CSN5 INFN-LNF

C. VACCAREZZA COORDINATORE LNF

CDL PREVENTIVI, JULY 6TH 2022

Outline

- CSN5 update
- CSN5-LNF overview
- New Experiment proposals and Calls
- Ongoing experiment report

CSN5 update

- NEW Data base preventivi 2023 open until July 17th Luglio 2022 (23:59)
- Data base assegnazioni (richieste aggiuntive, sblocchi sj) open until July 18th 2021
- Next CSN5 meeting: July 20-21-22 2022 at LNF
  - Highligths: New selection rules for experiment proposals
    - July 10th 2022 deadline for new experiment proposal at csn5.nuoveproposte@lists.infn.it + DB detailed compilation in due date
    - New proposals fine ranking for funds assignment

CSN5 overview

People= 172 : Ric. 96, Tec. 76 FTE= 44.0

DETECTORS 7	INTERDISCIPLINARY 4	ACCELERATORS 10
• DARTWARS • ENTER_BNCT • IDDLS • LLMCP • PEROV • QUB_IT • URANIA_V	• OLAGS DTZ • RESOLVE • SAMADHA • SAMARA	• ARYA • IMPACT_CSN5 • MICRON • PBT • SHERPA (Grant) • SAMARA DTZ • SINGULARITY • SL_COMB2FEL • SL_EXIN • TUAREG

- Tra i progetti in cui è coinvolta la farm del calcolo scientifico di Frascati (Tier2 di ATLAS e PADME) c'è: **IDDLS**: Italian Distributed Data Lake for Science, **Gr V**
- Partecipanti: GARR, INFN (CNAF, Bari, LNL, Napoli, Roma1, Pisa, Perugia)

New proposals for 2023

New proposals con RN @ LNF

- Fairtel — RN S. Bini
- NEMMUS — RN S. Bellucci

New from PNRR:

- EUAPS
- IRIS
- TECHNOPOLE

New proposals con RL @ LNF

- HB2TF — RL L. Faillace

Extensions:

- ENTER_BNCT
- PEROV
- SINGULARITY
- TUAREG

Ongoing experiments in 2022

Exp ongoing with RN at LNF

- IMPACT_CSN5 RN A. Marcelli
- PEROV RN M. Testa
- QUB_IT RN C. GATTI
- SINGULARITY RN S. Pioli
- SL_COMB2FEL RN E. Chiadroni
- TUAREG RN D. Alesini
- URANIA_V RN G. Bencivenni

Exp ongoing with RL at LNF

- ARYA RL R. Cimino
- DARTWARS RL C. Ligi
- ENTER_BNCT RL R. Bedogni
- LLMCP RL T. Spadaro
- MICRON RL L. Faillace
- PBT RL A. Biagioni
- RESOLVE RL S. Dabagov
- SAMADHA RL R. Bedogni
- SL_EXIN RL M.P. Anania

Exp ongoing on Dotazioni GR5

- OLAGS RL A. Clozza
- SAMARA RL D. Di Gioacchino

Exp w extension required

- ENTER_BNCT RL R. BEDOGNI
- PEROV RN M. Testa
- RESOLVE RL S. DABAGOV
- SINGULARITY RN S. Pioli
- TUAREG RN D. Alesini

Exp closing

- SHERPA RN M. Garattini
- IDDLS RN V. Elisabetta

New proposals with RN@LNF

FAIRTEL

ultra-FAst InfraRed TELescope

RN S. Bini

Research Area:

Detector per astrofisica in time domain

L'astronomia multi-messenger richiede l'uso e lo sviluppo di telescopi e detector per osservazioni in tutto lo spettro elettromagnetico. L'interesse è verso detector di tipo longitudinale cioè che possano effettuare osservazioni astronomiche nel tempo piuttosto che trasversalmente (cioè con fotografie o spettrografie). La proposta FAIRTEL vuole costruire un detector molto veloce nel MIR (medio infrarosso) che potrà essere utilizzato oltre che per l'astronomia multi-messenger, anche per la ricerca di transienti astronomici, analogamente a quanto è stato osservato in range elettromagnetici differenti con i FRB (Fast Radio Burst) e i GRB (Gamma-Ray Burst). L'astronomia in time domain sta crescendo di interesse e intende studiare eventi in una scala temporale che dai millisecondi può arrivare ai microsecondi e anche meno. Il detector proposto dall'esperimento FAIRTEL (FAst IR TELescope), è basato su semiconduttori HgCdTe e verrà provato presso SINBAD, la linea IR di DAFNE, (i test iniziali sono in corso), e presso l'OPC (Osservatorio Polifunzionale del Chianti) e potrà osservare eventi con transienti fino al nanosecondo. Una estensione del progetto prevede l'estensione dalle osservazioni a terra anche a quelle con l'utilizzo di un pallone aerostatico per studi astronomici.

FAIRTEL

ultra-FAst InfraRed TELescope

RN S. Bini

Research Area:

Detector per astrofisica in time domain

anagrafica	Simone Bini, Resp. Naz. e Loc., (tecnologo, LNF)	40%
	Alessandro Drago (associato senior LNF)	100%
	Mariangela Cestelli Guidi (prima tecnologa, LNF)	20%
	Augusto Marcelli (primo ricercatore, LNF)	20%
	Emanuele Pace (UNI-FI, direttore OPC)	0%
	Valerio Bocci (primo tecnologo, ROMA-1)	0%
Totale: 1.8 FTE		
durata	1 anno	

The purpose of this experiment is to explore the emission of nuclear radiation from non-radioactive substances that are inert subjected to ultrasound and cavitation. The examined substances are in liquid phase at atmospheric pressure and at room temperature. The nuclear radiations to be measured are neutrons and gamma rays.
From previous experiences are expected neutron emissions in the form of pulses of variable duration and intensity, also the time intervals between successive pulses are expected to be variable. Regarding the gamma emissions, from previous measurements reported in the literature, are not expected to be higher than the natural background.
We will use mercury and/or metal nanoparticles in colloidal solutions. We intend to drive the reaction of metamorphosis of nuclear matter, to maximize the production of alphas and protons with respect to neutrons; we intend then to collect electric charges of nuclear origin -that is alphas and protons generated by metamorphosis of matter- with a semicircular capacitor acting as electric charge collector and charge it at a potential difference. Then short-circuiting it on a suitable impedance, we will be able to obtain current approved for introduction into the electrical network, this is the so-called direct conversion of electrical energy, which has the advantage of eliminating energy losses related to the use of dynamo (where the first loss is in the conversion primary mechanical energy for the passage of state water - industrial steam from 600 to 900 celsius; the second loss is due to friction on the axis of the turbine and its fins; the third source of loss is given by the joule effect of the current produced by the dynamo before it is fed into the network, in the transition from DC to AC current). In essence, a direct conversion is planned, precisely in order to maximize the efficiency of the energy generated by the nuclear

Nuclear emission from Matter Metamorphosis by Ultrasound Sonication

NEMMUS

CALL Area Interdisciplinare

RN S. Bellucci

Unità INFN: Laboratori Nazionali di Frascati (LNF)

Collaborazioni in Italia: High Sonic Technologies srl (HST)

NEMMUS

- **LNF Unit: 1 first researcher, 3 post-doc fellows (plus 1 post-doc fellows to be recruited)**.

  NEXT- nanotechnology group has extensive expertise in modelling, manufacturing, characterization, and nanodevices realization, as well as expertise from associated personnel including design and realization of setup for electric and electronic measurements and molecular design by chemical approach.

  LNF also matured remarkable capabilities and experience in electromagnetic shielding, electrical nanoIC, quantum electrodynamics, design, fabrication and electrical characterization of nanocarbon based electronic devices gas sensors.

  The contribution of LNF to the project will include nanomaterials production by CVD and MW thermal exfoliation, chemical functionalization, SEM, AFM, FTIR, Raman spectroscopy.

INFN team conducts research in the fields of nanoscience and nanotechnology, nanomaterials and nanocomposites modelling, manufacturing, characterization and nanodevices realization.

The group has been active in the last 23 years in the theory of nanostructures and 20 years in experimental nanoscience and nanotechnology applications.

- **HST High Sonic Technology srl**

  provides to the collaboration the know-how for ultrasonic machines and zinc sulfide neutron detectors (Ortek, Zn sulfide alpha detectors), useful for the detection of both alpha and neutrons, with measurement made both for energy and counting.

NEMMUS WP's e richieste finanziarie

WP#	Work Package Title	Lead Participant	Person-Months	Start Month	End month
1	Project management	**INFN**	6	1	36
2	Theoretical modeling for the microscopic mechanism of the hypothetical piezonuclear reactions, by inertial confinement	**INFN**	16	1	24
3	Development of the synthesis method for metal nanoparticles preparation	**INFN**	12	1	30
4	Realization of a prototype for the metamorphosis of matter by sonication of liquid and solid materials	**HST**	38	1	36
5	Validation of the prototype in laboratory conditions: yield of energy produced, in the form of both heat and electricity	**HST**	38	22	36
6	Exploitation and dissemination of the Project results	**INFN**	24	7	36
	Total Person-Months		134		

Capitolo	Descrizione	Parziali (k€)		Rimuovi	Modifica	Totale (k€)	
		Richieste	SJ			Richieste	SJ
altri_cons	2 Assegni di ricerca senior	78.00	0.00			78	0
consumo	gas, reagenti e altri consumabili	5.00	0.00			5	0
missioni	partecipazione a conferenze su tematiche dell'esperimento	5.00	0.00			5	0
inventario	nuove linee di gas e canister per sublimazioni metalli	118.00	0.00			118	0
manutenzione	manutenzione e ricambi strumentazione elettronica	2.00	0.00			2	0
Totale						208	0

New proposals w RL@LNF

HB_2TF CALL proposal

➢ Development of a High Brightness Beams Test Facility (HB_2TF) at the INFN-LASA laboratory.

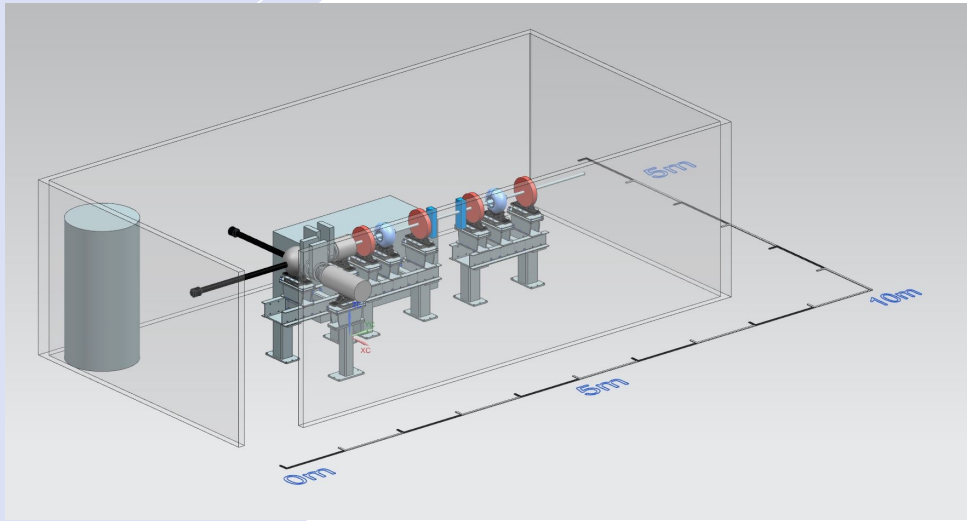
The Test Facility will allow to perform developments in the areas listed below and to carry out experiments with the high current CW electron beam in frontier areas of accelerator physics.

- High duty-factor, for higher average performance figures;
- High beam quality, for higher single-bunch performance figures;
- Novel techniques for gun developments;
- High operational reliability of the entire injector system;
- More performing cathodes and cathode research;
- Deeper study of electron injectors design.

The Test Facility setup will comprise a high-performance laser driven DC Gun followed by a normal conducting RF buncher-acceleration section to provide 1 MeV 5 mA CW electron beam.

The engineering design of a Superconducting RF booster linac able to increase the electron energies up to 5-10 MeV maintaining beam current up to 2.5 mA will be part of the proposal even if its financing and realization will be delegated to other requests.

Units: MI, LNF, LNL, LNS, BO, NA



Unit	Partecipant	Role	FTE
LNF	D. Alesini	Dir.Tec. INFN	10%
LNF	L. Faillace (RL)	Tec. INFN	20%
LNF	C. Vaccarezza	Primo Tec. INFN	15%
LNF	F. Cardelli	Tec. INFN	10%
LNF	L. Piersanti	Ric. INFN	10%

New from PNRR

EUAPS

IRIS

TECHNOPOLE

Innovative Research Infrastructure on applied Superconductivity

Call PNRR «Infrastrutture di Ricerca»

Technical Coordinator: Lucio Rossi, Unimi & INFN-Mi

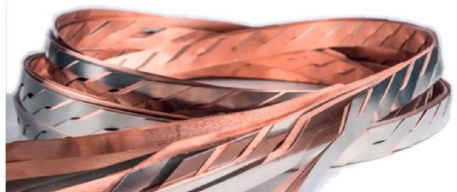
Spokeperson: Pierluigi Campana, INFN

OBIETTIVI

Creazione di una nuova infrastruttura di ricerca distribuita sul territorio per le tecnologie basate sulla superconduttività, tramite il potenziamento di una rete di laboratori

Due dimostratori:

- costruzione di un prototipo di linea elettrica “green”, capace di trasportare 1 GW di potenza senza emissioniLinea trasporto energia - Transizione energetica
- costruzione di un magnete HTS a basso consumo (sostenibilità) – acceleratori, medicina

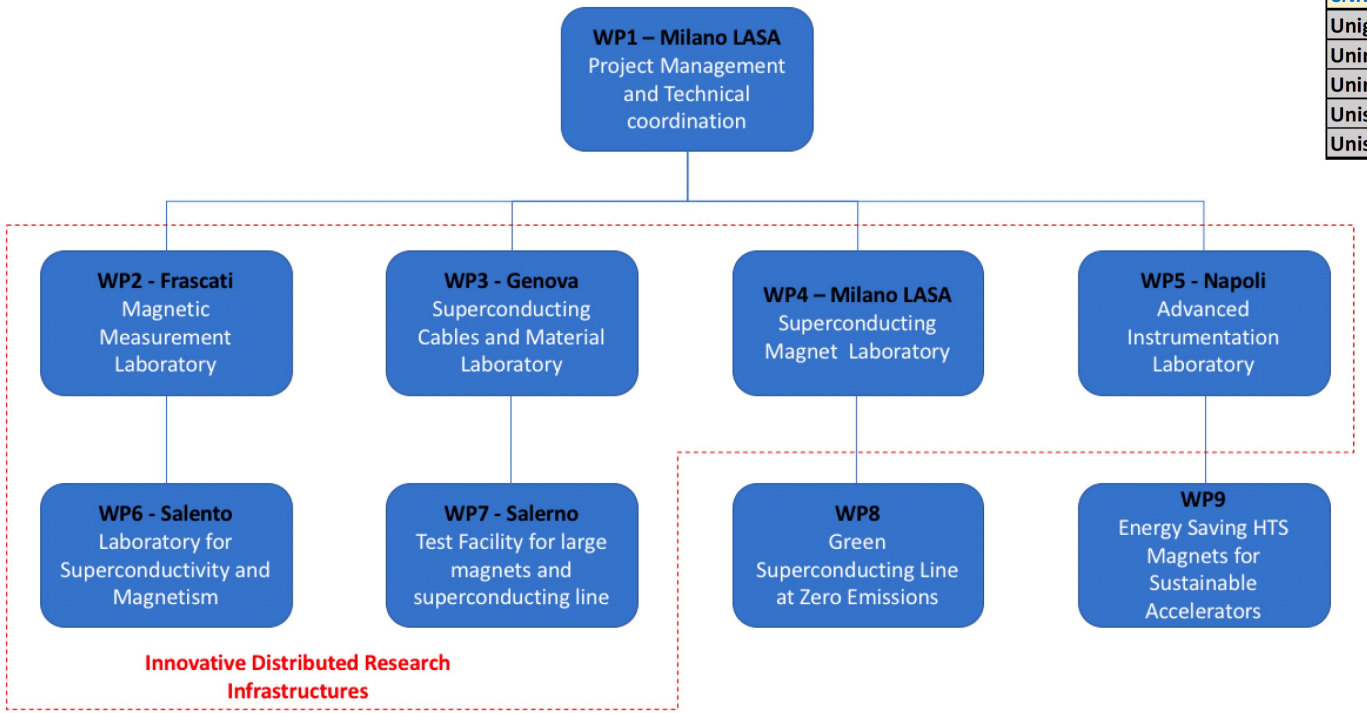


PARTENARIATO E BUDGET

IR	tot rev
INFN	€ 39,572,238.37
SPIN	€ 2,416,027.45
UniGE	€ 1,182,350.94
UniMI	€ 5,532,061.30
UniNA	€ 2,044,395.50
UniSalento	€ 3,605,900.00
UniSA	€ 5,643,994.61
Totale	**€ 59,996,968.17**

Institutes	WP#	Reported	7%ovhd	TOT.Reimb
INFN	LNF WP2	1,046,760.00 €	73,273.20 €	1,120,033.20 €
INFN	GE WP3	3,211,899.80 €	224,832.99 €	3,436,732.79 €
INFN	MI WP1-4-8-9	25,401,910.34 €	1,778,133.72 €	27,180,044.07 €
INFN	NA-SA WP7	7,322,830.20 €	512,598.11 €	7,835,428.31 €
INFN	*TOT*	*36,983,400.34 €*	*2,588,838.02 €*	*39,572,238.37 €*
CNR-SPIN	GE WP3	1,090,099.58 €	76,306.97 €	1,166,406.55 €
CNR-SPIN	NA WP5	480,020.00 €	33,601.40 €	513,621.40 €
CNR-SPIN	SA WP7	687,850.00 €	48,149.50 €	735,999.50 €
CNR-SPIN	*TOT*	*2,257,969.58 €*	*158,057.87 €*	*2,416,027.45 €*
Unige	TOT WP3	1,105,000.88 €	77,350.06 €	1,182,350.94 €
Unimi	TOT WP4-9	5,170,150.75 €	361,910.55 €	5,532,061.30 €
Unina	TOT WP5	1,910,650.00 €	133,745.50 €	2,044,395.50 €
Unisalento	TOT WP6	3,370,000.00 €	235,900.00 €	3,605,900.00 €
Unisa	TOT WP7	5,274,761.32 €	369,233.29 €	5,643,994.61 €
	Grand Tot	**56,071,932.87 €**	**3,925,035.30 €**	**59,996,968.17 €**

