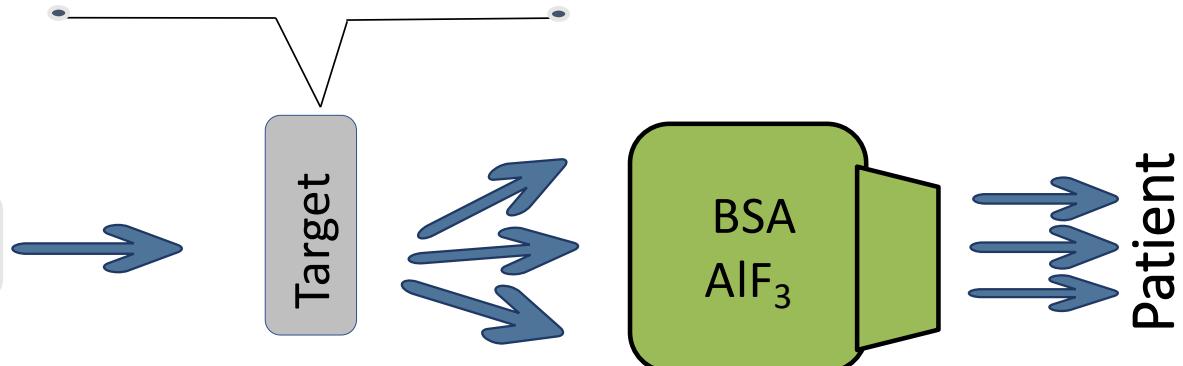
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RFQ 5 MeV, 30 mA CW

Proton Accelerator

Thin Be target, 3 layers (Be-Va-Cu)



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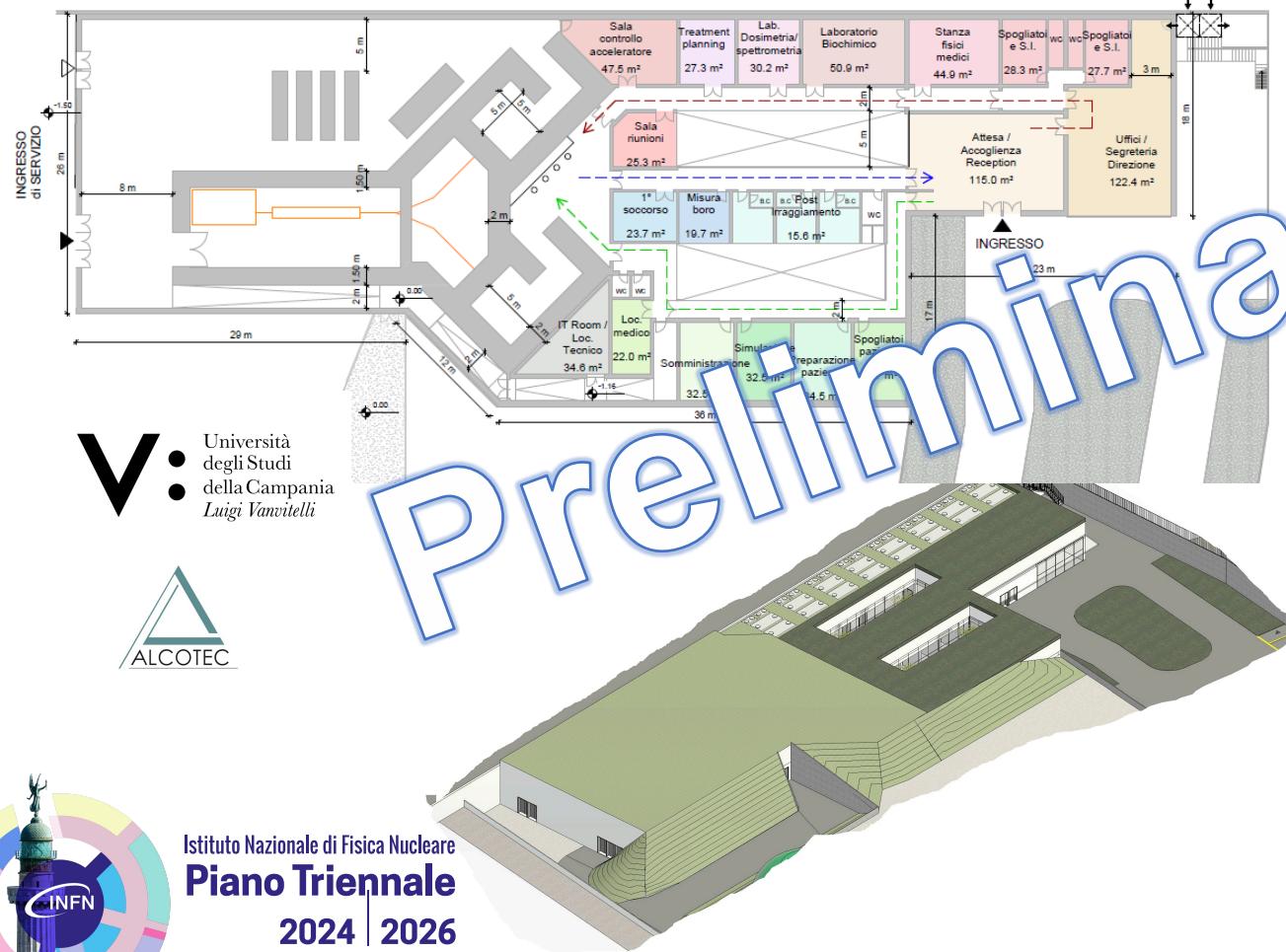


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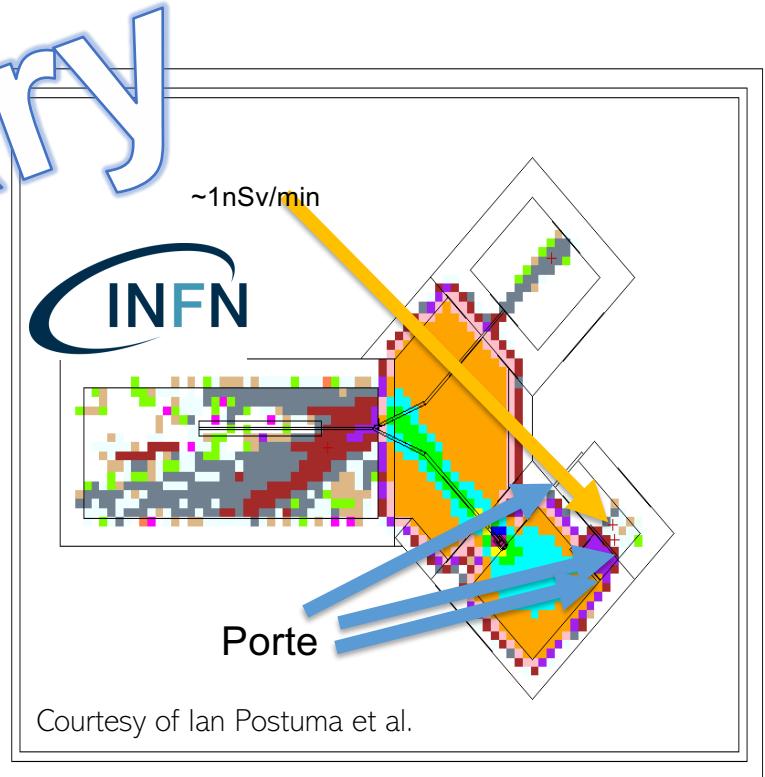


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Distribuzione di Dose nella facility  
Rate di Dose Neutroni in Sv/min  
Flux converted to Dose then to Equivalent Dose



Courtesy of V. Vercesi



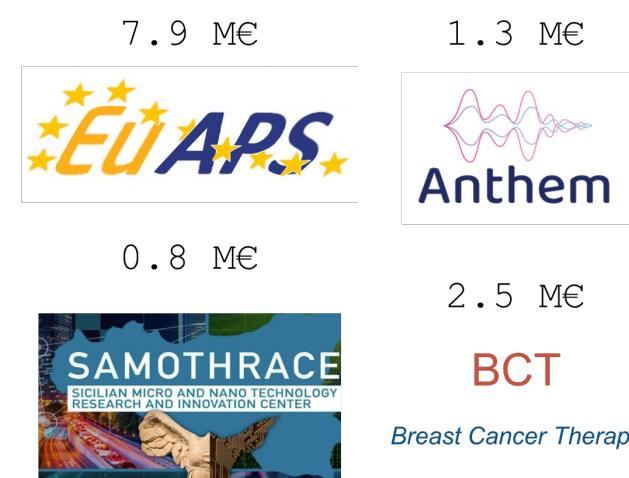
I-LUCE

INFN Laser induced radiation production



- **Two laser beamlines:** pulse duration < 23 fs
- **Low repetition rate high-power:** 1 Hz up to 350 TW
  - ▷ Power density at the target:  $> 1.25 \cdot 10^{21} \text{ W/cm}^2$
  - ▷  $I^* \lambda_2: > 8 \cdot 10^{20} \text{ W} \cdot \mu\text{m}^2/\text{cm}^2$
  - ▷ Proton beams: max energy 50 MeV;
  - ▷ Proton fluence:  $5 \cdot 10^{11} \text{ MeV}^{-1} \text{ Sr}^{-1}$
  - ▷ Electron beams up to 3 GeV
  - ▷ X-Rays, neutrons
- **Higher repetition rate, lower power:** >10 Hz
  - ▷ Specific power at the target:  $> 2.9 \cdot 10^{20} \text{ W}$
  - ▷  $I^* \lambda_2: > 1.33 \cdot 10^{20} \text{ W} \cdot \mu\text{m}^2/\text{cm}^2$
  - ▷ Proton beams: max energy 6 MeV;
  - ▷ Proton fluence:  $5 \cdot 10^{11} \text{ MeV}^{-1} \text{ Sr}^{-1}$
  - ▷ Electron beams up to 500 MeV
  - ▷ X-Rays, neutrons

UHDR Ultra High Dose Rate (UHDR) regime: FLASH and beyond



We are discussing the possibility to increase the duration of the laser pulse to the **ps level**



- Nuclear reactions in plasma
- Stopping power in plasma
- Nuclear decay
- Inertial fusion
- .....