ORGANIZZAZIONE



Rome Technopole
Ecosistemi per l'Innovazione

→ *PNRR_Tecnopolo_CSN5*

Partenariato e budget

Partner	Budget totale
Università La Sapienza (Capofila)	44.582.761,00 €
Università Roma Tor Vergata	12.918.173,00 €
Università Roma Tre	11.648.481,00 €
Università di Cassino	5.150.200,00 €
Università della Tuscia	5.982.669,00 €
CNR	4.702.775,00 €
LUISS	1.157.759,00 €
INFN == INFN-LNF	**2.885.370,00 €**
ISS	3.639.161,00 €
ENEA	3.129.799,00 €
Università Campus BioMedico	2.687.921,00 €
AirbusItalia	232.026,00 €
Almaviva	988.721,00 €
BVTech	1.716.746,00 €
Catalent Anagni	1.483.253,00 €
Coima	221.220,00 €
ENI	150.000,00 €
Leonardo	794.361,00 €
Lventure Group	1.027.737,00 €
Maire Tecnimont	497.606,00 €
MBDA	494.361,00 €
Takis Biotech	988.721,00 €
Thales	1.931.456,00 €
Unicredit	494.361,00 €
Unidata	494.361,00 €
	109.999.999,00 €

- **8 Giugno 2022**
  Costituzione Fondazione
- **1 Luglio 2022**
  Inizio progetto
- **Milestones**
  ogni Ottobre – Maggio
- **30 Giugno 2025**
  fine progetto

Rome Technopole @LNF

SPOKE 5 - Out-reach, public engagement e life long learning
Leader: Università degli Studi della Tuscia

SPOKE 6 - Open Lab - Joint Lab, formazione in collaborazione con le imprese
Leader: Università degli Studi La Sapienza

- **FP6 -** Artificial intelligence, virtual reality and digital twin for advanced engineering and aerospace (Digital Transition)
- **FP2 -** Energy transition and digital transition in urban regeneration and construction (Energy Transition and Digital Transition)
- **FP4 -** Development, innovation and certification of medical and non-medical devices for health (Health and Biopharma)
- **FP7 -** Advanced and automated innovation labs for diagnostic and therapeutic biopharma solutions (Health and Biopharma)

- ❑ Contribution to the outreach and public engagement aimed at disseminating the culture of digital transition and green technology for urban regeneration including the design and realization of multimedia products with examples on existing areas (e.g. the Castelli Romani area).
- ❑ Design and realization of multimedia ICT products illustrating the development of medical devices and the experimental testing needed for their validation, of artificial intelligence (machine & deep learning), of diagnostic and therapeutic biopharma solutions.

- ❑ Empowerment and training at Open Research Infrastructure for Innovation of Lazio (IARI).
- ❑ Joint Open Labs with spoke network to develop Co-design and co-engineering thinking to discover new innovative solutions to be tested, validated and integrated in the field of advanced engineering for aerospace and medical applications exploiting emerging digital technologies: Artificial Intelligence, big-data analytics, Virtual and augmented reality, Digital Twin.

Rome Technopole @LNF

SPOKE 5 - Out-reach, public engagement e life long learning

Personale	Mesi-Uomo
Antonio Budano	3
Danilo Domenici	3
Elisabetta Vilucchi	1
Emiliano Dané	3
Francesca Cuicchio	3
Francesca Scianitti	3
Matteo Mario Beretta	1
Paola Angeletti	3
Paola Gianotti	1
Pasquale Di Nezza	3
Ruggero Ricci	1
Simona Incremona	3
Susanna Bertelli	**4**

SPOKE 6 - Open Lab - Joint Lab, formazio in collaborazione con le imprese

Personale	Mesi-Uomo
Andrea Ghigo	3
Antonio Falone	4
Bruno Buonomo	4
Claudio Di Giulio	4
Enrico Di Pasquale	4
Fabio Cardelli	4
Fabio Villa	3
Luca Piersanti	4
Lucia Sabbatini	1
Maria Pia Anania	3
Stefano Pioli	**4**

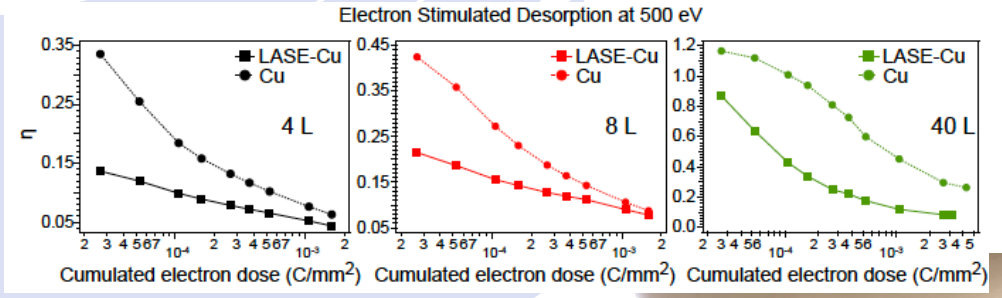

2022 ongoing
experiments

ARYA

SurfAce and mateRial studies for Accelerator TechnologY And related topics

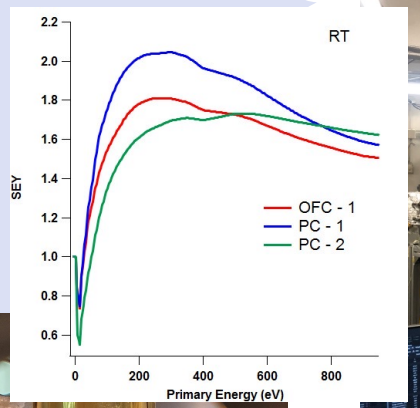
LNF-INFN
Na-INFN
Roma1-INFN
CERN

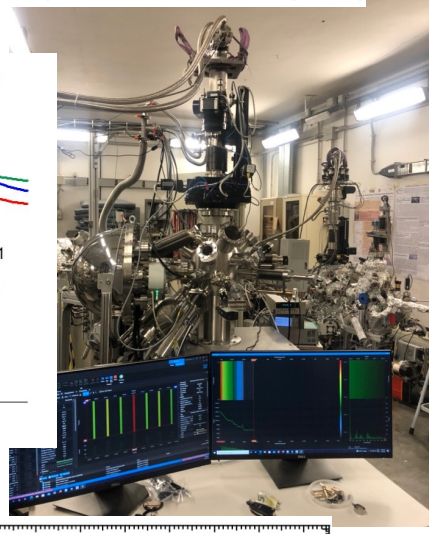
WP	TITLE	UNITS INVOLVED	RESPONSIBLE
WP1	Comparative study and characterization of stimulated desorption induced by electrons and photons.	LNF-INFN CERN	M. Angelucci & L. Spallino
WP4	LHCspin: Validation of the surface properties of the accumulation cell with atomic Hydrogen.	CERN LNF-INFN	P. Di Nezza & M. Angelucci

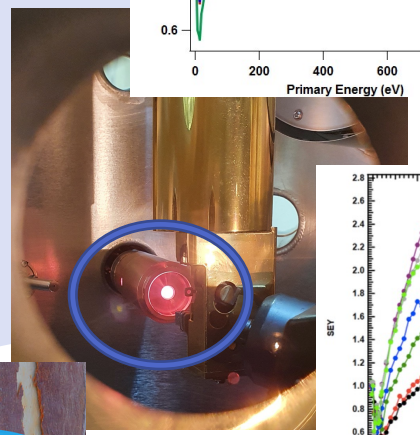


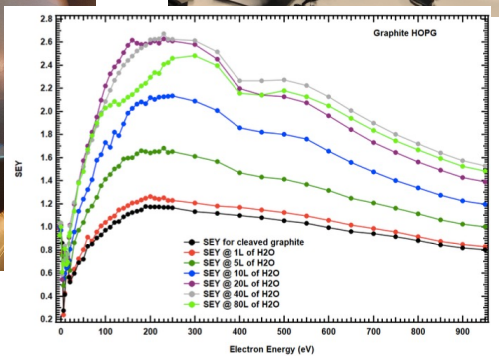
Attività @LNF 2022

- WP1:
  - Misure di Elettrodesorbimento da campioni porosi
  - Misure SEY a RT e LT sui campioni LIPSS in collaborazione con gruppo Na-INFN
  - Montaggio e commissioning nuovo sistema di misura
- WP4:
  - Montaggio e test sorgente idrogeno atomico
  - Misure preliminari di SEY su H_2O criosorbita su Cu e Grafite









- Preparazione workshop e-Cloud'22

ARYA

SurfAce and mateRial studies for Accelerator TechnologY And related topics

LNF-INFN
Na-INFN
Roma1-INFN
CERN

Attività e milestone @LNF 2023

Grazie al nuovo sistema multifunzione si utilizzeranno le diverse tecniche complementari a disposizione per studi combinati di XPS, SEY, ESD, su materiali (LIPSS, LASE, a-C, etc.) di interesse per il progetto. L'obiettivo è la comprensione degli effetti indotti dalle interazioni delle superfici con elettroni e fotoni in funzione di gas adsorbiti, coatings e della morfologia.

- **WP1**:
  - Commissioning finale nuovo sistema di misura
  - Misure e caratterizzazioni campioni di interesse per la collaborazione e il progetto
- **WP4**:
  - Misure SEY di H_2O criosorbita su campioni forniti dal CERN
  - Investigazione effetti idrogeno atomico su superfici criogeniche con H_2O criosorbita

FTE (3.1 tot): R. Cimino (50%, Resp. Loc.), M. Angelucci (50%), L. Spallino (50%), P. di Nezza (10%), R. Larciprete (100%), A. Balerna (20%), A. Liedl (20%), S. Bini (10%), F. Cioeta (10%), M. Zobov (10%) (da confermare)

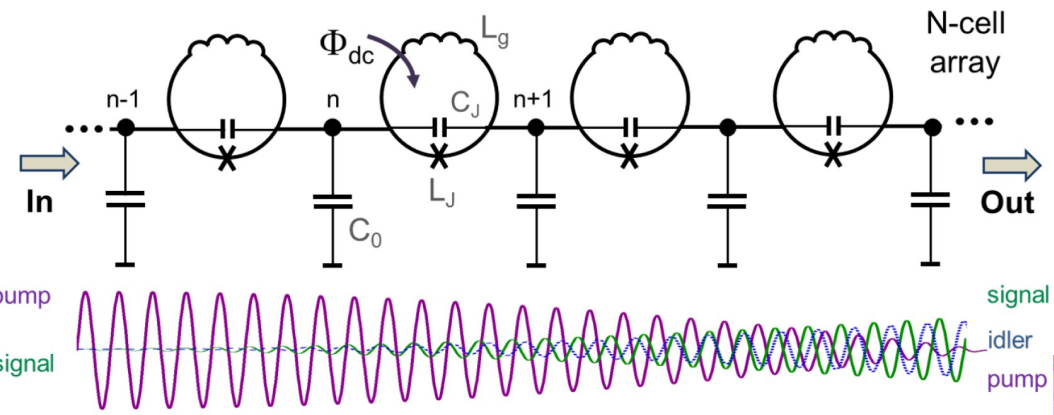
Richieste Finanziarie WP1 + WP4:

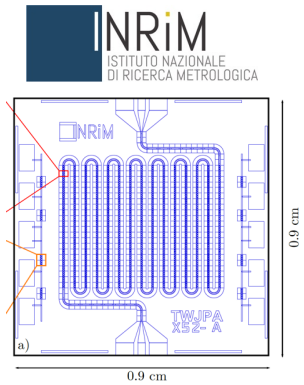
- Consumo: WP1 20k€ + WP4 5k€ = 25k€
  Flange e guarnizioni, tubi compressore elio, lavorazioni meccaniche, gas puri, sensori pressione…
- Missioni: WP1 12k€ + WP4 8k€ = 20k€
  Spostamenti tra laboratori, CERN, IPAC'23…

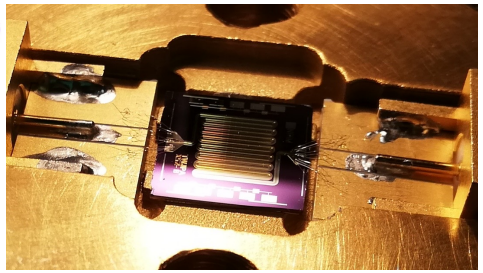
C Gatti C Ligi

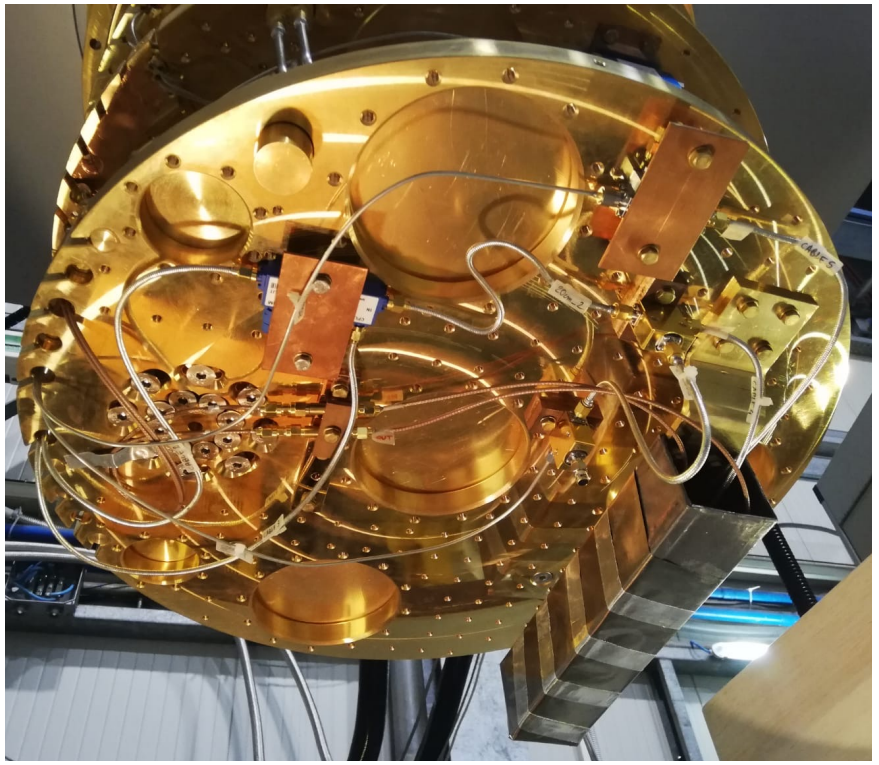
DART WARS: Detector Array Readout with Travelling Wave AmplifieRS

Travelling Wave Josephson Parametric Amplifiers amplify microwave signal over a broad range adding the minimum noise set by quantum mechanics.









DART WARS 2021-2023 (Call GR V)
MIB (PI)
LNF (RL Ligi)
INFN Sa
TIFPA
INRIM
INFN-Le

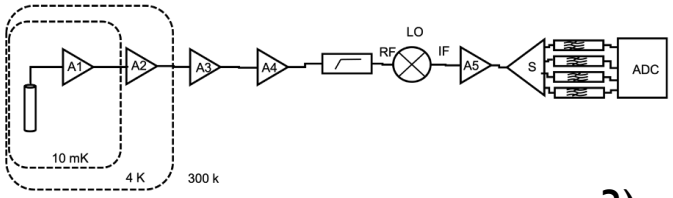
DARTWARS
Detector Array Readout with Traveling Wave AmplifieRS

ACTIVITY 2021-2022

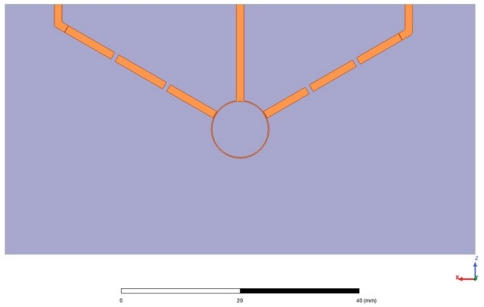
1. Scheme of signal acquisition system from multiple cavity with TWPA
2. Design and simulation of Diplexer, a low loss combiner for cavity signals
3. Characterization of LNF cryogenic setup for Quantum measurements with JJ and JPA
4. Design, simulation and fabrication of new sample-holder with multiple DC and RF lines
5. Characterization of TWJPA of INRIM

LNF Goal: Exploit TWPA large bandwith and noise at quantum limit to read out the signal from multiple resonant cavities for axion detection.

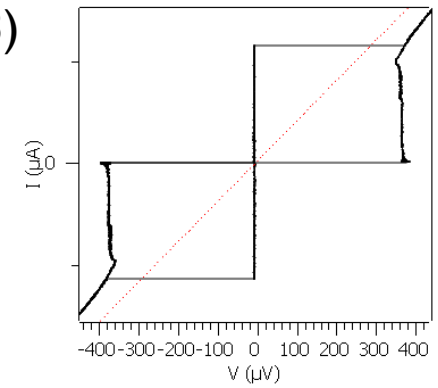
1)



2)



3)



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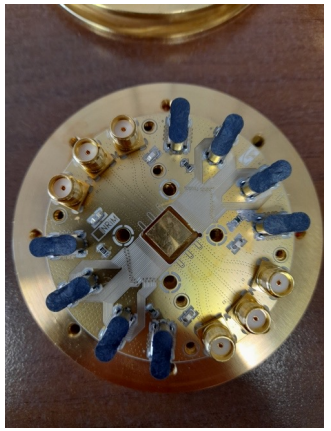

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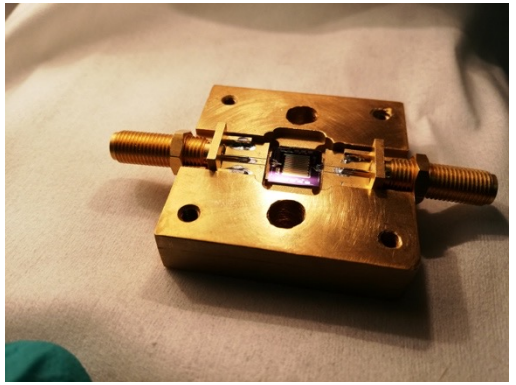


ACTIVITY 2023

DART WARS LNF	FTE
Carlo Ligi (RL)	0,3
Claudio Gatti	0,1
Giovanni Maccarrone	0,3
Alessio Rettaroli (AdR)	1
Luca Piersanti	0,2 (PNRR-PE ?)
TOT	1,9

Tasks Description

Task 4.1: Set up of the experimental instrumentations (M1-M6) DONE

Task 4.2: Experimental characterization of the performances of produced TWJPAs (M12-30); Done on first production. Waiting for second production.

Task 4.3: Test of produced TWJPAs and read out demonstration with detectors (M24-36); Task for 2023

Deliverables

D4.1 : Setup of the experimental instrumentations (M6) DONE

D4.2 : Report on the TWJPA characterization (M18/M30) DONE on first production

D4.3 : Report on the read out demonstration with TWJPA (M36) Deliverable for 2023

- 15K€ Fabbricazione TWPA at INRiM
- AdR 25 k€ (extension existing AdR)
- Xilinx ZCU208 16.5 keuro
- 5keuro travel
- Consumo 10 keuro (resonant cavity, diplexer)

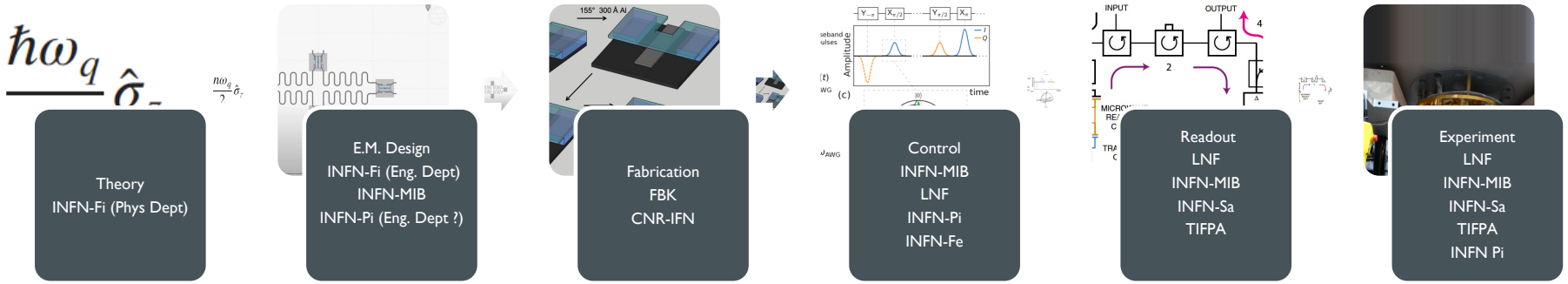
Qub-IT

Objective: Realization of an **itinerant single-photon counter** based on **entangled qubits**

Specific Objectives:

1. Design and simulation of a SC qubit coupled to resonators
2. Fabrication of superconducting circuits with SC qubit
3. Single shot readout of SC qubit with quantum amplifier
4. Control of SC qubit with FPGA-based board
5. Quantum sensing experiment with entangled sensors

Qub-IT



Qub-IT 2022-2025
LNF (PI Gatti)
INFN MIB
INFN Sa
TIFPA
INFN Pi
INFN Fi
INFN Fe
FBK
CNR-IFN

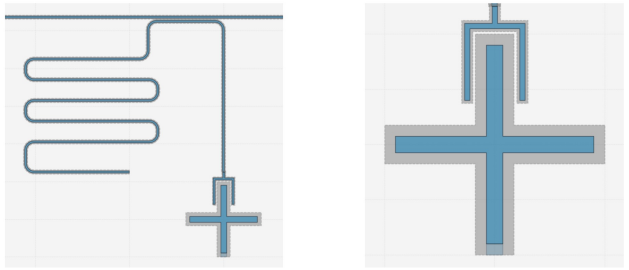
ACTIVITY 2022

Deliverables:
D1.1 Components design (resonators, capacitors, JJ) (M6) DONE
D1.2 Design of Transmon coupled to 1 resonator (M10) DONE
D1.3 Design 3D Transmon (M12) Starting
D1.4 Design of JPA (M13) DONE

Milestones:
M1.1 Realization of first Transmon chip layout (M6) DONE

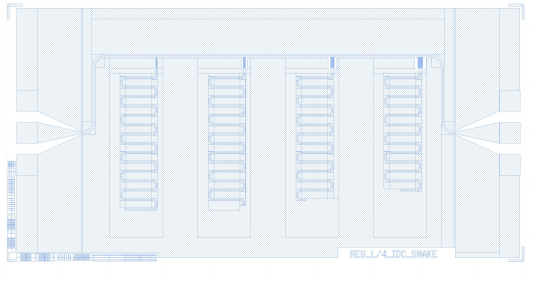
Deliverables
D2.1 Fabrication of test chip with components, resonators, capacitors and JJ for process calibration (M9) ONGOING at FKB
D2.3 Fabrication of JPA (M18) ONGOING at FKB (1 year in advance)

D1.2 and M1.1



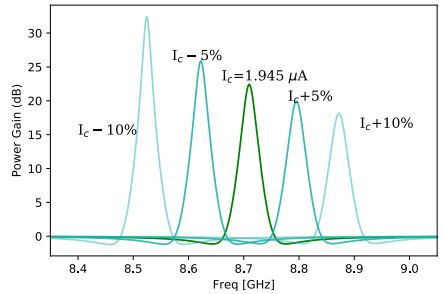
Example of resonator chip design

D1.1

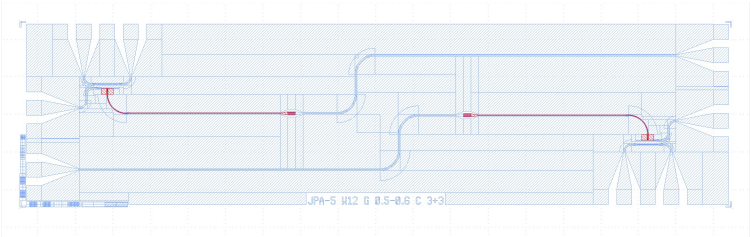


Simulation of JPA Gain

D1.4



JPA chip design



ACTIVITY 2023

QUBIT LNF	FTE
Carlo Ligi (RL)	0,2
Claudio Gatti (RN)	0,3 (PNRR-CN)
Babusci Danilo	0,4
Luca Piersanti	0,1 (PNRR-PE ?)
Matteo Beretta	0,25 (PNRR-CN)
Bruno Buonomo	0,2
Luca Foggetta	0,2
Daniele Di Gioacchino	0,2
Guido Torrioli	0,2 (CNR-IFN)
Fabio Chiarello	0,3 (CNR-IFN)
Francesco Mattioli	0,2 (CNR-IFN)
Simone Felicetti	0,2 (CNR-IFN)
TOT	2,75 (0,5 PNRR)

Deliverables:

D3.1 First release of the Qibo qubit hardware control package (M18) We will install and configure Qibo software to control lab instruments for qubit control; FPGA firmware for pulse generation of readout and control of qubits.

D4.1 Circuit components characterization (M12) We will test resonators and junctions
D4.2 Experiments with Transmon coupled to one resonator (M14) We will test the first production of transmon qubits

Milestone:

M4.1 Succesful characterization of first Transmon qubit (M14)

- Device fabrication CNR-IFN 15k€
- DC power supply 1 k€
- Microwave (MixerIQ, splitters, SC cable, programmable attenuator) 15k€
- Travel 3k€
- Sonnet licence xk€

RICHIESTE 2023 COLD LAB (QUAX, QUBIT, DART WARS …)

Richieste COLD LAB 2023:

- 4 mu tecnico meccanico
- 4 mu tecnico elettronico
- 4 mu progettazione meccanica (DA)
- 4 mu progettazione elettronica
- 4 mu officina meccanica
- 6 mu tecnico criogenico

In linea con richieste 2022

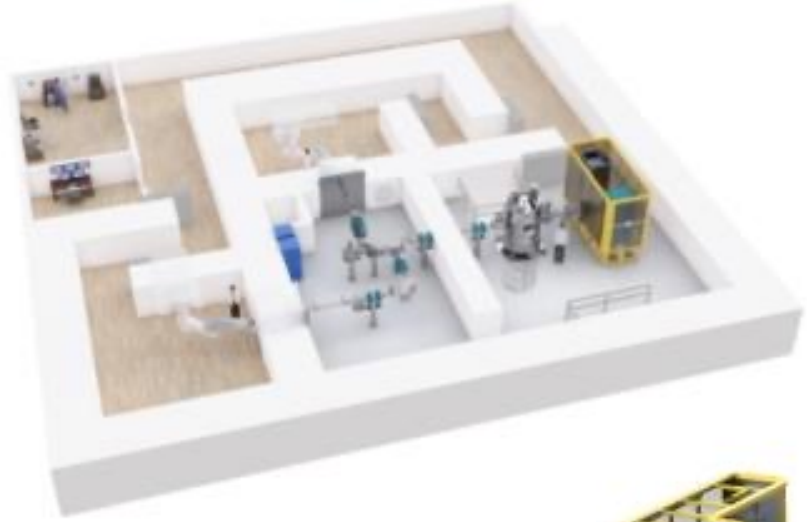
ENTER_BNCT

2020-2022 + prolungamento 2023

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

Filling the technology gap between research and clinical application of Boron Neutron Capture oncologic Therapy (BNCT)

Pavia, Torino, LNL, LNF
R.N. Saverio Altieri (Pv)



Anagrafica LNF 2023

- Roberto Bedogni (0.3 FTE, resp. loc.)
- Alessandro Calamida (0.3 FTE, borsista)
- Claudio Cantone (0.2 FTE)
- José Maria Gomez Ros (0.2 FTE, ass.)
- Carlos Domingo Miralles (0.2 FTE, ass.)
- Antonino pietropaolo (0.5 FTE, ass.)

Totale 1.7 FTE

alpha beam

Alphabeam neutron system from TAE Life Sciences for CNAO: Tandem, 10 mA, 2.5 MeV p+ on Litihium

ENTER_BNCT

2020-2022 + prolungamento 2023

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

BNCT

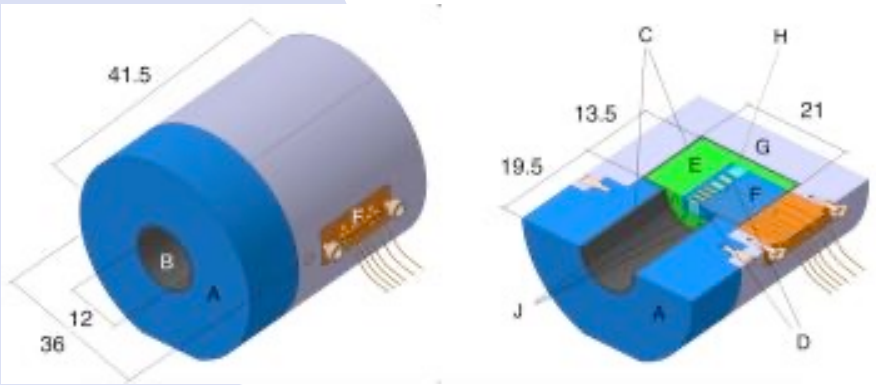
- Stable ^{10}B in drug is injected to reach cancerous cells
- a neutron beam induces ^{10}B (n, α) ^{7}Li reactions preferentially in tumor cells "labeled" with Boron
- The α and ^{7}Li secondary charged particles are densely ionizing (range 5-9 µm) and damage the tumour selectively and locally.

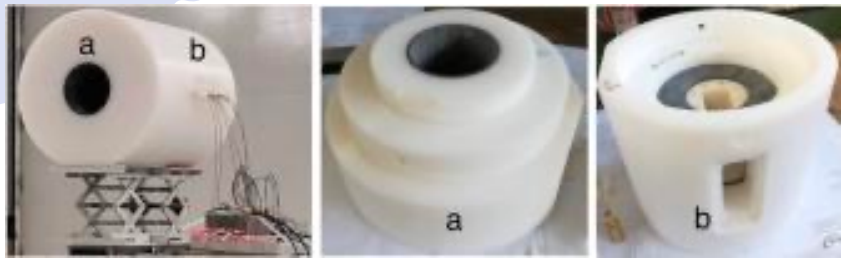
CNAO will build an accelerator-based BNCT line (from TAE Life sciences) and could be the first centre worldwide to administer hadron therapy (protons, carbon) and BCNT in combination.

ENTER_BNCT

- LNL: Studying proton beams and neutron targets
- PV: Neutron Beam shaping, in-vivo boron measurements
- LNF + To: Diagnostics for the therapeutic neutron beam
  - ✓ NCT-WES = eV - MeV single-moderator thermal spectrometer
  - ✓ CONES = dosimetry probes for in-vivo measurements

NCT-WES





ENTER_BNCT

2020-2022 + prolungamento 2023

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

LNF activity plan

2022

- Developed and tested the compact dosimetry probes (CONES)
- Characterised radiation hard SiC sensors as sensitive elements for NCT-WES and CONES
- NCT-WES spectrometer calibrated with monoenergetic n beams at NPL (UK) (13-15 June) energies: 71, 144, 565, 842, 1200 keV

Extension requested to cover 2023

Test in clinical beam can NOT be done in 2022 as expected, as commissioning of Helsinki BNCT facility will be completed only at end 2022.

2023 Funding requests for LNF

- 5.5 k€ missioni
- 3.5 k€ spedizione materiale
- 2 k€ consumo
- Nessuna richiesta ai servizi

IMPACT (1st year)

Improve Materials Performances with Advanced Coatings Technologies

Proposal for 2022-2023 (1+1) [LNF +RM1] Contacts with other units are in progress

- The goal of this project is to enhance the properties of strategic materials like copper or niobium using advanced coatings technology for the new accelerator. The proposal is based on the experience gained within NUCLEAAR and TERA projects [5th National Committee].
  Thin film of transition metals oxides or dichalcogenides can be used to:
  - *Enhance properties of high power RF-cavities made by oxygen free copper*
  - *Improve the emission properties of photo-anode in state of the art seeded FELs.*
  - *Coat high entropy alloys: a new class of materials for the space applications.*

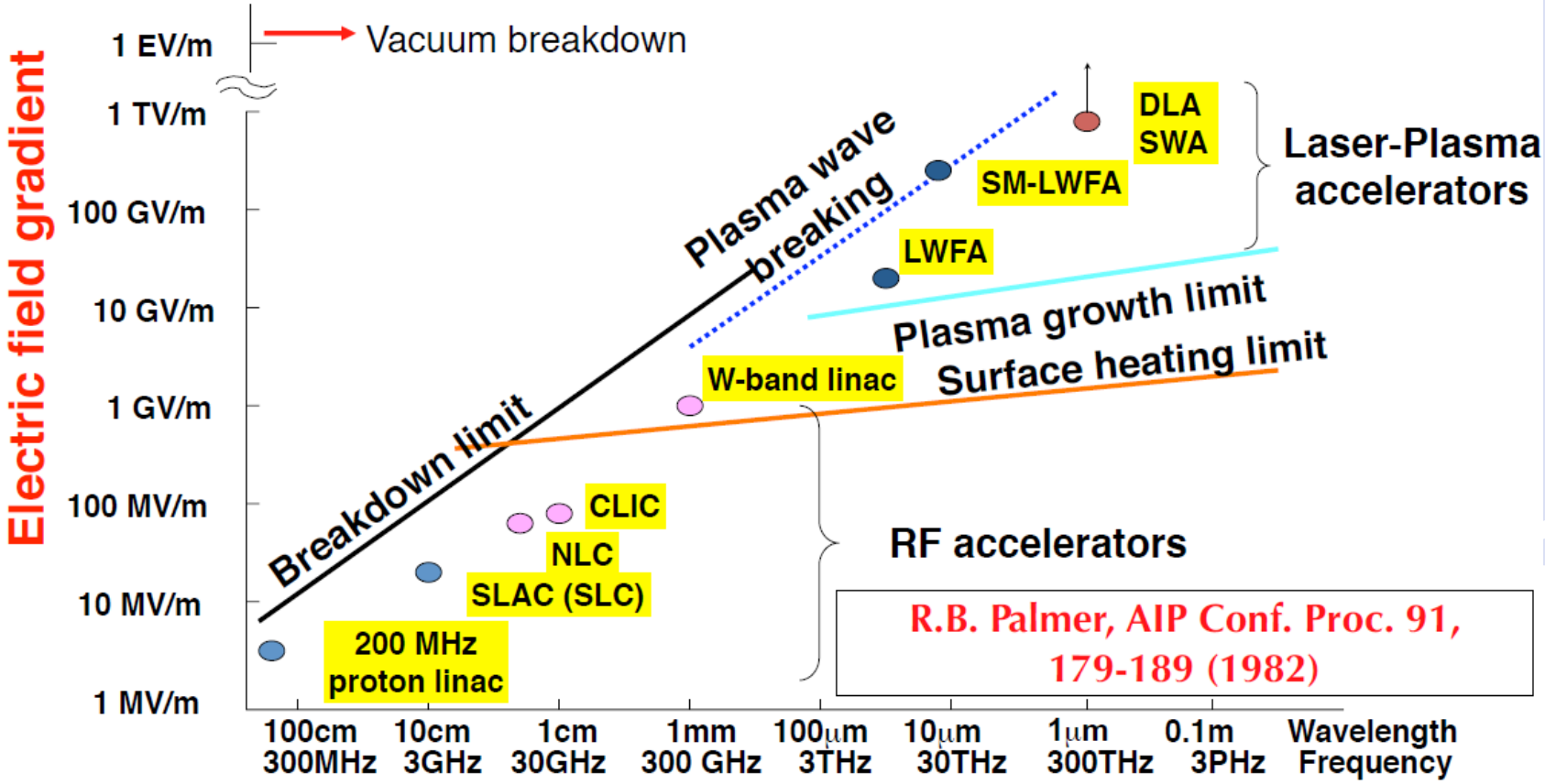
Milestones

Year 1: Synthesis and optical tests at low and high electric field of films with different thickness and degree of cristallinity