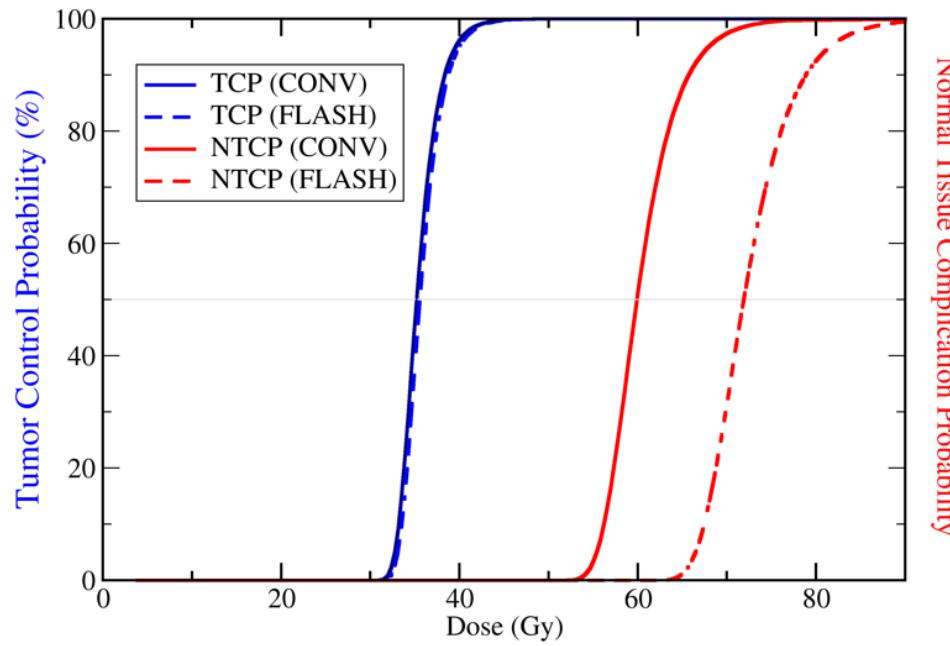
- ✓ Radiobiologia
- ✓ Studi flash therapy (elettroni di alta energia)
- ✓ Radionuclidi medicali



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Courtesy of G.A.P. Cirrone

# FLASH.. In a nutshell



> Radiother Oncol. 2022 Sep;174:87-91. doi: 10.1016/j.radonc.2021.12.045. Epub 2022 Jan 5.

## Comparison of ultra-high versus conventional dose rate radiotherapy in a patient with cutaneous lymphoma

A patient with a cutaneous lymphoma was treated on the same day for 2 distinct tumors using a 15 Gy single electron dose given in a dose rate of 0.08 Gy/second versus 166 Gy/second. Comparing the two treatments, **there was no difference for acute reactions, late effects at 2 years and tumor control.**



Courtesy of A. Sarti

# FRIDA: in a nutshell

(FLASH Radiotherapy with hIgh Dose-rate particle beAms)

INFN CSN5 call 2022-2024, ~ 1M€, 8 INFN units, 30 FTE, 100 people

- WP1 • Explore the time scales at which the FLASH effect occurs, refine the experimental characterization and modelling of the effect.
- WP2 • Develop compact, high intensity sources and delivery solutions for EBRT with e- and p
- WP3 • Explore novel detection strategies both for dosimetry and beam monitoring applications
- WP4 • Assess the FLASH effect potential using dedicated MC simulations and an ad hoc modelling of the NT sparing to provide optimised treatments that can be compared with state of the art RT and PT results

## FRIDA goals

understand the effect

provide facilities/beams for experiments (e-,p)

provide beam monitoring/control tools

provide treatment planning tools, evaluate technique potential

<https://web.infn.it/FRIDA>

ws Links & Documents ▾

Search ...  Sign In   

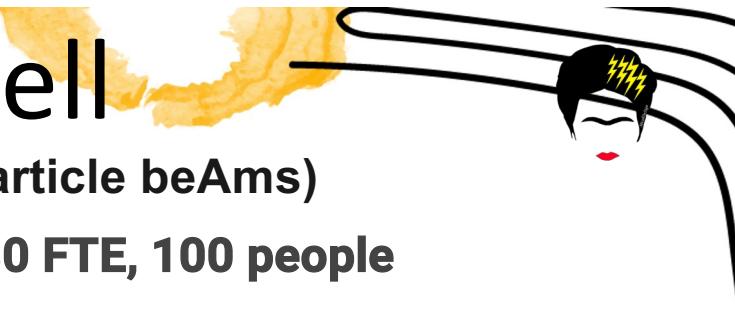


FLASH Radiotherapy with hIgh  
Dose-rate particle beAms

## The FRIDA project



The external beam radiotherapy research community is currently experiencing an exciting time: experimental evidence is growing, supporting the evidence of a considerable normal tissue sparing effect when treatments are delivered with dose rates much larger (100 times or more) with respect to the conventional ones. If confirmed, this so-called 'FLASH effect' has the potential to re-shape the future of radiation treatments especially with charged particles, with a significant impact on many oncology patients.



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# overview

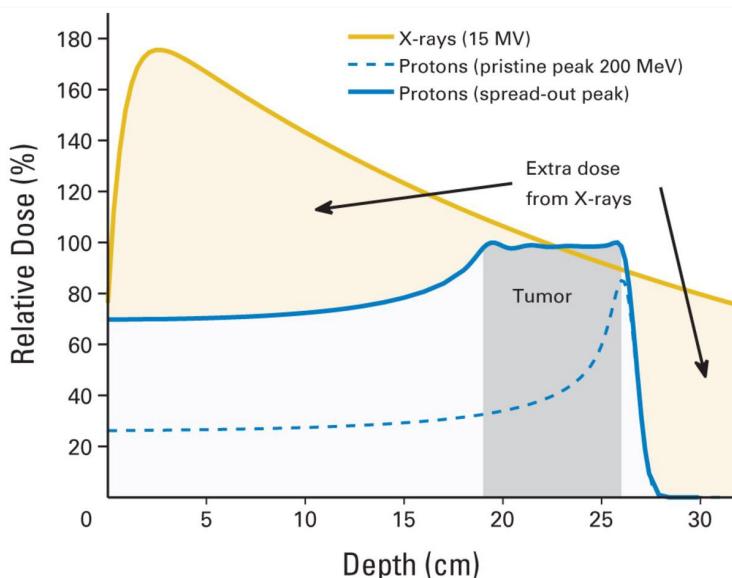
- Significant presence in the international context:
  - Conferences: ECMP (Dublin), FRPT (Barcellona), ERRS (Catania)...
  - UHDPulse [<http://uhdpulse-empir.eu/>] will be renewed and INFN is one of the few institutions that made it in the next consortium..
- Spreading knowledge
  - Ex: AIFM (Caldirola) school on FLASH therapy with most of the speakers from FRIDA collaboration
- Allowing access to the experimental facilities in Italy:
  - CPFR @ Pisa for low energy electrons
  - TIFPA @ Trento for protons
  - In Torino an Elekta accelerator is being converted to allow for FLASH e- low energy measurements
- Within FRIDA @ Very High Energy Electrons technological solution is being developed, to allow to reach the 100 MeV energy @ FLASH intensities that will enable the treatment of deep seated tumours.
- ... And much more (see [the website](#) and the [indico page](#) for updates).

# FOOT Experiment

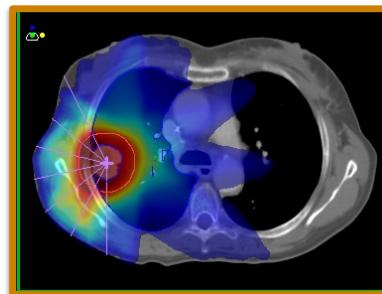
Measurement of fragmentation cross sections  
for **Hadrontherapy** and **deep space radioprotection**

$$80 \text{ MeV/N} < E_{kin} < 400 \text{ MeV/N}$$

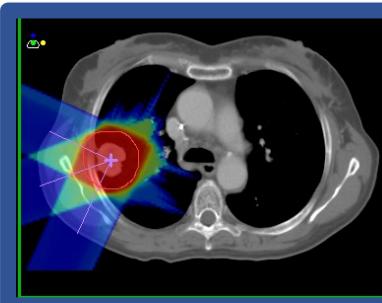
$$0.5 \text{ GeV/N} < E_{kin} < 2 \text{ GeV/N}$$



Traditional radiotherapy



Particle therapy



$p + C, O, N$   
 $C + C, O, Si$   
 $Fe + C, Si, Al$      $\frac{d\sigma}{d\Omega}, \frac{d\sigma}{dE_{kin}}$

Goal accuracy <5%



Spacecraft shielding  
Radio-protection in Space



Collaboration:

100 members
10 institutes
4 laboratories
5 countries

Courtesy of M. Villa

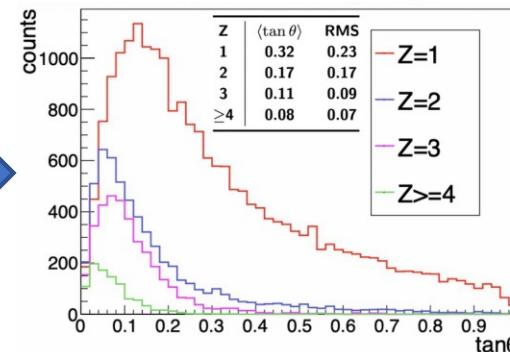
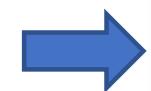
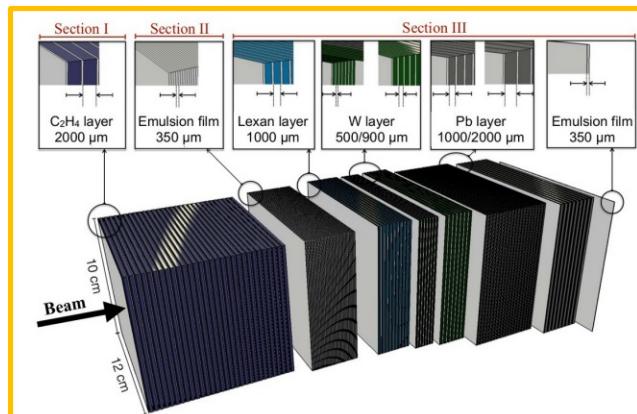


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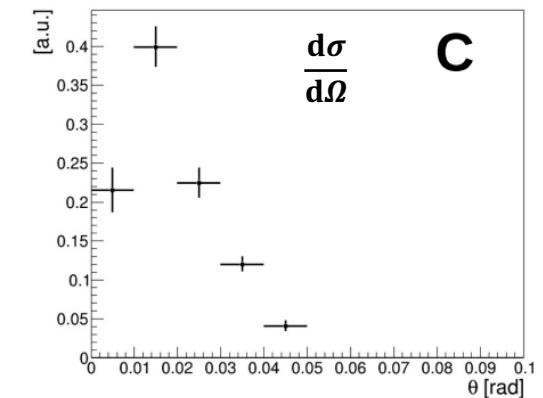
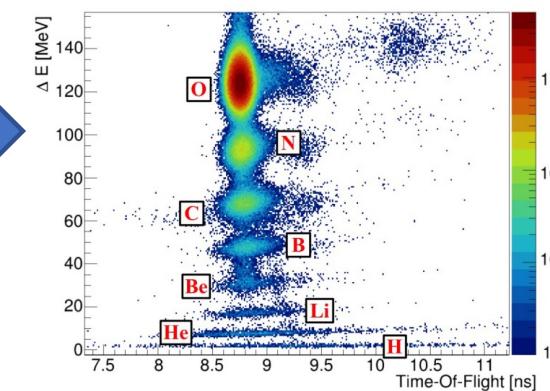
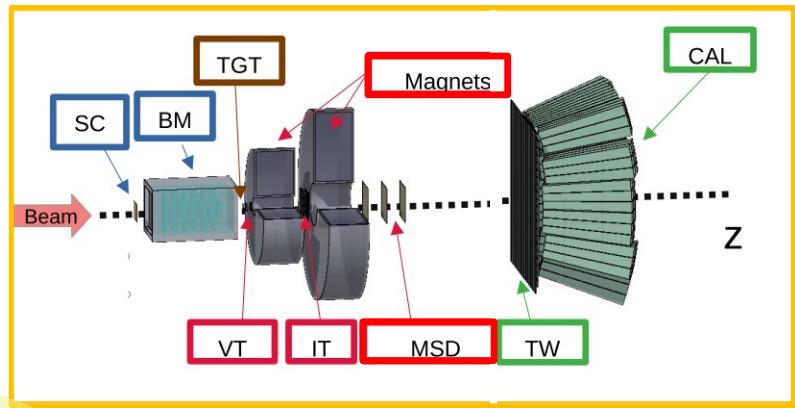
# FOOT Setup and results

**emulsion**



Measurements at GSI  
Beam:  $^{16}\text{O}$ , 400 MeV/N  
Target: C

**electronics**



Courtesy of M. Villa



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# INFN@CNAO



New research line:  
Experimental room independent from therapy clinical rooms



New superconducting ion source (AIsha2): H, He, Li, C, O, Fe  
(POR-FESR Regione Lombardia 2014-2020)

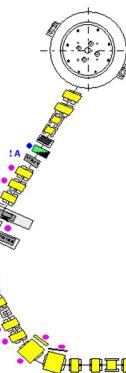


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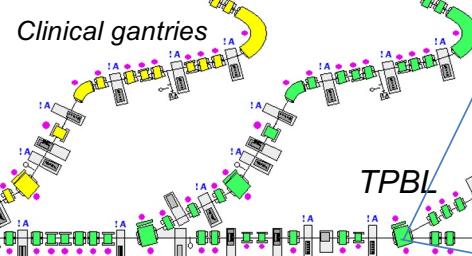
Courtesy of V. Vercesi

# Highlights from the Trento Proton Beam Laboratory

- Over 100 exps from 2018, by local /external groups on



TIFPA managed exp facility  
@ APSS Trento Protontherapy center



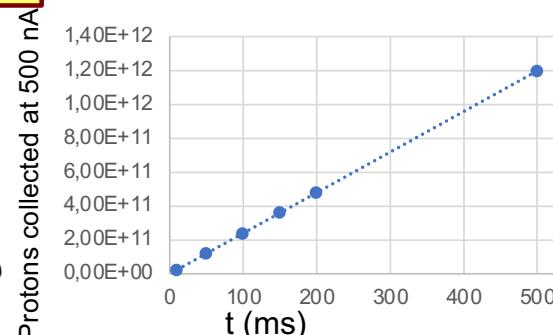
- Radiation Biophysics
- Radiobiology
- Space Research
- Detector Development

- used in over 20 INFN projects

PAC: [www.tifpa.infn.it/sc-init/med-tech/p-beam-research/](http://www.tifpa.infn.it/sc-init/med-tech/p-beam-research/)

**April 2023:** Ultrahigh dose rate modality started and in course of tuning  
200 Gy/s reached on 1cm<sup>2</sup>  
**1st p-FLASH experimental facility in Italy**