Year 2: Plasmonic and polaritonic dynamics investigation of films by THz sources (high power lasers and FELs)

IMPACT

Accelerating field limits



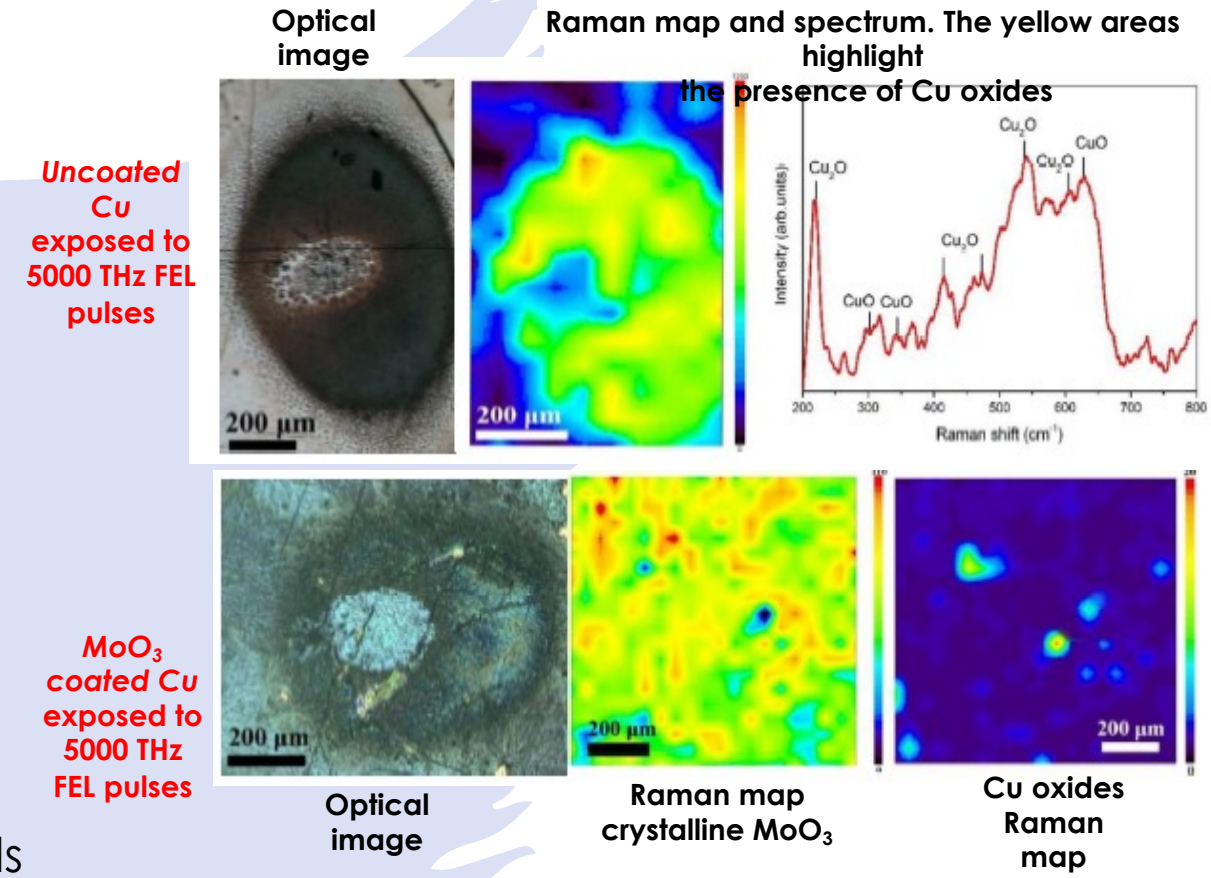
The breakdown phenomenon on the surface limits the performance of high electric field gradient accelerators.

Minimize Breakdown phenomena using coating technologies

IMPACT

- Starting from the experience and the instrumentation developed in NUCLEAAR we deposited TM oxides with different degrees of crystallinity. In particular, we demonstrated the efficiency of MoO_3 coatings as protective layer for metallic copper. the increase of the Work Function (WF) of ....., and the excitation of quasi particles (e.g., polaritons) we observed extreme confinement of radiation in thin and ultra thin films (hundreds of nm).

- We will concentrate on the deposit of MoO_3 coatings, but a certain time will be dedicated also to other oxides (e.g., V_2O_5, another Van der Waals and hyperbolic material with a high WF).
- Tests on synthesized films and flakes from single crystals will be carried out in collaboration with the Roma1 unit, using the experimental set-up developed with the TERA Project approved by the 5th National Scientific Committee.
- A test device of cylindrical shape about 10 cm made with MoO_3 coatings is going to be assembled.



References

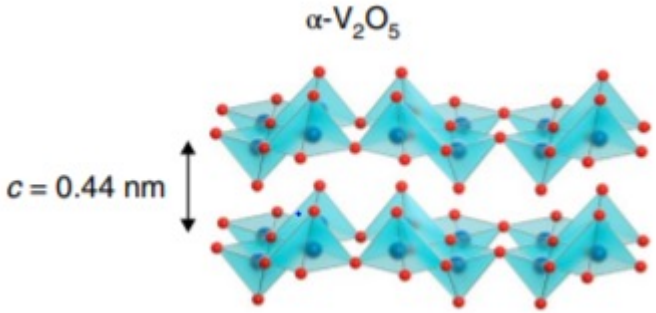
- S. Macis et al, Journal of Vacuum Science & Technology A **37**, 021513 (2019) https://doi.org/10.1116/1.5078794;
-S. Macis et al, Condens. Matter (2019) , 4(2) https://doi.org/10.3390/condmat4020041

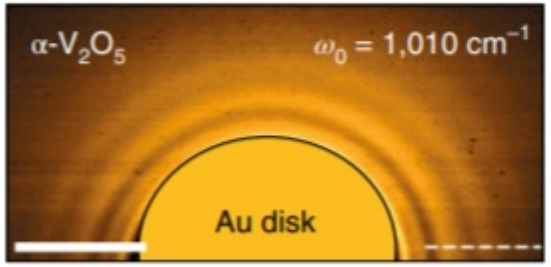
IMPACT

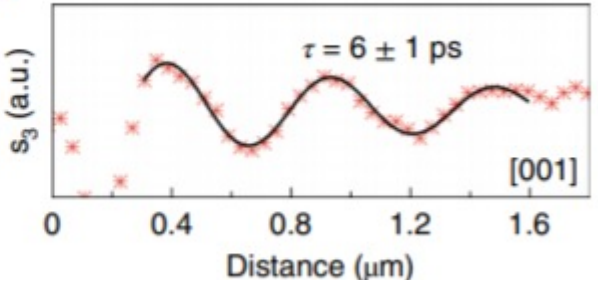
WP1: Study of MoO3 & new hyperbolic vdW materials

In addition to the high WF, MoO_3 is a hyperbolic material able to confine the radiation and the electric field within few nanometers of thickness exploiting a hybrid light matter state called polaritons.

Another material with these characteristics is V_2O_5 , a van der Waals material which is able to confine and distribute radiation on its surface on the ultra fast time scale, therefore perfect as protective coating.







- J. Taboada-Gutiérrez, et al, Nature Materials 19, (2020), https://doi.org/10.1038/s41563-020-0665-0
- A. D'Elia et al. Phys. Chem. Chem. Phys., 22, (2020), https://doi.org/10.1039/D0CP00216J

IMPACT 2022

- Preparation of thin and thick films on copper with different degrees of crystallinity characterized by low electron field emission, high work function, high conductivity and high mechanical resistance
- Damage (breakdown) tests at high electric field using THz radiation up to several GV/m

Milestones 2022-2023

	Description	Deadline
WP1	Synthesis and preliminary structural and Work function characterization of amorphous and crystalline films deposited on Cu and on insulating substrate	June 2022
	IR-THz characterization of amorphous and crystalline films deposited on Cu. Preliminary tests of breakdown with high electric field THz Laser.	December 2022
WP2	Synthesis of $NbSe_2$ thin films and exfoliation of $NbSe_2$ down to monolayer. Preliminary structural and electrical caracterization using micro raman and measuring electronic transport properties	June 2022
	Accurate magneto transport properties for thin film and monolayer samples	December 2022

IMPACT – 3 FTE

Participants LNF 1.8 FTE

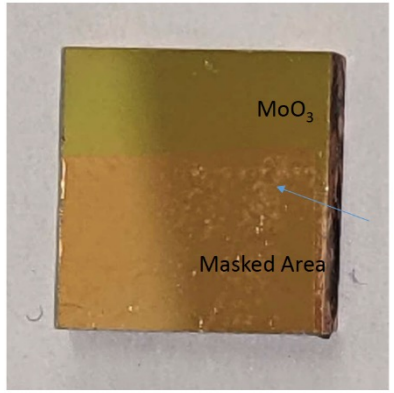
- Augusto Marcelli 30%
- Salvatore Macis 30%
- Paola De Padova 30%
- Javid S. Rezvani 30%
- Zeinab Ebrahimpour 30%
- Marcello Coreno 20%
- Luigi Faillace 10%
- Bruno Spataro 0%

Participants RM1 1.2 FTE

- Stefano Lupi 30%
- Sen Mou 30 %
- Annalisa D'Arco 30 %
- Massimo Petrarca 30 %

Collaborazioni

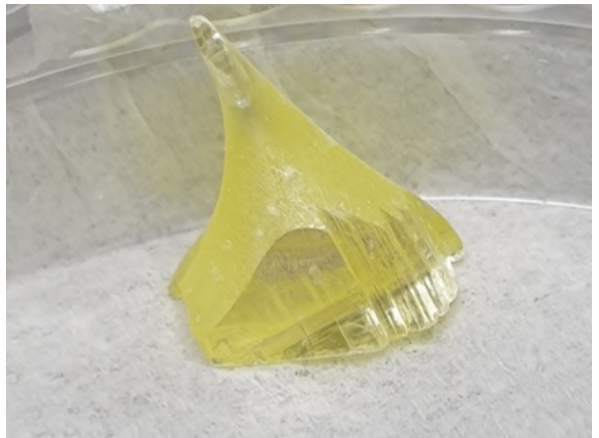
- Cambridge, Nottingham and Cranfield Univers
- Osaka University
- Seoul National University
- University of Science and Technology of China
- Tor Vergata University (Prof. Ivan Davoli, Prof. Massimiliano Lucci)
- Co u



Film visible on the masked side

ISIR@Osaka

MoO_3 single crystal



Attività progetto LLMCP

Gruppo LLMCP LNF (1.3 FTE)

A. Antonelli (0.3), S. Martellotti (0.3), M. Angelucci (0.1), Cestelli Guidi M. (0.1), T. Spadaro (RL, 0.4)

Gruppo LLMCP BO (1.3 FTE)

G. Bruni, L. Capriotti, F Ferrari, D. Manuzzi, S. Perazzini, V. Vagnoni (RN)

Scopo del progetto

Sviluppo di un nuovo rivelatore, evoluzione dei fotomoltiplicatori basati su multi-channel plates (MCP), con:

- Risoluzione temporale di O(ps)
- Alta resistenza a radiazioni (flussi di LHC upgrade)
- Costo moderato
- Potenziali applicazioni in LHCb/NA62

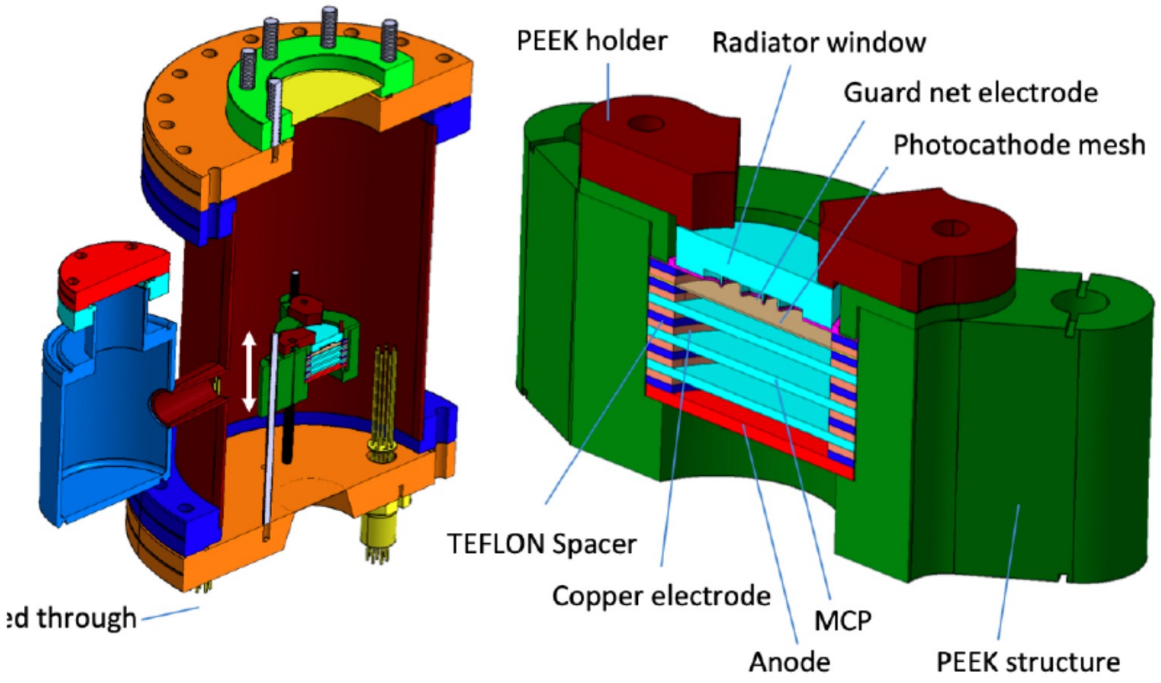
Attività 2021 a LNF

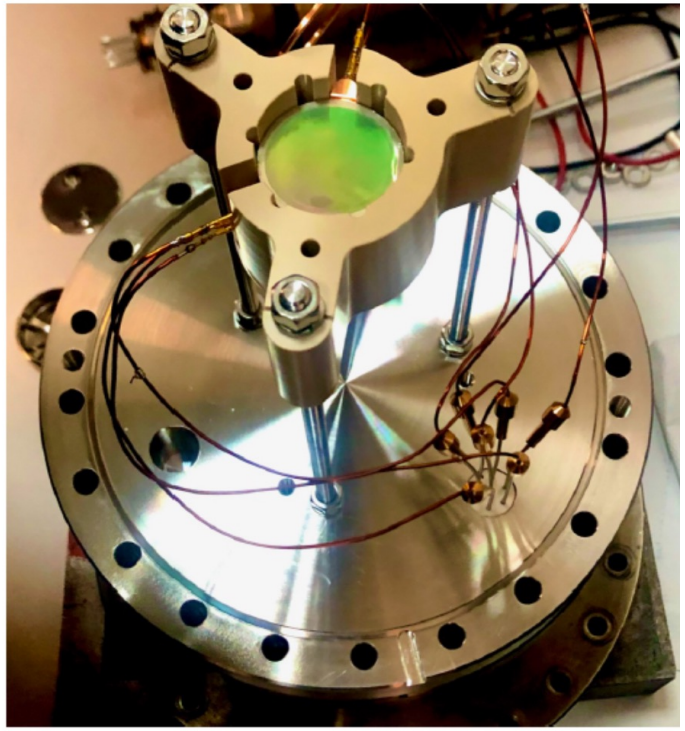
1. Progettazione e realizzazione prototipo “demountable”
2. Test su linea DUV Dafne Luce ($\lambda < 200$ nm)

1. Attività 2021 a LNF

Progettazione e realizzazione prototipo “demountable” [SPAS, S. Tomassini, A. Croce]

- Struttura isolante in PEEK, operazioni in vuoto < 10^{-5} mbar
- Fotocatodo a mesh con deposizione CsI
- Stage moltiplicazione con 2 MCP, elettrodi in rame
- Anodo [progettazione SEA, A. Balla]

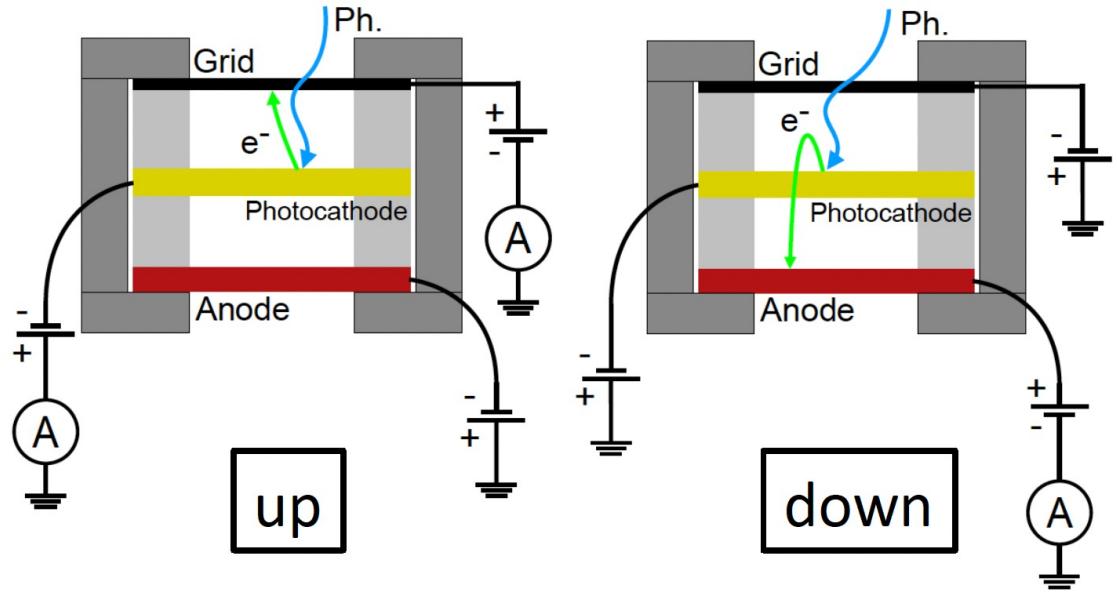




2. Attività 2021 a LNF

Test su linea DUV Dafne Luce ($\lambda < 200$ nm) [Ringraziamenti ad A. Grilli!]