FRIDA-CSN5

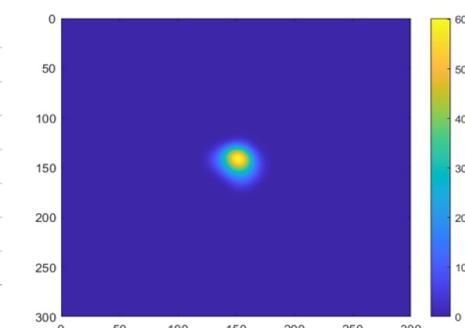


Therapeutic energy range  
 $E = 70 - 225 \text{ MeV}$



Tommasino et al.  
Phys Med 2019

Tommasino et al.  
NIMA 2017



Courtesy of E. Scifoni

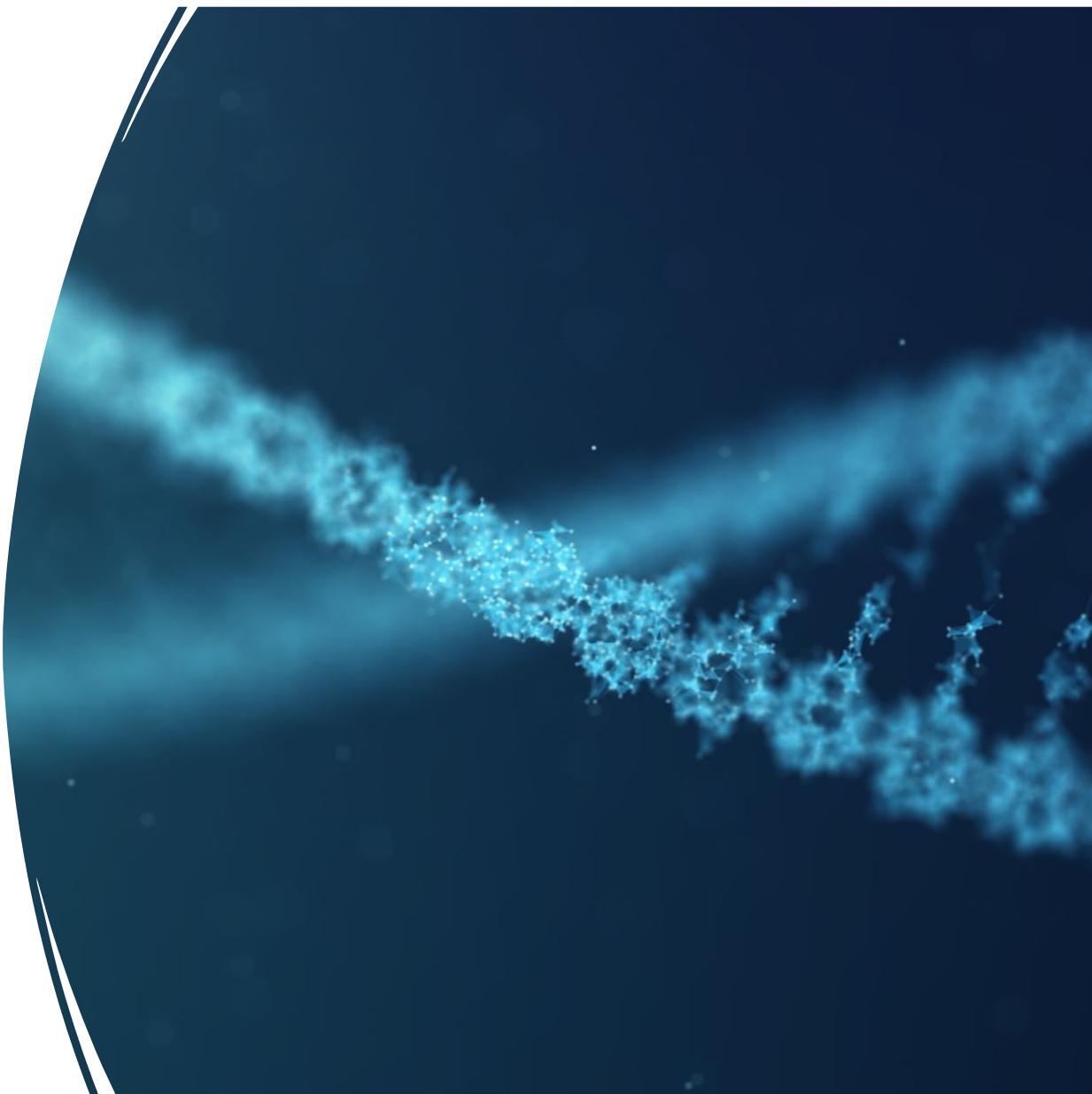


Trento Institute for  
Fundamental Physics  
and Applications



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# Radionuclidi e radiofarmaci



# Radioisotopi per la Medicina e la Fisica Applicata: SPES- $\gamma$

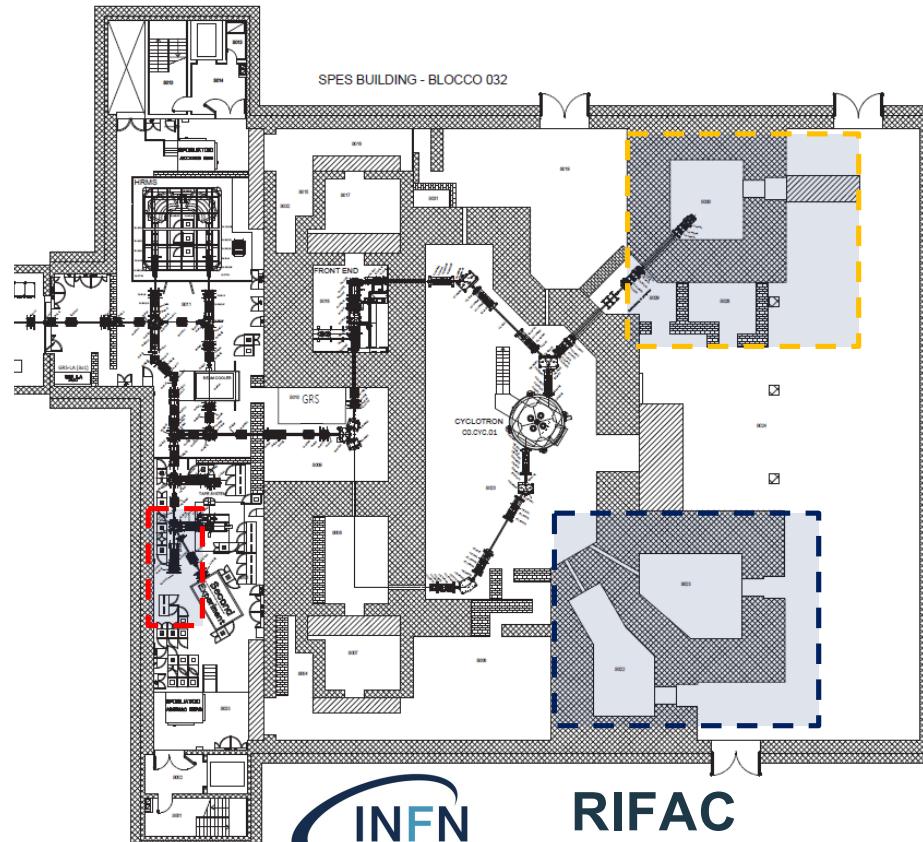


ISOL technology



[A. Andrigetto et al., J. Rad. Nucl. Chem. 2019](#)

Further from stability, high purity  
E.g.,  $UC_x$  target:  $^{111}Ag$ ,  $^{131}I$ ,  $^{90}Y$ ,  $^{89}Sr$  ...



DIRECT technology



LAboratory of  
Radionuclides for  
MEDicine

[J. Esposito et al., Molecules 2019, 24, 20](#)

Standard medical production method  
Closer to stability, higher intensity  
E.g.,  $^{67}Cu$ ,  $^{47}Sc$ ,  $^{99m}Tc$ ,  $^{51}Mn/^{52}Mn$  ...

RIFAC  
Possible partnership  
with industry

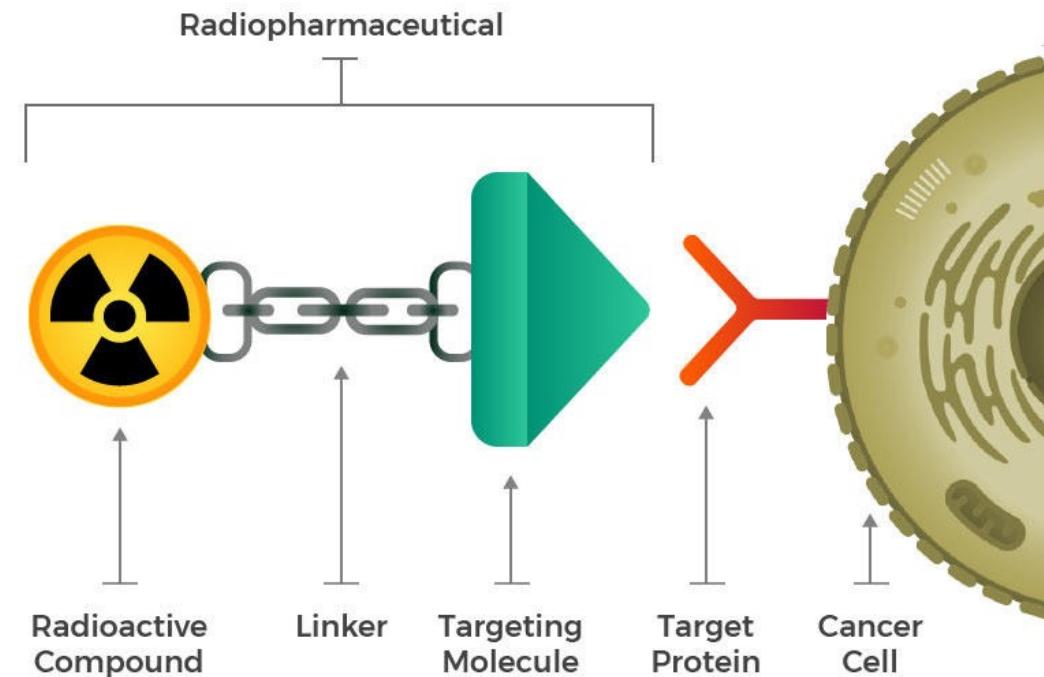


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# Radioisotopi per la Medicina e la Fisica Applicata: SPES- $\gamma$



Importanza  
varietà di  
radionuclidi!



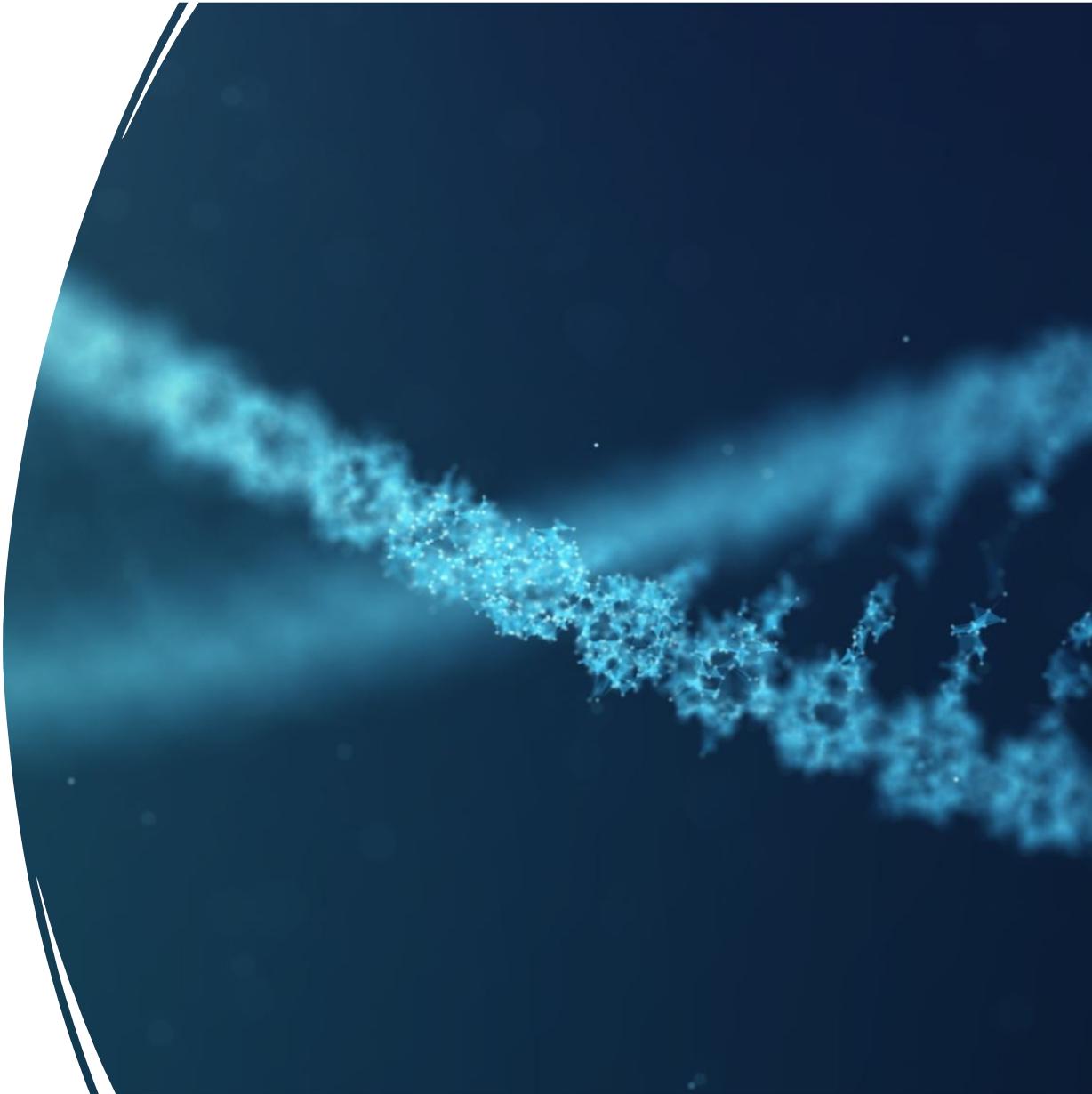
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LOI CSN3  
Resp. naz. E. Mariotti

# Imaging

- Rivelatori per dosimetria ed imaging
- Intelligenza Artificiale per analisi immagini



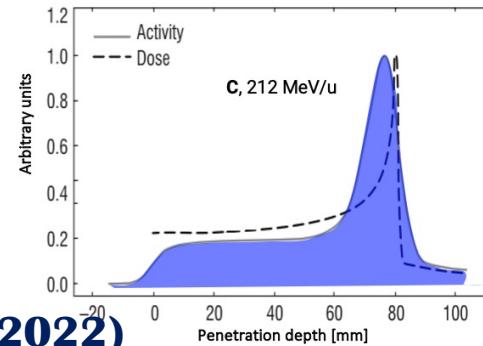
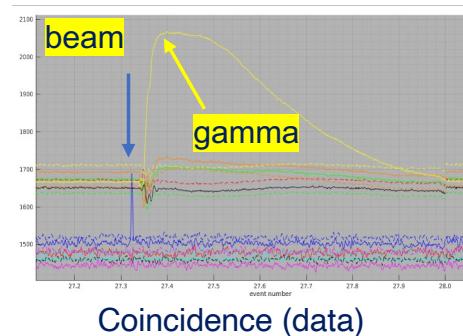
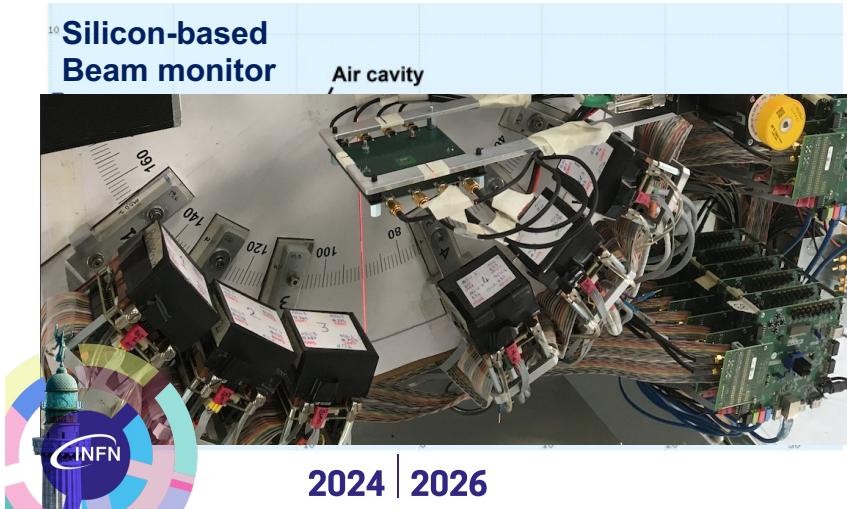
# Next-gen online range verification



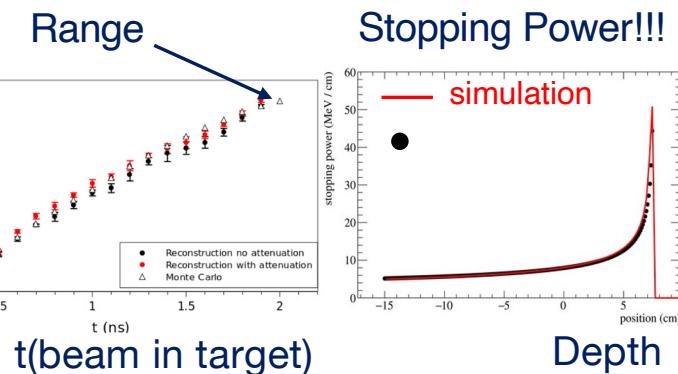
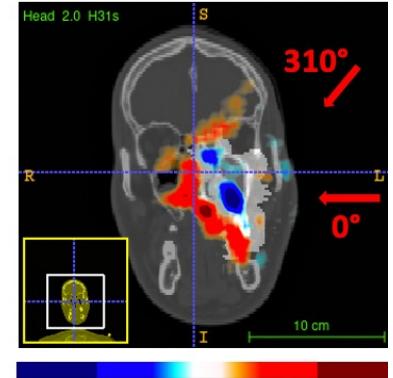
- Design for integration in Ion gantry (SIG project)

- PET optimization (INSIDE2, SYNCT)
  - Low statistics with ion treatment ☹
  - Activity peak close to end of range ☺
    - Dedicated rec. algorithm development
- Prompt Gamma Timing (MERLINO, HONEY-PRIN 2022)

$$t(\text{beam in target}) = t_f(\gamma) - t_i(\text{beam}) - t(\text{beam in air}) - t_{\text{fly}}(\gamma)$$



Activity difference between control and planning CT

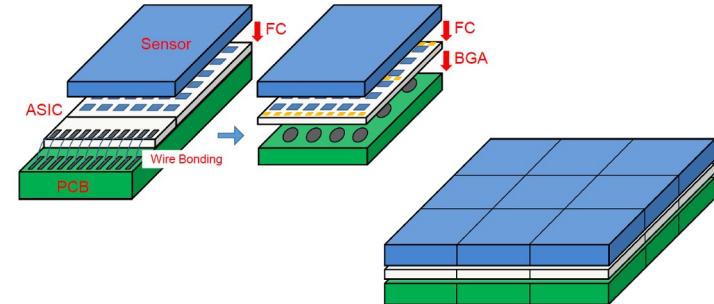
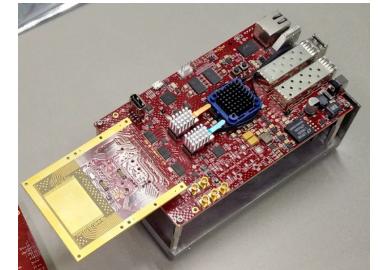
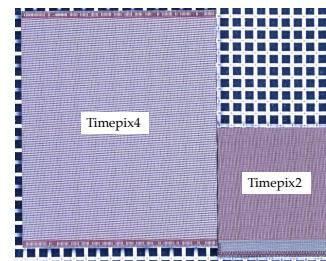