- Caratterizzazione dell'efficienza quantica (QE)
- 2 setting ad hoc: raccolta su griglia superiore (up) o su anodo attraverso la mesh (down)
- QE(up) soddisfacente, QE(down) sotto le attese → necessari miglioramenti nella deposizione su fotocatodo



Attività 2022 [gruppo pressoché confermato]:

- Nuovo round test su linea DUV, possibilmente test BTF
- Test irraggiamento in ENEA Casaccia (gamma, neutroni)

MICRON (**MI**niaturised a**C**cele**R**at**O**rs **N**etwork)

Motivations

µICRON
MIniaturised aCceleRatOrs Network

INFN LNS

High <u>accelerating</u> gradients enable compact/miniaturized particle accelerators

<u>MAIN GOAL</u> of the PROPOSAL: <u>Miniaturization</u> of Accelerating Structures

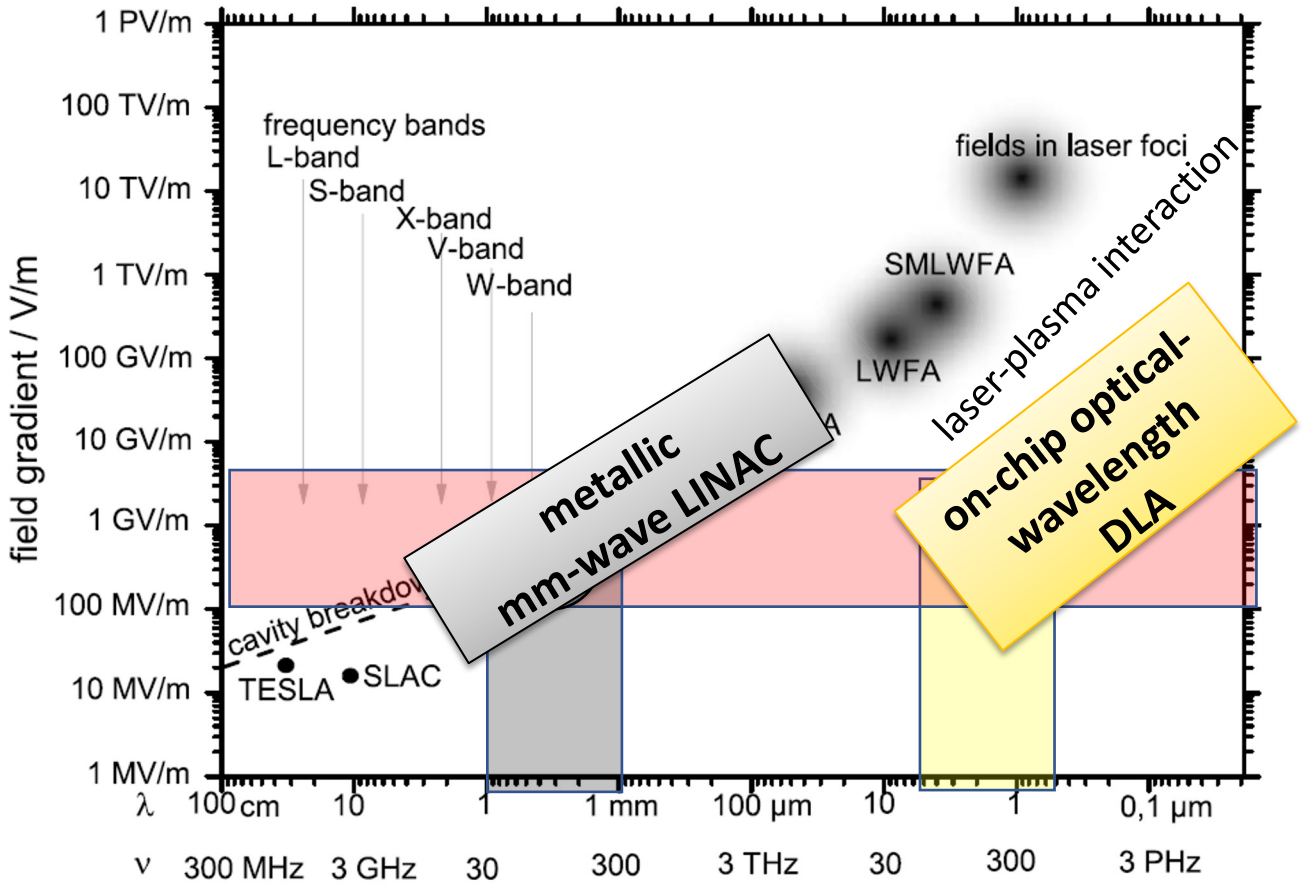
TARGET OF THE PROSAL

Accelerating Gradient: <u>~ 100 MV/m - 2 GV/m</u>

1) **<u>Metallic Structure</u> from <u>Ka to W-band</u> (35-200 GHz, mm-wavelength)**

2) **<u>Dielectric Laser Accelerator (DLA) structures operating at optical wavelengths</u> (~ 1- 5 µm)**

schematic overview of the accelerating gradient for different types of accelerators



MICRON (**MI**niaturised a**C**cele**R**at**O**rs **N**etwork)

Main goals

DIELECTRICS

1) "Technology-driven fabrication" based <u>Modeling of Photonic Crystal Dielectric Accelerating Structures</u>, having these features:

- **CW laser-pumped**
- **Wave-particle co-linear coupling**
- **MeVs** final energy
- **Acc. gradient >500 MV/m**

(also by identifying pitfalls & potential showstoppers)

2) <u>Basic tests of the fabrication technologies</u> to infer tolerances and other critical points to inspire structure configurations and numerical design.

METALS

1) **<u>Modeling of metallic Ka-band and W-band accelerating structures</u> providing Acceleration Gradient > 100 MV/m and superior breakdown-resistance.** R&D focus on:

- **"OPEN" Structure (jointless)**
- **"Four quadrants" RF cavity structure** that will allow **HOM damping**, **easy assembly**, **tuning** and re-machining, **no brazing**

2) <u>Prototype manufacturing</u> by CNC high-precision milling (R&D on material, hard-copper or copper alloy, and welding techniques)

1st YEAR MILESTONES

METALLIC

- **1.** Evaluation of Figure of Merits on the numerical model (R_{Sh} > 150 MΩ/m, Q> 5000) ✓
- **2.** Manufacturability test (tol < +- 3μm, Ra< +- 50 nm) (fine anno)

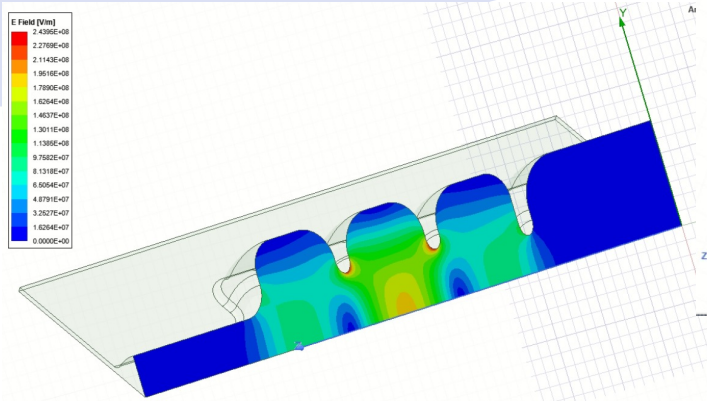
3.1 Fabbricazione Campioni (ordine approvato) ✓

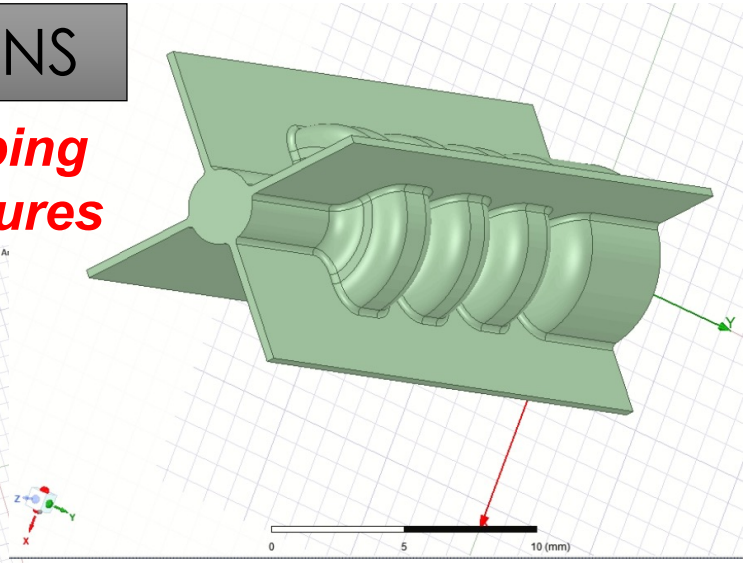
3.2 Misure metrologiche/test campioni (fine anno)

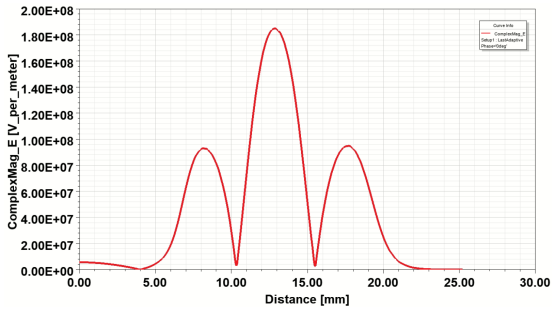
3.3 Misure Temperatura vs weling/brazing, e feedback al modeling (fine anno)

Attività LNF, Roma 1, LNS

Cavity Design and Prototyping – Multiple parts open structures







The electric field in the middle cell is two times higher in the middle cell in order to localize and analyze the RF breakdown events.

Quadrants vs. Closed structure

- Similar longitudinal shunt impedances;
- Higher lower-modes separation;
- Higher vacuum pumping capacity through slots;
- The quality factor decreases by only 2%.

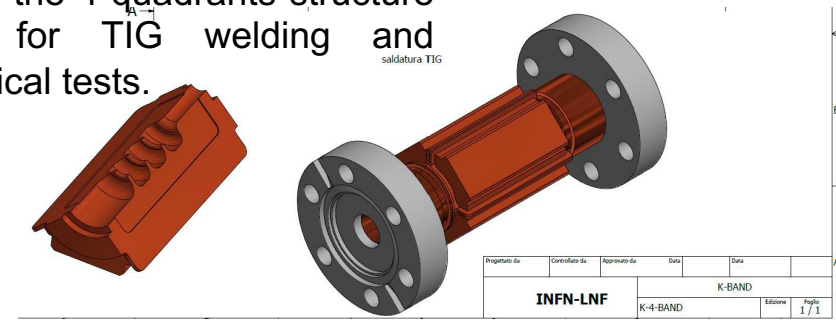
TIG welding on the outer slots → avoiding high temperature brazing and/or diffusion bonding processes (the typical assembly methods widely used to manufacture ultrahigh vacuum accelerating devices) which - occurring at about 800–1000 °C - significantly change the cavity mechanical properties.

Main RF Parameters

Resonant Modes	Closed structure	4 quadrants
0 mode frequency (GHz)	33.897	33.838
Pi/2 mode frequency (GHz)	34.603	34.580
Pi mode frequency (GHz) Operating mode	35.982	35.982
0 mode Quality factor	5,980	5,883
Pi/2 mode Quality factor	5,806	5,711
Pi mode Quality factor	5,978	5,877
Operating mode (pi) Longitudinal Shunt Impedance (MΩ/m)	240	235

Ka- band cavity Prototyping

Drawing of the 4-quadrants structure prototype for TIG welding and morphological tests.



MICRON (**MI**niaturised a**C**cele**R**at**O**rs **N**etwork)

Anagrafica 2022

MICRON TEAM MEMBERS

LNS		LNF		Milano		ROMA1		BOLOGNA	
NOME	**FTE**	**NOME**	**FTE**	**NOME**	**FTE**	**NOME**	**FTE**	**NOME**	**FTE**
Giuseppe Torrisi	50	Luigi Faillace	30	Alberto Bacci	25	Mauro Migliorati	40	Rita Rizzoli	15
David Mascali	10	Luca Piersanti	10	A. Rossi	20	F. Bosco (PhD)	50	Simona Marasso	15
Giorgio S. Mauro	50	Fabio Cardelli	10	M. Rossetti Conti	10	D. De Arcangelis	100	Valentina Bertana	0
Gino Sorbello	40	Alessandro Gallo	10	C. De Angelis	30			Caterina Summont	15
Loreto Di Donato	30	Marco Bellaveglia	10	G. Della Valle	50			Virginia Boldrini	10
Santi Pavone	25	Mostafa Behtouei	80	A. Locatelli	40			Fulvio Mancarella	0
Nunzio Salerno	60	Claudio Marcelli	10	L. Vincetti	40				
Tommaso Isernia	30	Antonio Falone	10	F. Broggi	20				
TOT	2,95	TOT	1,7	TOT	2,35	TOT	1,9	TOT	0,55

FTE_TOT 9,45

Anagrafica 2023 @LNF

NOME	FTE	Ruolo
Luigi Faillace	30	RL
Luca Piersanti	10	
Fabio Cardelli	10	
Alessandro Gallo	10	
Marco Bellaveglia	10	
Claudio Marcelli	10	
Antonio Falone	10	
Bruno Spataro	0	

TOT. FTE 0,9

Richieste finanziarie per l'anno 2023

STRUTTURA	MISSIONI [k€]	CONSUMO [ek]
LNF	5 k€ (SLAC)	21 k€ (prototipo)+7 k€ (leghe CU/Ag)

OLAGS
Optical Links for Atomic Gravity Sensors

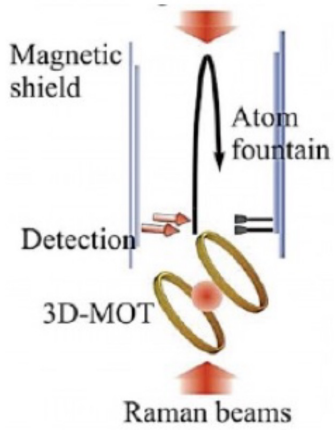
Coord. Naz. F. Sorrentino

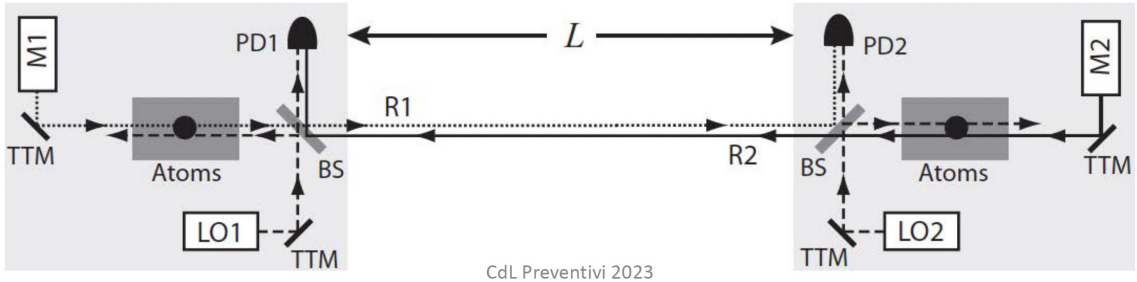
Coord. Locale A. Clozza

Attività LNF (0.4 FTE)

- 2021
  - Sviluppo elettronica di controllo delle movimentazioni antisismiche
    - Questa attività ha subito un ulteriore rallentamento a causa del perdurare dell'emergenza COVID-19
    - Assegnati 5 keuro S.J. Sbloccati a fine 2020 e subito impegnati.
- 2022
  - Le richieste sono per ottimizzazioni e ulteriori sviluppi dell'elettronica e della meccanica di controllo.
    - 7 keuro consumo per sviluppo di schede elettroniche di controllo movimentazioni antisismiche
    - 1.5 keuro missioni

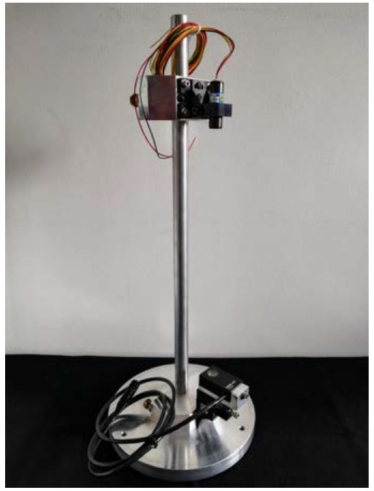
- GRAVIMETRI ATOMICI
  - Sono basati sull'interferometria atomica: laser cooling + manipolazione coerente di pacchetti d'onda atomici
  - Il rumore sismico è uno dei principali limiti di sensibilità (LNF)
- Concetto di Base
  - Dimostrare la possibilità di misurare il gradiente gravitazionale con due sensori atomici distanti interconnessi mediante un link ottico coerente
- Ambiti applicativi
  - Fisica terrestre e dell'ambiente
  - Rivelazione di onde gravitazionali
  - Fisica fondamentale