Courtesy of P. Cerello

# Medipix4 Collaboration



- Medipix4 international Collaboration based at CERN
  - 18 members, 2 ASICs
  - INFN joined in 2020
- Scientific goals: development of hybrid pixel detector ASICs
  - 2 ASICs for 4-side buttable large pixel detectors thanks to vertical integration (Through Silicon Via)
    - Spectroscopic X-ray imaging at rates compatible with medical CT scans (**Medipix4**)
    - Single-threshold particle tracking detector chip with improved energy and time resolution and data-driven architecture (**Timepix4**)
  - INFN groups in MEDIPIX4 CSN5 project: FE (R.N.), LNS, NA, PI, TS
    - Main goals: medical imaging, nuclear medicine, dosimetry



Courtesy of M. Fiorini

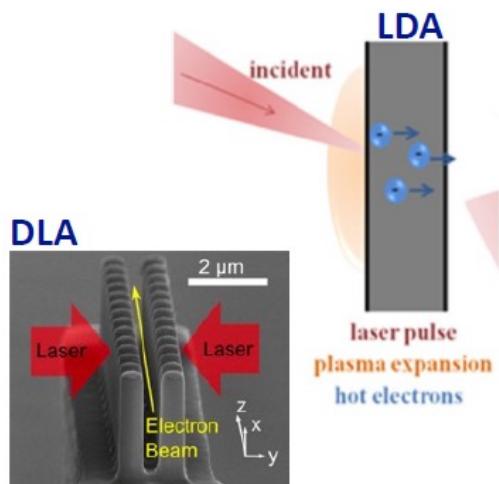


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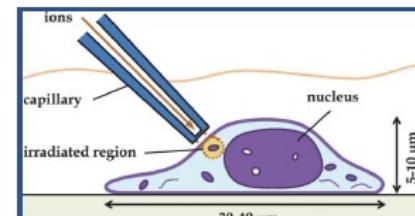
### Pillar Health

#### Micro accelerators

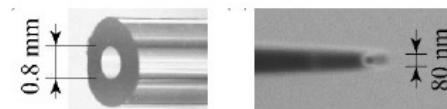
##### Laser Driven Acceleration



#### Micro e Nano beams

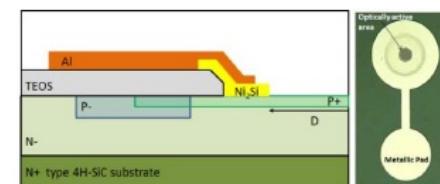


##### Micro-Nano capillaries



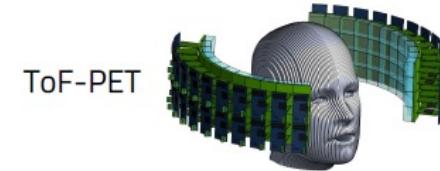
Micro and nanobeams,  
protons/light ions in the keV/MeV  
range

#### Photodetectors



##### New SiC-APD UV sensors

Solar blindness

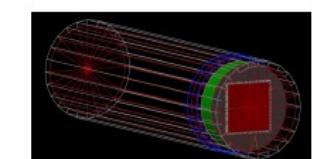
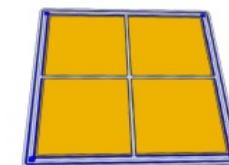


SiPM  $\rightarrow$  SiCPM

#### Particle detectors

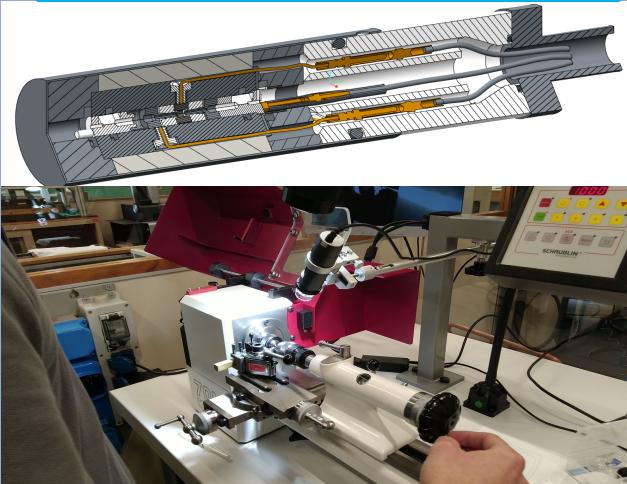
##### New SiC devices

- ✓ Dosimeters
- ✓ Micro-dosimeters
- ✓ beam-monitors
- ✓ Imaging devices



# LNL: the smallest Tissue equivalent proportional counter for hadron therapy

## DESIGN AND CONSTRUCTION



Micro-mechanical workshop

## ASSEMBLING AND TEST OF MINIATURIZED TISSUE EQUIVALENT PROPORTIONAL COUNTERS



Engineering of microdosimetric device for clinics (4MiCA project, R4I-2021).

## A Monitor for Quality Assurance of Radiation Quality

### Technical characteristics:

- High precision micro-mechanics machining
- Tissue equivalent constructive materials
- Cylindrical sensitive cavity for almost-isotropic response
- 1 micrometre water-equivalent thickness
- Small cross-sectional area 0.9 mm x 0.9 mm
- External diameter 2.7 mm for high precision positioning
- High sensitivity: detects the single ionization
- High dynamic range: detect the full LET spectrum

### Advantages

- High sensitivity = detects the single ionization (better than silicon or diamond based microdosimeters)
- Thickness equivalent to 1 micrometre of biological tissue
- Full LET range (from 0.2 to 5000 keV/ $\mu$ m)
- Fast response (a single measurement in a few minutes) as compared to radiobiological measurements
- High reproducibility, high stability

### Applications:

- Hadron therapy, BNCT, for monitoring the radiation quality



- 4MiCA (Trasferimento Tecnologico INFN, bando 2021)
- Neptune (Call CSN5, 2019-2022)
- Microbe\_IT (CSN5, 2020-2023)
- Diode (CSN5, 2022-2024)
- Discover (CSN5, 2023-2026)

### Funded research projects in the last 5 years

- Fondi esterni: TTA\_18LNL\_072 & TTB\_20LNL\_114
- Bando complementare al PNRR: progetto ANTHEM

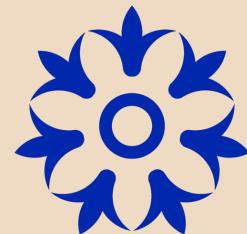
- Grant giovani CIMICE di Anna Selva (2019-2021)
- Grant giovani MUSICa di Anna Bianchi (2023-2024)

Courtesy of V. Conte





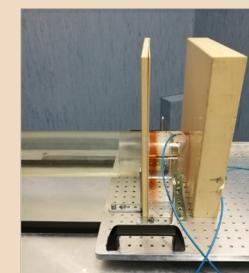
# PNRR ECS THE Tuscany Health Ecosystem



INFN and Univ. of Pisa are involved in  
**Spoke 1 - ADVANCED  
RADIOTHERAPIES AND  
DIAGNOSTICS IN ONCOLOGY**  
coordinated by L. Gizzi (CNR, Pisa)

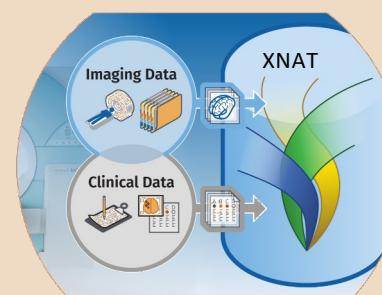


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The CPFR ([Centro Pisano Flash RadioTherapy](#)), partnered by INFN, is ready to perform in vitro experiments to investigate basic mechanisms and parameter dependency of FLASH effect

INFN is contributing to the prototyping of a **suitable dosimeter** for ultra-high dose-per-pulse and dose rates (Di Martino et al, 2022 doi:10.1016/j.ejmp.2022.08.010)

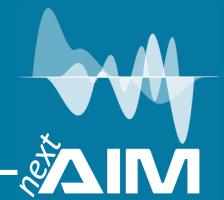


A dedicated technologists has been recruited (2 years, starting Dec. 2023)

INFN is developing an **informatic platform for data storage**, sharing and automated data processing based on the XNAT technology ([www.xnat.org](http://www.xnat.org)) to support the research interactions between WPs

Courtesy of A. Retico and M. G. Bisogni

# next\_AIM - Artificial Intelligence in Medicine: *next steps*



## INFN-CSN5

Project coordinator:  
**A. Retico, Pisa**

13 Research Units:  
Bari ([S. Tangaro](#))  
Bologna ([D. Remondini](#))  
Cagliari ([P. Oliva](#))  
Catania ([M. Marrale](#))  
Ferrara ([G. Paternò](#))  
Firenze ([C. Talamonti](#))  
Genova ([A. Chincarini](#))  
Lab. Naz. Sud ([G. Russo](#))  
Milano ([C. Lenardi](#))  
Napoli ([G. Mettivier](#))  
Pavia ([A. Lascialfari](#))  
Padova ([A. Zucchetta](#))  
Pisa ([M.E. Fantacci](#))

Long-standing collaboration with  
Italian centers (hospitals and  
IRCCS) and with international  
consortia for data sharing



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### WP1

#### Challenge I: no-so-big data

Strategies for efficient learning with  
limited data samples.