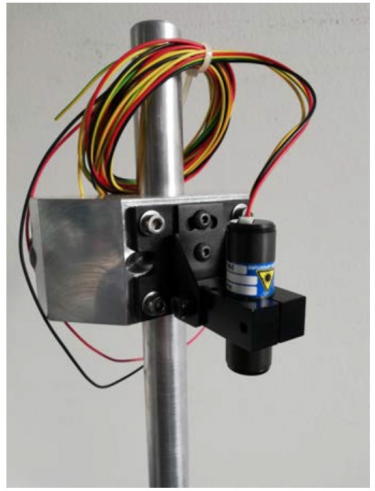




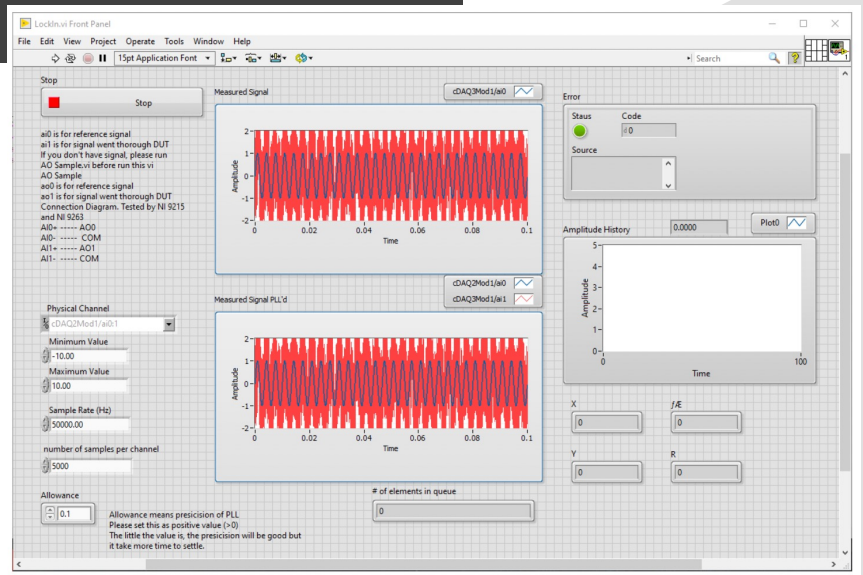
Attività LNF (0.4 FTE)

- 2022
  - Assegnati 3 keuro per apparati.
  - Realizzazione di un banco di test per rivelatore ottico di posizione

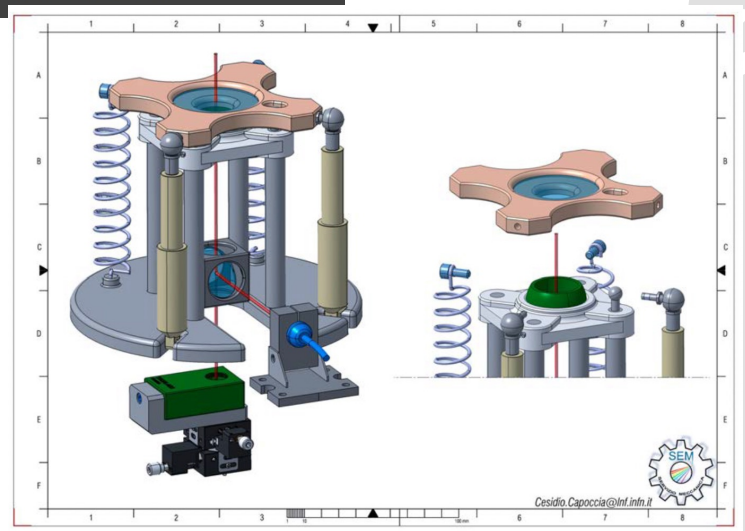




- 2022
  - Sviluppato un software per acquisizione segnale dal sensore ottico



- 2022
  - Realizzato progetto di massima del posizionatore e acquistata elettronica di pilotaggio motori



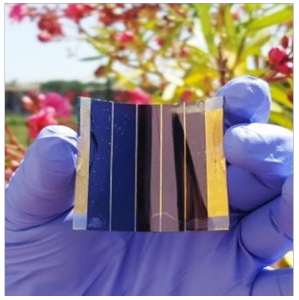
PEROV

R&D for photodetectors based on Organo-Metal Halide Perovskite material

LNF-INFN (Resp. Naz.)
INFN Sezione di Roma 1
Uniroma2 – Dip. Ing. Elettronica
UniMi– Dipartimento Chimica
CNR – NanoTec,ISR,ISM

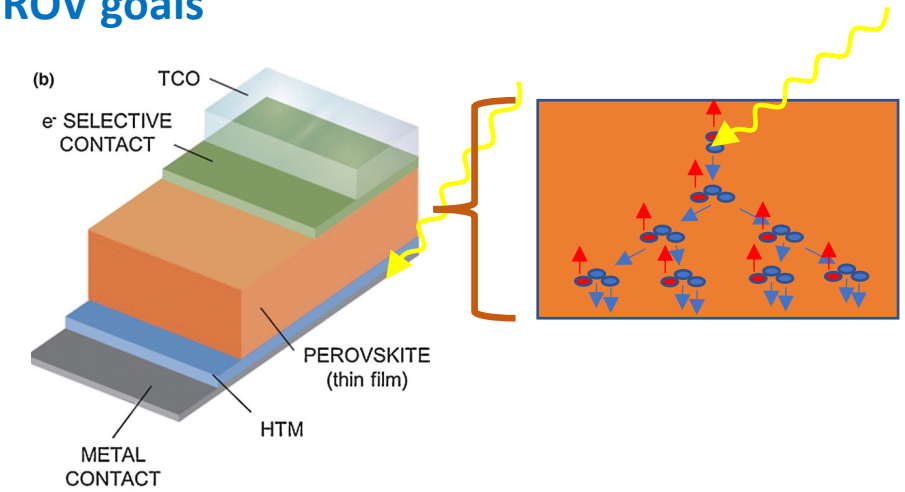
Organo Metal-Halide Perovskites = class of hybrid organic-inorganic semiconductors

- emerging as new generation photovoltaic material
- grown in solution
- **promising candidate as large area and flexible sensitive photodetectors → interest for HEP detectors !**



PEROV goals

1) **Observation or exclusion of internal avalanche multiplication**
   - not yet observed so far
   - no first principle preventing it



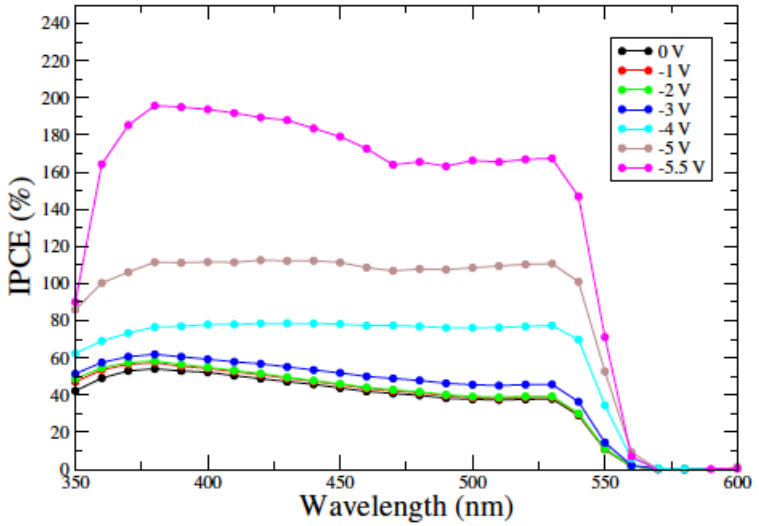
2) Study Stability under:
   - Time under reverse bias
   - Radiation hardness under synchrotron radiation at DAFNE

Methodology

Published results in thin 300 nm films

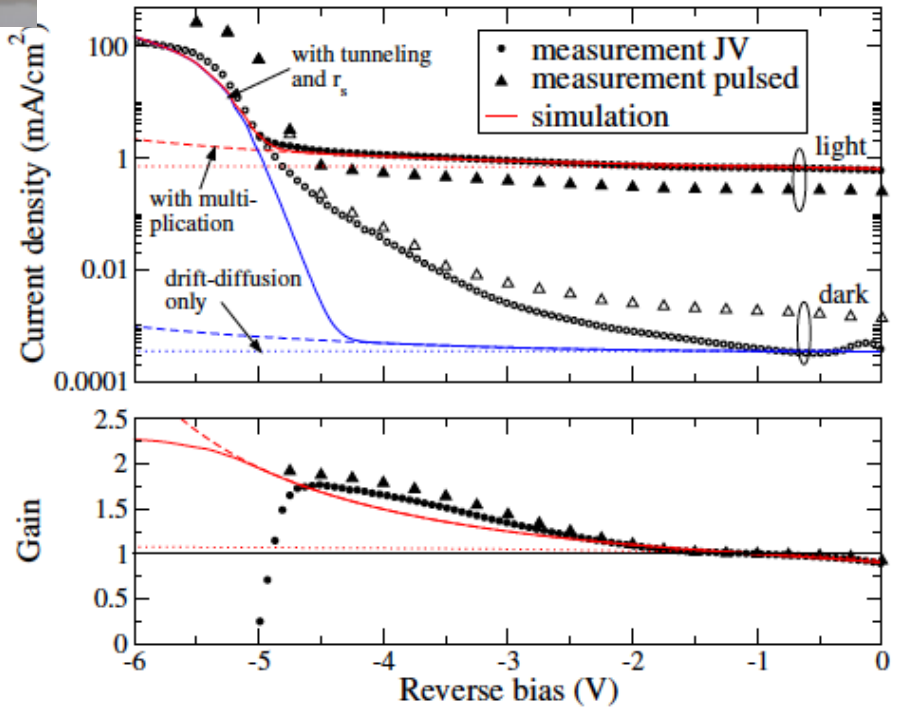
Pro:	Contra:
• Scalable to large area • small transit time due to low thickness • flexible substrate	• polycrystalline • grain boundaries • large variability between samples

- Small amount of photocurrent gain
- Incident photon to current efficiency IPCE = J_{ph} hc / (P_{in} e λ) ~ 2



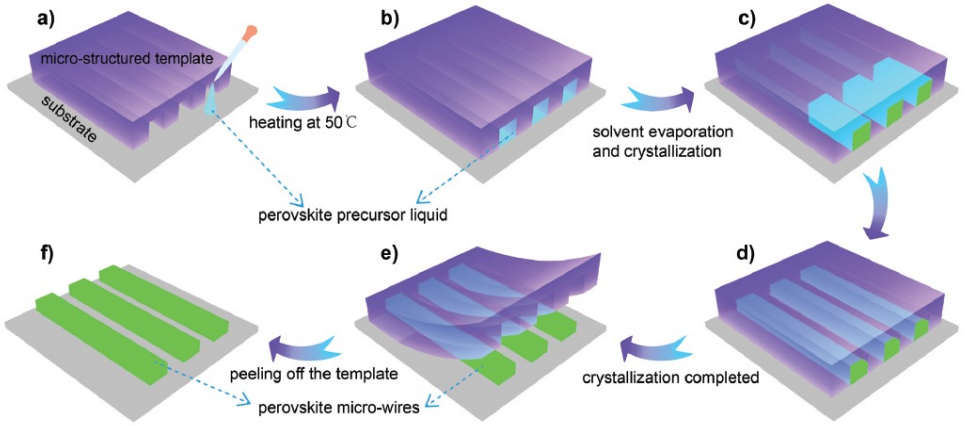
Appl. Phys. Lett. ***120****, 113505 (2022)*
M. Testa, A. Di Carlo, F. Matteocci, M. Auf der Maur

- Breakdown-like behavior at around -4–5 V
- Developed phenomenological model to explain the observed reverse bias behavior and gain through
  - *tunneling-assisted electron extraction at the TiO_2 /$MAPbBr_3$ interface*
  - *carrier multiplication*
- Both processes mediated by the electric field due to *mobile ions Br-*



Results on micro channels

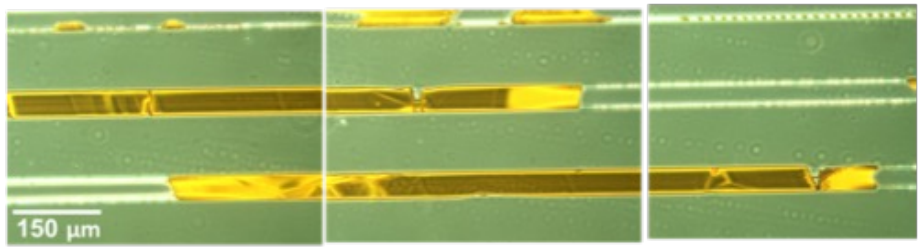
Micro-fluidics for perovskite crystals production:

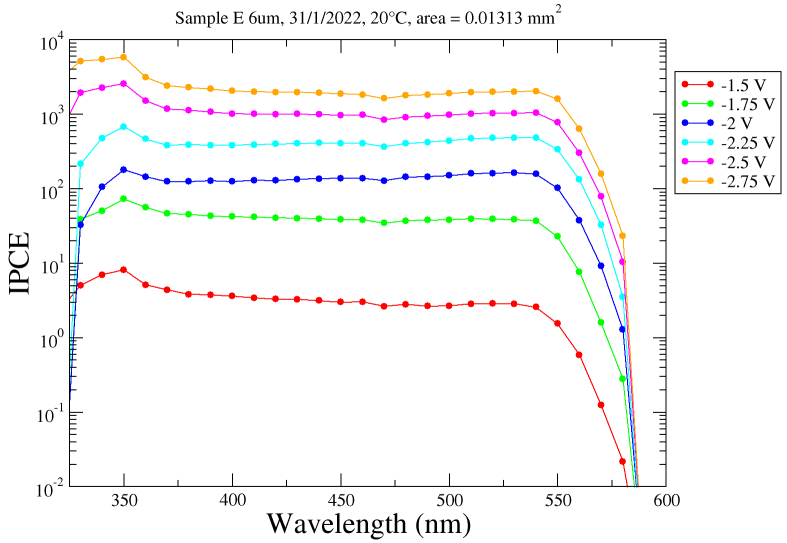


Pro:
- large flexibility in dimension
- moderate area
- pixelization
- flexible substrate
- Deposited directly on substrate

Contra:
- need high optimization of parameters (pressure, temperature,..)

Typical dimension: W x L x H = 150 μm x 500 μm x 6(2) μm
Production by CNR - Nanotec





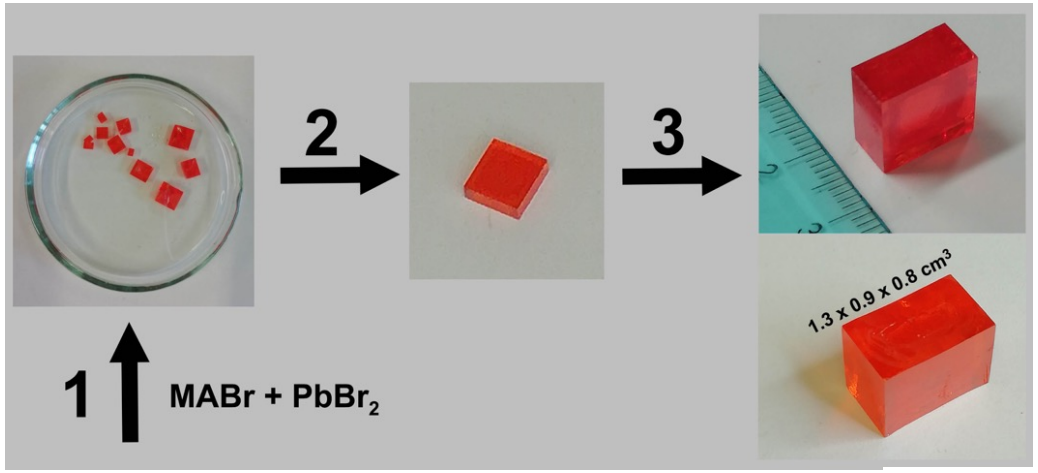
- Device realized with CH_3NH_3PbBr deposition on **patterned** Indium Tin Oxide/ $CH_3NH_3PbBr_3$ and Au evaporation
  - Innovative technique
  - *Deposited patent (INFN + CNR)* 102022000010469
- Gain observed at larger bias for thickness of 2 and 6 um
- Modelling (very challenging) on going

PRIN submitted for X-rays detector based on perovskite + cmos; Radiation campaign proposal submitted to Radnext call

Large Bulk Crystals

Pro:
- **ideal for single crystal large dimension, up to O(1) cm^3**
- **low defects**

Contra:
- **No scalability to large area**
- **Need to be cut mechanically for low thickness**

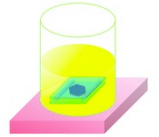


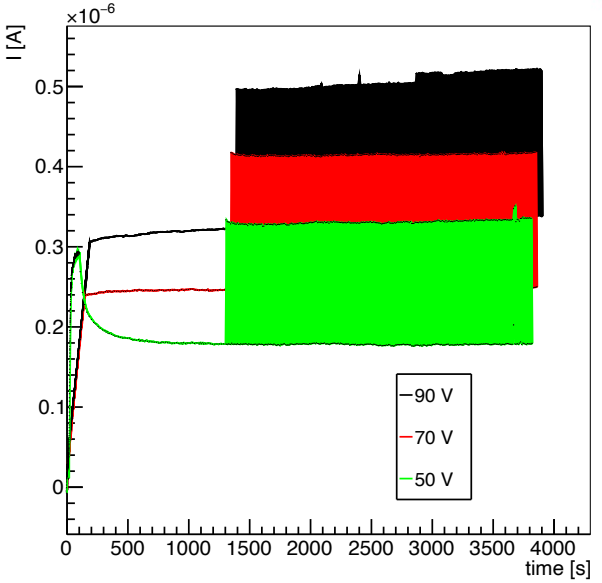
- Dimensions up to 1.0 x 1.5 cm^2 and up to 0.5 cm thick down to 300 µm by cutting the crystals along one of the $\{100\}$ cubic planes