Evaluation of robustness and  
reliability of trained models.

### WP2

#### Challenge II: explainable AI (XAI)

Make AI results understandable to  
humans.

Which image/data features are  
relevant to make a decision?

<https://www.pi.infn.it/aim/>

AIM [2019-2021]

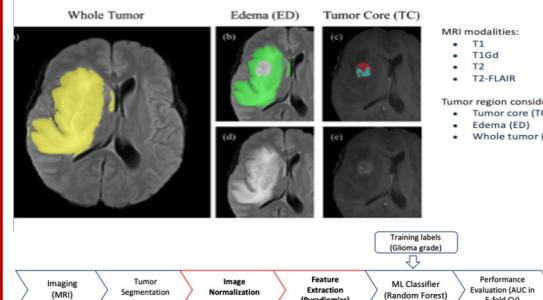
next\_AIM [2022-2024]

Courtesy of A. Retico

### WP3

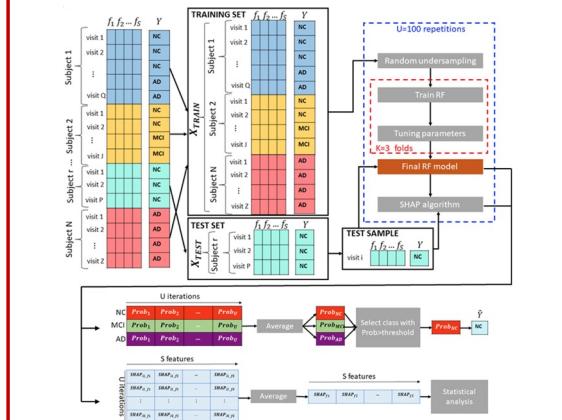
#### Applications to real-world data samples include ....

Evaluation of the robustness of radiomic  
features in multiparametric MRI and its impact  
on predictive value of AI models



Ubaldi L, Saponaro S, Giuliano A, Talamonti C, Retico A. Deriving quantitative information from multiparametric MRI via Radiomics...  
*Phys Medica* 2023;107:102538  
<https://doi.org/10.1016/j.ejmp.2023.102538>.

Robust implementation of explainable AI methods



Lombardi A, Diacono D, Amoroso N, Biecek P, Monaco A, Bellantuono L, ... Tangaro S, Bellotti R. A robust framework to investigate the reliability and stability of explainable artificial intelligence .... *Brain Informatics* 2022; 9:17. <https://doi.org/10.1186/s40708-022-00165-5>.

### WP4

#### Computing resources and SW repository organization

ReCaS, IBiSCo, INFN-  
Cloud + local HW  
resources

### WP5

#### Exploitation of research results and communication

conferences, publications  
and outreach,  
collaboration with



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# PNRR PE1 – FAIR: Future AI Research

## Spoke 8: Pervasive AI

Coordinated by Michela Milano, University of Bologna

### WP8.8. Experimental use cases in pervasive domains

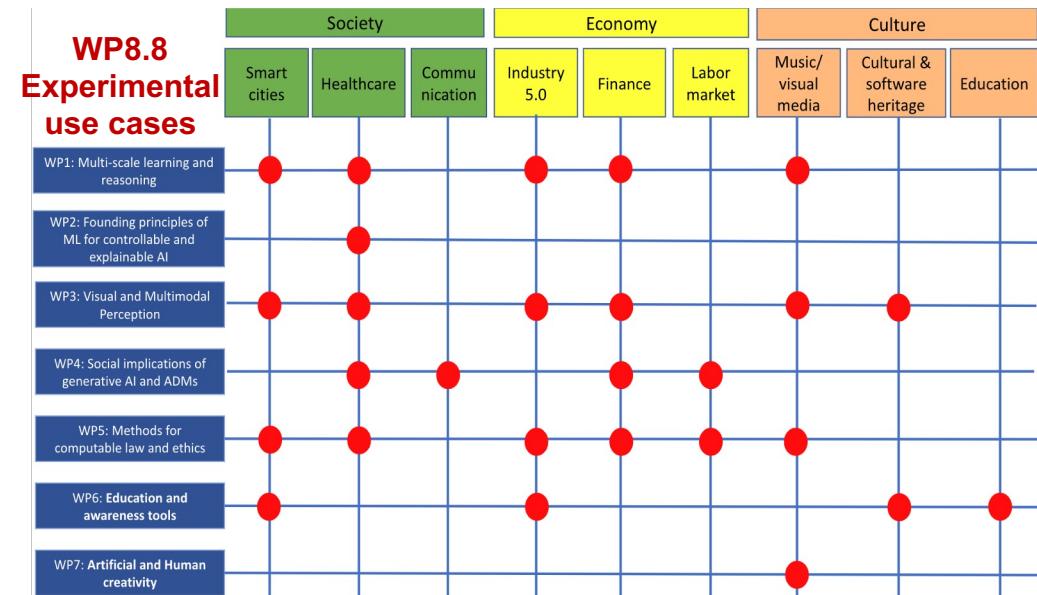
Leader INFN – PI: A. Retico, co-PI: A. Chincarini

WP8.8 provides the **experimental framework** for the formal results achieved on WP8.1-8.7 of Spoke 8.

We will coordinate the use case development in three big macro sectors:

- society (smart cities, e.g. Bologna digital twin, and **personalized medicine**)
- economy (industry 5.0, finance/banking and labor market)
- culture (cultural and software heritage, humanistic AI and music)

Two technologists have been recruited



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A. Retico and A. Chincarini, PNRR-PE1 FAIR, Spoke 8

Courtesy of A. Retico



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# PNRR CN1 – ICSC

## Spoke 8: In Silico Medicine and Omics Data

Coordinated by Andrea Cavalli (IIT) and Francesco Pappalardo (UNICT)

INFN coordinator Spoke 8: Alessia Tricomi

In silico  
medicine

Omics  
data



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WP1 Implementation of modelling & simulation platforms (open Source and commercial) through HPC solvers (Francesco Pappalardo)

WP2 Digital Twins and In Silico Trials (Marco Viceconti)

WP3 Integrated digital data flow between clinics and HPC centres and Easy-to-use GUI for HPC solvers (hiding complexity for ultimate users) (Barbara Martelli)

WP4 Genome bioinformatics pipelines for GPU-based HPC infrastructures (Chiara Romualdi)

WP5 Development of clinical machine learning algorithms for EHRs and omics data (including radiomics) (Luigi Terracciano)

WP6 Drug-target studies and drug repurposing (Giorgio Colombo)



Title: ML and DL for Omics Data

Contributors:

Giuseppe Jannuzzi<sup>1</sup>, Marco Chiesi<sup>1</sup>, Monica Moretti<sup>1</sup>, Matteo Pozzani<sup>1,2</sup>, Shalayne Noel<sup>1</sup>, Piero Fanelli<sup>1</sup>, Mario Dante Lucio Giacopini<sup>2</sup>, Ugo Alfè<sup>1</sup>, Fabrizio D'Acoczo<sup>1</sup>, Vitoantonio Bevilacqua<sup>3</sup>, Alessandro Retico<sup>4</sup>, Alessandro Lucciadore<sup>5</sup>, Francesco Leca<sup>6</sup>, Ernesto Picardi<sup>1,2</sup>, Graciano Pessina<sup>1,2</sup>

<sup>1</sup>Data Science for Health unit, Bruno Kessler Foundation, Italy

<sup>2</sup>Department of Computer, Computational and Integrative Biology, University of Texas, Italy

<sup>3</sup>Department of Medical Sciences, University of Torino, Italy

<sup>4</sup>Data Analysis and Modelling Unit, Department of Veterinary Sciences, University of Torino, Italy

<sup>5</sup>Department of Electrical and Information Engineering, Politecnico University of Bari, Italy

<sup>6</sup>National Institute for Nuclear Physics (INFN), Pisa Division, Italy

<sup>7</sup>Department of Physics, University of Pavia and INFN, Pavia Division, Italy

<sup>8</sup>Department of Biology and Biotechnology "L. Spallanzani", University of Perugia, Italy

<sup>9</sup>Department of Biosciences, Biotechnologies and Environment, University of Bari, Italy

<sup>10</sup>Institute of Biomembranes, Bioenergetics and Molecular Biotechnologies, National Research Council, Bari, Italy

Introduction

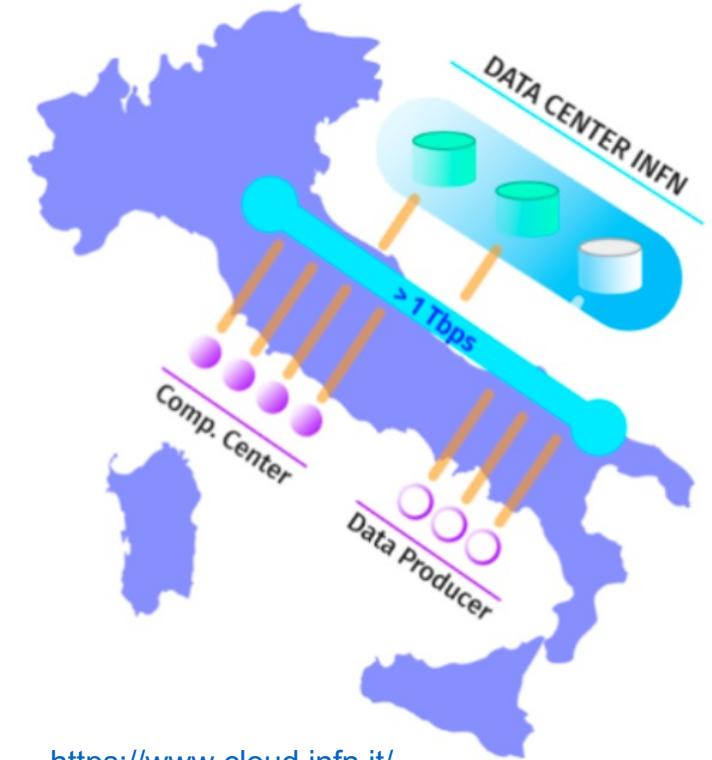
The innovation and development of biotechnologies techniques are opening the era of "big data" in omics, thanks to the availability of large amounts of data. The availability of large data provides a great opportunity only if goes at the same pace as the development of computational tools to analyze and extract knowledge from such data. For this reason, it is crucial to adopt, in the omics

**Spoke 8**  
**Plenary meeting**  
**22<sup>nd</sup> June 2023**

Courtesy of A. Tricomi, B. Martelli and A. Retico

# INFN Cloud

- A **multi-site, federated Cloud** infrastructure **integrating HPC and HTC resources**
- In **production** since March 2021.
- The **seed** of a National Datalake **for research and beyond**, building on existing, renewed or new e-Infrastructures.
- Architectural foundations:
  - No vendor lock-in (open-source, vendor-neutral)
  - Federation of existing resources (computing and data management)
  - Dynamic orchestration of resources via INDIGO PaaS Orchestrator
  - Consistent AuthN/AuthZ at all cloud levels via OpenID-Connect/OAuth2
- Includes a secure, GDPR-compliant region dedicated to life-science use cases: **EPIC (Enhanced Privacy and Compliance) Cloud**



<https://www.cloud.infn.it/>

(2019-2029)

## HEALTH BIG DATA

<https://www.alleanzacontroilcancro.it/progetti/health-big-data/>

Courtesy of B. Martelli



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PNC

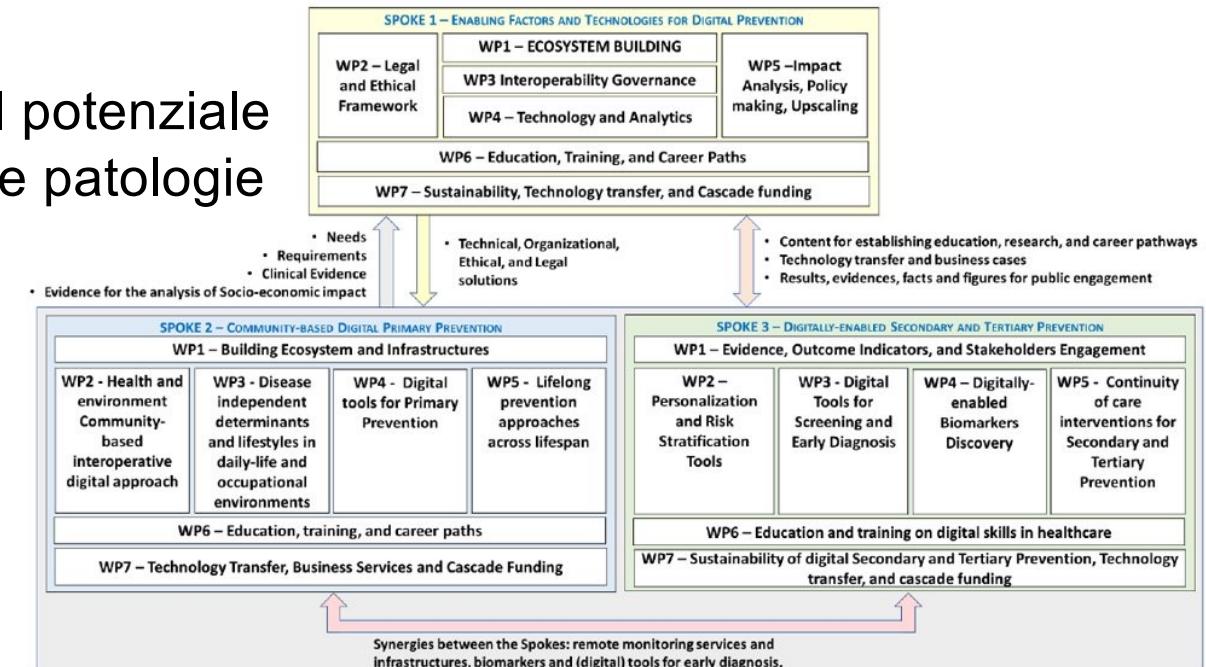
Piano nazionale per gli investimenti  
complementari al PNRR  
Ministero dell'Università e della Ricerca

# DARE \_ DigitAI lifelong pRevEntion

Obiettivo: Migliorare gli strumenti e le conoscenze necessarie per sfruttare il potenziale dei big data per monitorare e predire le patologie

INFN sviluppa la piattaforma di calcolo sicura e GDPR-compliant per tutto il progetto (Spoke 1)

- Basata su INFN Cloud
- Focus su interoperabilità e scalabilità
- Contributo anche sotto l'aspetto legale (gestione dati sensibili)



Istituto Nazionale di Fisica Nucleare  
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2024 | 2026

Courtesy of B. Martelli



# PNRR Ministero della salute



 <b>Ministero della Salute</b> Direzione generale della ricerca e dell'innovazione in sanità PNRR: M6/C2_CALL 2022 Full Proposal	 <b>Finanziato dall'Unione europea</b> NextGenerationEU
<b>Project Code:</b> PNRR-POC-2022-12376726	<b>Call section:</b> Proof of concept
<b>Applicant Institution:</b> Ospedale Policlinico San Martino	<b>Applicant/PI Coordinator:</b> MORBELLI SILVIA DANIELA

**Predictive tools for precision medicine in prodromal stages of neurodegeneration: quantification of molecular imaging and integration with other biomarkers**

## Institutions

- Ospedale Policlinico San Martino (PI)
  - Development of a new tool for quantification of dopaminergic imaging
- Istituto Nazionale di Fisica Nucleare, Sezione di Genova
  - responsible of image and other biomarkers postprocessing and statistical analyses.
  - data analyses, development of new quantification approaches to imaging;
- Ospedale SS. Annunziata
  - EEG analysis; evaluation of DLB patients datasets

**PNRR M6C2 - POC**



 <b>Ministero della Salute</b> Direzione generale della ricerca e dell'innovazione in sanità BANDO RICERCA FINALIZZATA 2021 esercizio finanziario anni 2020-2021 - Progetto Completato	<b>Project Title:</b> Probing neuroinflammation in the prodromal stages of alpha-synucleinopathies. A multimodal neuroimaging, neurophysiological, neuropsychological proof-of-concept study in patients with idiopathic rapid-eye-movement sleep behavior disorder. <b>Project duration (months):</b> 36
<b>Project Code:</b> RF-2021-12374240	<b>Principal Investigator:</b> NOBILI FLAVIO MARIANO
<b>Research Type:</b> a) Theory-enhancing: sviluppare procedure altamente innovative e nuove conoscenze utili al miglioramento delle opportunità di prevenzione, diagnosi, trattamento, riabilitazione anche attraverso...	<b>Applicant Institution:</b> Ospedale Policlinico San Martino

**Probing neuroinflammation in the prodromal stages of alpha-synucleinopathies. A multimodal neuroimaging, neurophysiological, neuropsychological proof-of-concept study**

## Institutions:

- Ospedale Policlinico San Martino (PI)
  - Enrollment and clinical evaluation and follow-up of patients. PET, SPECT and MR imaging. Cognitive evaluation
- Istituto Nazionale di Fisica Nucleare, Sezione di Genova
  - responsible of image and neurophysiological post-processing and statistical analyses

**PNRR RF2021**

*A. Chincarini, PNRR POC M6C2, PNRR RF2021*



Le attività in corso applicate  
allo studio delle **scienze della**  
**vita** sono tante..

.. lavoriamo insieme  
affinché INFN possa restare  
**fucina di innovazione,**  
**anche tecnologica**, per  
avere domani ricadute che  
oggi appena intravediamo

**Grazie per l'attenzione**

Etna, Sicilia