- Device realized with Indium Tin Oxide / $CH_3NH_3PbBr_3$ / Au

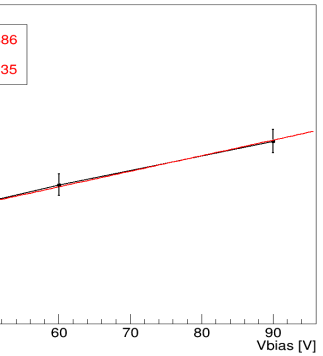
- Stability response measured under 500 nm pulsed light illumination
  - ~ 15 minutes to stabilize dark current
  - Observed memory effect between consecutive measurements
    - Critical role of mobile ions Br^-
- Due to large thickness, not suited for light detection
  - Interest for radiation detection (next slide)

Seeding Techniques
Dip. Chimica Milano



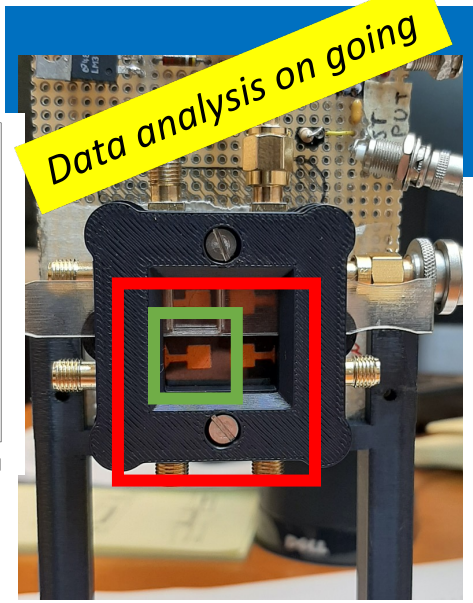


Setup for stability measurements realized by B. Ponzio



Test Beam@LNF-BTF

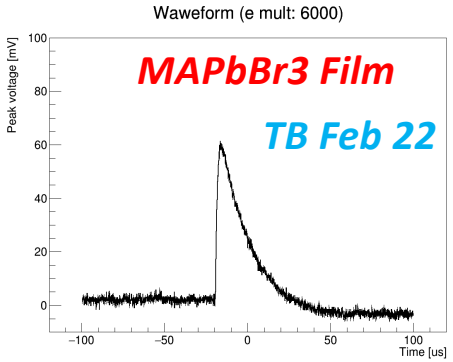
e- of 370 MeV
bunch spot 1.9 mm x 1.6 mm
duration 10ns

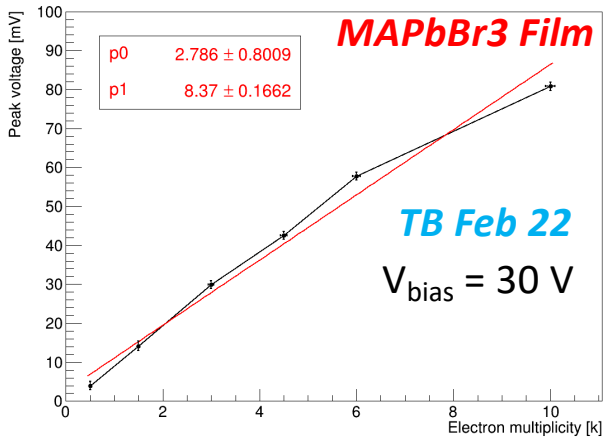


MAPbBr3 film (multiple pads 4x4 mm²)

LYSO Crystal (7x7x5 mm³)

Beam: e⁻(@370 MeV) multiplicity from 0.5k to 10k

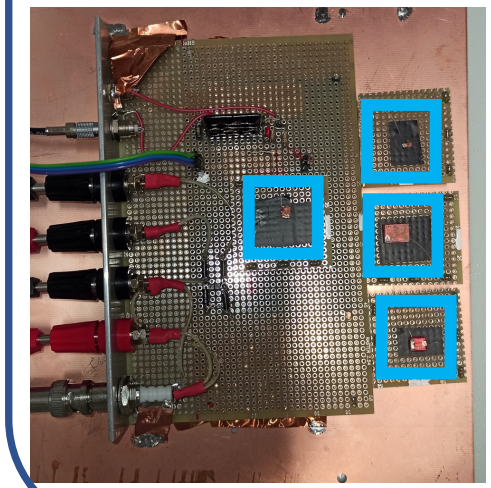




Setup by Electronic Service (G. Papalino, G. Felici);

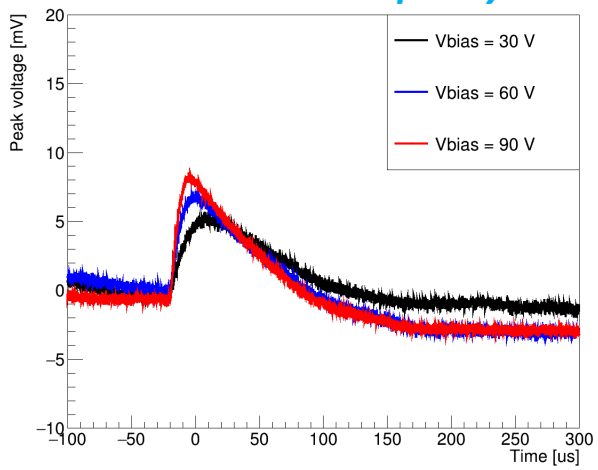
MAPbBr3 Bulk Crystals (4x4x1.6 mm³)

Beam: e-(@370 MeV)



TB Feb 22

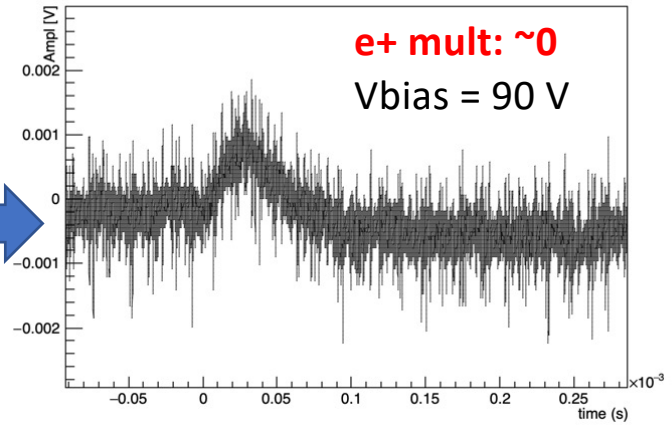
Min e- multiplicity 250



TB May 22

Improved crystals production

Single particle observed



Thanks to BTF team for technical and scientific support and mechanics workshop for supports design and realization

Financial request for 2023 (TBC)

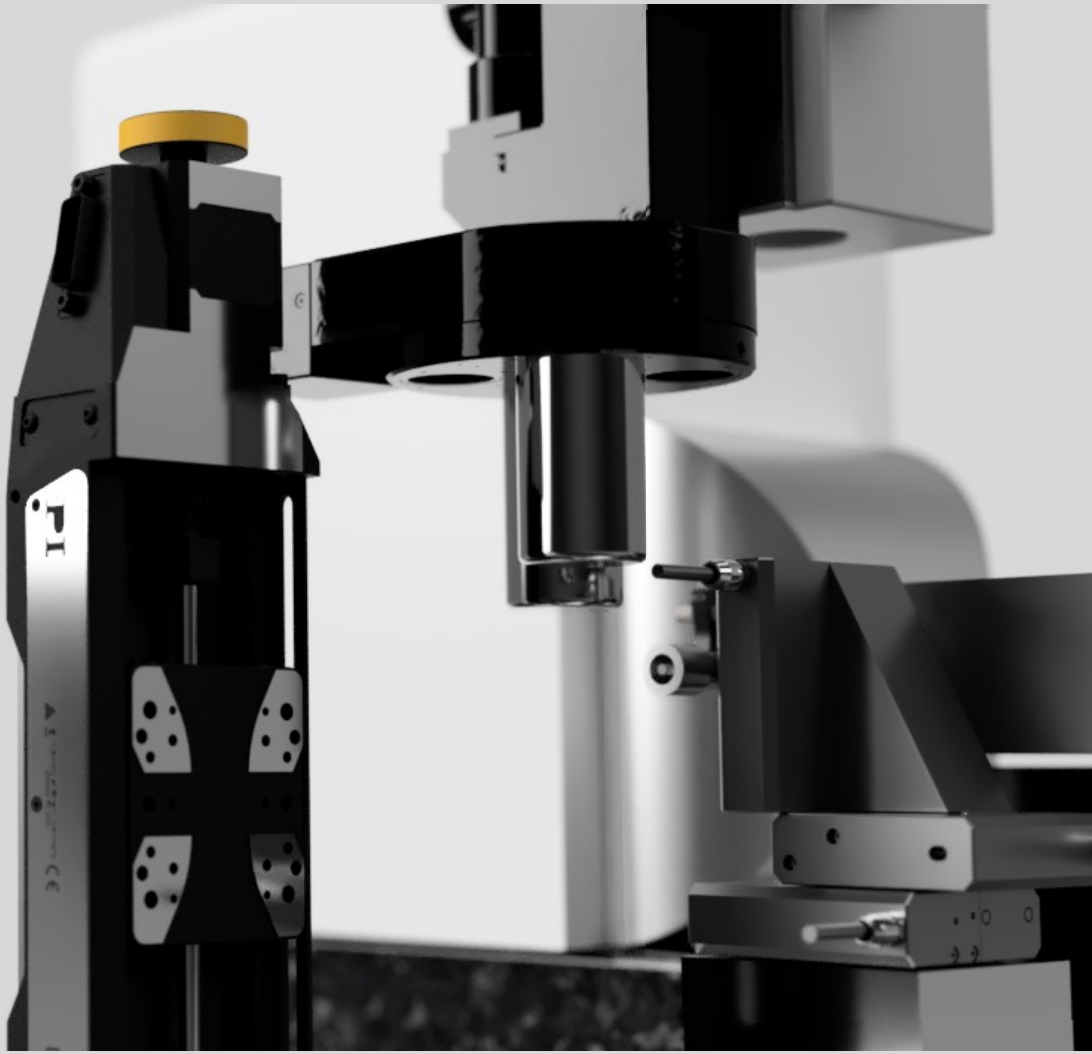
	Scope	Type of request	Cost
LNF, Roma2, UNiMi, CNR (associati a LNF)	• chemicals • lab materials materials	Consumables	• 2.5 kE
TIFPA	• Active boards CMOS to deposit perovskite on	Consumables	• 1kE
FBK (TBC)	• Passive sensors to deposit perovskite on	Consumables	• 1.5 kE
LNF	• dosimeter	Equipment	• 5 kE SJ preventivo – gia' chiesto per 2022
LNF	• Radiation hardness in EU site if proposal to radnext call is accepted	Travel	• 3kE SJ to positive result of call radnext

- Sum of FTE for 2023: 2.2
- New members :
  - TIFPA /Unitreno will join PEROV in 2023 with 0.3 FTE
  - FBK (TBC)
- Parere positivo dei referee per estensione al 2023

Possibili variazioni del ~20%

RESOLVE

high dose-rate and spatially resolved X-Ray EffectS On LiVing cElls



06 luglio 2022

RESOLVE X-ray microbeam set-up

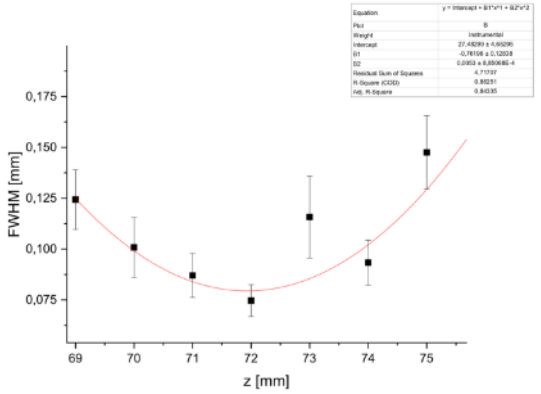
Optical Microscopy

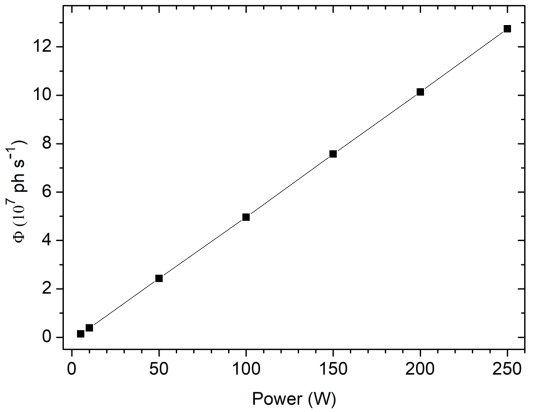
OptoSigma

Supporti rivelatori e microscopio in progettazione presso lab. tecnologico

Caratterizzazione fascio focalizzato

Spot RX 70×70 µm²





Flusso: 1 · 10⁸ ph s⁻¹

XRay fluorescence

Vortex

AMP TEK

Metal Jet Xray Source

XR Diffraction

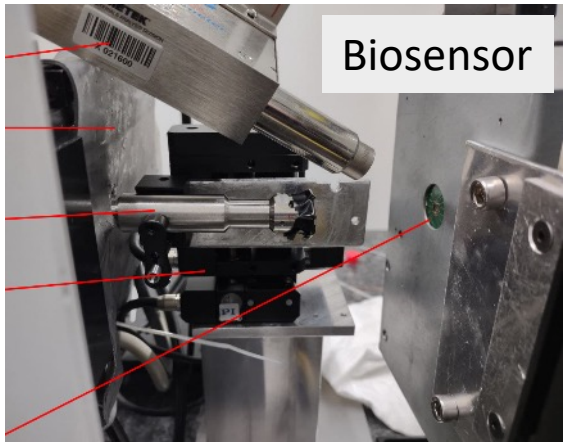
TELEDYNE DALSA

Motorized stages

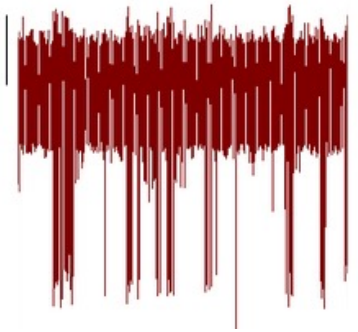
PI

Focusing Xray Optics

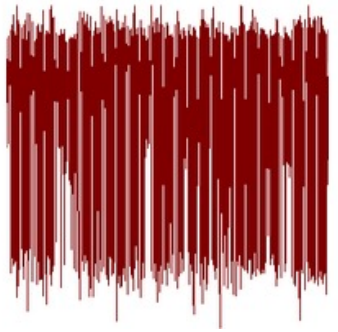
Primi misure con cellule - potenziali d'azione neuroni



Controllo



Dopo irraggiamento



RESOLVE team

INFN-LNL (local coordinator: V. Rigato, total 0.3 FTE)

core expertise: *MeV ion beam lithography and analysis*
Radiobiology

facilities: *AN2000 Van de Graaff accelerator*
CN radiobiology line

INFN-TO (local coordinator: M. Truccato, total 4.4 FTE)

core expertise: *High intensity X ray application Biosensing*

facilities: *Metal-jet laboratory → RESOVE lab*
"PhyNe" laboratories (UniTo)

INFN-LNF (local coordinator: S. Dabagov, total 1.0 FTE)

core expertise: *polycapillar X ray optic fabrication*

facilities: *XlabF laboratories*

RESOLVE (national coordinator: F. Picollo)
TOTAL FTE 5.7

Member	Position	Role in the Project	%
Dabagov Sultan	Dir. Ricerca	Local Coordinator	30
Coreno Marcello	Ricercatore	Participant	50
Hampai Dariush	Tecnologo	Participant	20
		Total FTE	**1.0**

RESOLVE estensione di 1 anno

Richiesta di estensione approvata dai referee al fine di raggiungere le milestones non ancora raggiunte a causa dell'inizio del progetto ad anno in corso e dei ritardi dovuti dalla pandemia

Milestones

1) **Commisioning stazione di irraggiamento con fascio RX focalizzato ed ad alto flusso**
2) **Studio degli effetti dei RX su secrezione e generazione di potenziali d'azione a bassi dose rate**
3) **Studio degli effetti dei RX su secrezione e generazione di potenziali d'azione ad alti dose rate**

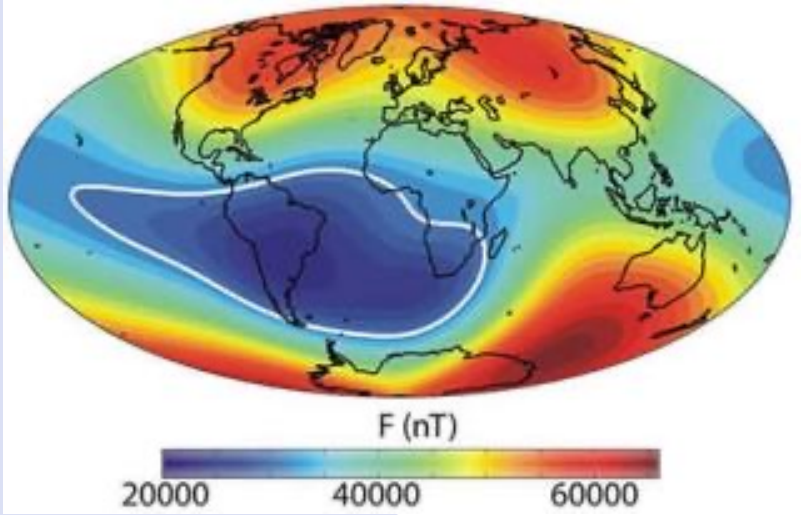
SAMADHA

2021-2023

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

South Atlantic Magnetic Anomaly Dosimetry at High Altitude

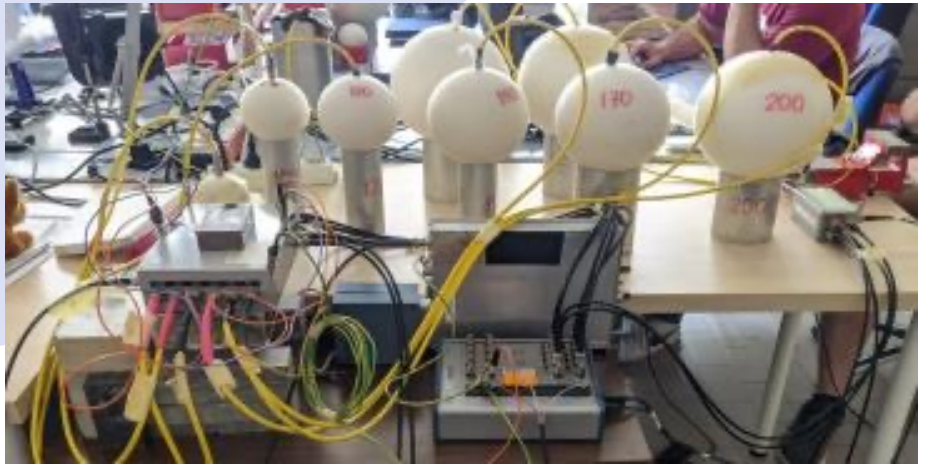
26 participants in 5 Labs/sections
Torino, Trieste, Frascati, Firenze, Napoli



Anagrafica LNF 2023

- Roberto Bedogni (0.3 FTE, resp. loc.)
- Alessandro Calamida (0.4 FTE, borsista)
- Claudio Cantone (0.2 FTE)
- José Maria Gomez Ros (0.2 FTE, ass.)
- Carlos Domingo Miralles (0.2 FTE, ass.)

Totale 1.3 FTE



SAMADHA

2021-2023

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

Scientific case

- Secondary neutrons produced by the interaction of cosmic particles in atmosphere **account for about one half of the effective dose** received by humans at high-altitudes (ex. commercial flights 5-7 km).
- Van Allen belts are regions where the geomagnetic field traps cosmic electrons and protons (GeV) in "bouncing" periodical trajectories.
- Magnetic storms cause trapped protons to precipitate, increasing ground level neutron doses
- In SAA the elevation of the belts is minimum: only 200 km. Here, higher astronauts doses and damage to the instrumentation were observed during space missions.
- Increased neutron doses were also observed during thunderstorms, but very few data are available, especially at high elevation (no data above 4 km).

SAMADHA Objectives

- Study the dependence of neutron dose from space weather and thunderstorms in "privileged" condition: SAA + high elevation
- Compare neutron doses in SAA + high elevation with similar condition outside the SAA.

LNF task

- Developing a Bonner sphere spectrometer for atmospheric neutron measurements
- Deploying the spectrometer in SAA + high elevation (Chacaltaya lab, 5.4 km elevation, Bolivia)

SAMADHA

2021-2023

Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

LNF activity plan

2022

- Spectrometer developed and currently under test in lab
- Preliminary testing at high elevation: Testa Grigia CNR lab (3.5 km elevation), 11-15 July 2022
- Shipping to Bolivia and starting acquisition

2023

- Data taking & elaboration
- End of year: dismantling and shipping back

2023 Funding requests

- 6 k€ missioni
- 2 k€ consumo
- Nessuna richiesta ai servizi

SAMARA

Superconducting Alternative Materials for Accelerating cavities and haloscope Resonators for Axions

- *SAMARA aims at developing and studying superconducting materials alternative to bulk Nb with low radiofrequency surface impedance at extreme conditions: high radiofrequency -rf- fields and high dc fields.*
- *new applications for SRF are emerging: the FCC beam screen and **haloscope resonators for axions detection** requires superconductors capable of working in unexplored RF high DC field regimes in which Nb is not suitable*

SAMARA tries to precisely meet these important challenges

- The proposal is focused mainly on Nb_3Sn a BCS superconductor (SC) with double Tc (18K) and double Hsh (400 Gauss) compared to Nb
- large critical magnetic field H_{c2} makes Nb_3Sn as a natural choice in High DC field applications

The final goal of SAMARA is twofold

- the realization of high performing elliptical accelerating cavities
- the test in high DC fied of a Nb_3Sn haloscope

- ✓ This project follows the excellent results obtained in TEFEN project (Gr.V)
- ✓ synergies with the QUAX project (Gr.II)

SAMARA

Superconducting Alternative Materials for Accelerating cavities and haloscope Resonators for Axions

Durata proposta:	3 anni (2022-2024)
Area di ricerca:	Acceleratori di particelle
Resp. nazionale:	**Pira Cristian (LNL)**
Unità partecipanti:	LNL, **LNF**, LASA, Roma Tre, Politecnico di Torino

LNF (Lab COLD)

[synergies with the QUAX activity project (Gr.II)]

Personale 2023

Daniele Di Gioacchino	(Ric dip LNF)	**0.3**
Javid Rezvani	(Univ. Camerino ass. LNF)	**0.3**

→ in dotazione Gr. V

Richieste 2023

Consumi:

a) **Elio liquido** per misure nel criostato con magnete ad 8 Tesla: **6 KEu**

1)Test cavità NbTi and Nb_3Sn,

2) misure suscettività multiarmonica x caratterizzazione film NbTi and Nb_3Sn

Missioni interne **1KEu**

SAMARA

Superconducting Alternative Materials for Accelerating cavities and haloscope Resonators for Axions

Activity in LNF (Lab COLD) 2022-2024

[synergies with the **QUAX** activity project (Gr.II)]

➢ ***Accelerating Cavities:*** *Nb_3Sn film coatings*

Characterization of planar samples: Pinning defects characterization

❖ multi-harmonic susceptibility measurements

➢ ***SRF in extreme conditions :*** *Haloscope resonators*

Haloscope developments

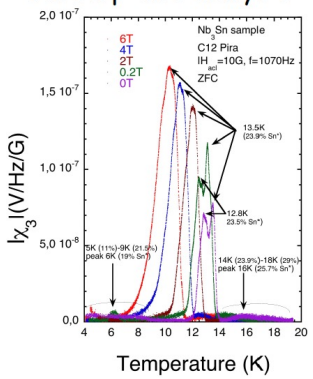
❖ design and production and test 4.2K

❖ Haloscope measurements at mK

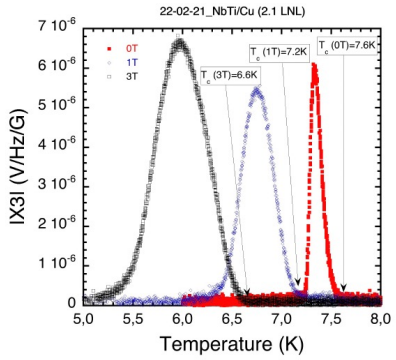
✓ activity carried out in 2022

❖ multi-harmonic susceptibility measurements

NbSn phase analysis

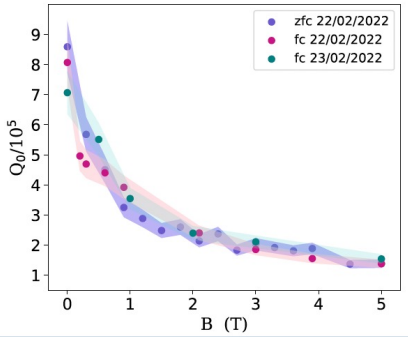


NbTi phase analysis



❖ Haloscope measurements at 4K

NbTi 9GHz cavity



✓ activity scheduled for 2023

❖ multi-harmonic susceptibility tests

Nb3Sn samples

❖ Haloscope measurements at mK

Nb3Sn cavity

SINGULARITY

Milestone 2023

Lo scopo del progetto è studiare la fattibilità di una completa automazione di un acceleratore di particelle attraverso lo sviluppo combinato di un middle layer, integrato nel sistema di controllo, basato su algoritmi di intelligenza artificiale (IA) e un hardware di sicurezza funzionale in grado di controllare e monitorare i dispositivi dell'acceleratore.

Open task	Milestone
Gestione Acceleratore	
• Sviluppo e validazione di algoritmi di Reinforcement Learning per pilotare l'intero linac di Dafne	12/22
• Benchmark di algoritmi di Reinforcement Learning per pilotare l'intero linac di Dafne	12/22
Monitor dinamica di fascio virtualizzato	
• Test rete neurale su SPARC_LAB con shifts dedicato e training su dati reali dell'acceleratore.	12/22
Machine Learning over FPGA	
• Acquisto Digital Processor e Analog Interface per Up/Down-conversion in X band di segnali RF in banda IF.	done
• Off-line training di una rete neurale per il riconoscimento di RF Breakdown su segnali storicizzati.	6/23
• Setup Digital LLRF presso RF Lab in configurazione open/closed loop.	6/23
• Test completo del DLLRF in real-time a TEX per pilotare Sorgenti RF e strutture acceleranti.	12/23

SINGULARITY

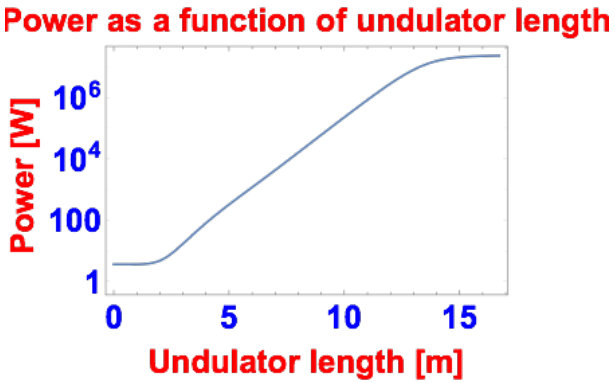
FTE 2023

	Ruolo	Struttura	FTE 2022
S. Pioli	Tecnologo	INFN-LNF	0.4
B. Buonomo	Tecnologo	INFN-LNF	0.2
C. DI Giulio	Tecnologo	INFN-LNF	0.2
F. Cardelli	Tecnologo	INFN-LNF	0.2
R. Pompili	Ricercatore	INFN-LNF	0.1
L. Piersanti	Ricercatore	INFN-LNF	0.1
M. Bellaveglia	Tecnologo	INFN-LNF	0.1
P. Ciambrone	Tecnologo	INFN-LNF	0.1
D. Di Giovenale	Tecnologo	INFN-LNF	0.2
		Totale:	**1.6**
V. Martinelli	Assegnista	INFN-LNL	0.4
D. Marcato	Assegnista	INFN-LNL	0.2
		Totale:	**0.6**

SL_COMB2FEL

Resp. Naz.:
E. Chiadroni (Sapienza University SBAI & LNF)

- **SL_COMB2FEL is a five-years experiment proposal** (2019-2023), aiming at
  - Demonstration of high quality of PWFA-electron beam through the final **measurement of the FEL gain curve**
    - Great effort on the transport and matching from plasma to the undulator
  - **Miniaturization** of ancillary components to move towards a **compact facility**
    - accelerating modules, diagnostics, measurement stations, beam position monitors, ..
  - **R&D on diagnostics**
  - **Practice with a plasma acceleration based user facility**
- **Path towards EuPRAXIA@SPARC_LAB test user facility**
  - SPARC_LAB is the test-bench of the EuPRAXIA@SPARC_LAB project
  - EuPRAXIA ("European Plasma Research Accelerator with eXcellence In Applications")
    - Horizon 2020 Design Study dedicated to the feasibility study of a **plasma-based** user **facility**



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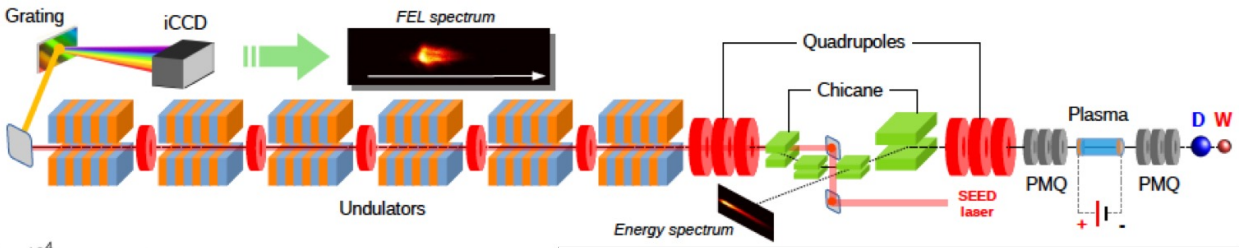
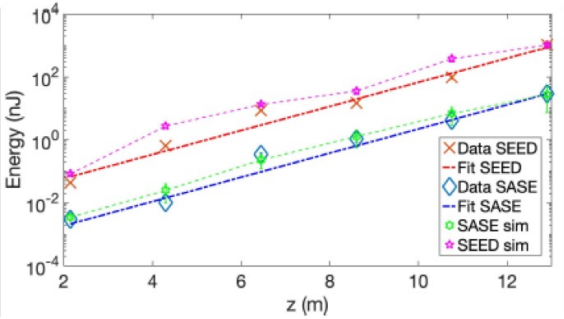
SPARC LAB





First PWFA-driven Seeded FEL

M. Galletti et al., submitted to Nature Photonics

Seeded FEL Radiation

- Part of the EOS laser used as seed
- Seed laser ~ 795 nm, FEL peak 827 nm
- Pulse energy increase from 30 nJ up to 1 μJ
- Increased stability of emitted radiation

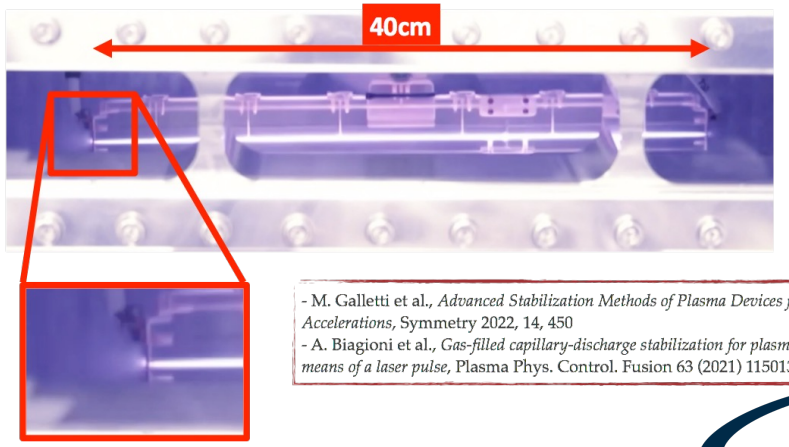
First 40 cm Long Gas-filled Capillary Discharge

Courtesy of A. Biagioni

Recent result in the Plasma Lab at SPARC_LAB: First EuPRAXIA plasma source enabling 1.1 GeV (1.5 GV/m)

Image captured during the formation of plasma in the **capillary 40 cm long** and **2 mm** in **diameter**.

The **applied voltage** pulse is **9 kV** and the **peak current** reaches about **500 A**.



- M. Galletti et al., *Advanced Stabilization Methods of Plasma Devices for Plasma-Based Accelerations*, Symmetry 2022, 14, 450
- A. Biagioni et al., *Gas-filled capillary-discharge stabilization for plasma-based accelerators by means of a laser pulse*, Plasma Phys. Control. Fusion 63 (2021) 115013

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INFN LNF

2022 Commissioning of the new RF gun and solenoid with:

- Operation at higher energy: 5.8 MeV vs 5.2 MeV (keeping fixed the injection RF phase at 40 deg from the zero-crossing)
- At the nominal power at the klystron exit (28 MW) the dark current produced by the gun is ~20 pC => At the same input power the old gun was producing 1.5-2.0 nC
- Breakdown rate is practically zero: a 24 hour long measurements of the dark current
- Quantum efficiency ~ 6.0×10-5, which is a usual value for Cu cathodes

Foreseen Activity in 2023

- Keep on both simulation and experimental studies going to **optimize the acceleration process** with particular attention to the **stability, reproducibility** and **quality** of the accelerated electron beam
  - Start-2-End simulations (including FEL), plasma ramps studies, plasma density optimization, driver removal
    - Update of **the intra-undulator** diagnostics to better characterize the exponential growth curve
- **Experimental studies with multi-driver bunches for exploring the resonant PWFA regime**
- Installation, operation and commissioning of the new photocathode laser system (First half of 2023)

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Ricercatori		Tecnologi		Post-Doc		Dottorandi	
Participant	%	Participant	%	Participant	%	Participant	%
E. Chiadroni (I Ric.)	50	D. Alesini (Dir.)	10	S. Romeo	40		
M. Ferrario (Dir.)	40	M. P. Anania (Tecn.)	40				
L. Giannessi (Dir.)	10	M. Bellaveglia (Tecn.)	10				
A. Giribono (Ric.)	30	A. Biagioni (Tecn.)	35				
R. Pompili (Ric.)	40	S. Bini (Tecn.)	30				
L. Piersanti (Ric.)	30	M. Del Franco (Tecn.)	30				
		G. Di Pirro (I Tecn.)	30				
		A. Gallo (Dir.)	10				
		A. Ghigo (Dir.)	10				
		V. Shpakov (Tecn.)	50				
		C. Vaccarezza (I Tecn.)	20				
		F. Villa (Tecn.)	50				
		A. Stella (Tecn.)	20				
		G. Franzini (TD)	20				
FTE	**2**	**FTE**	**3.65**	**FTE**	**0.9**	**FTE**	**0.5**

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TUAREG (*The Ultra Advanced RF Electron Gun) RN D. Alesini*

STATUS

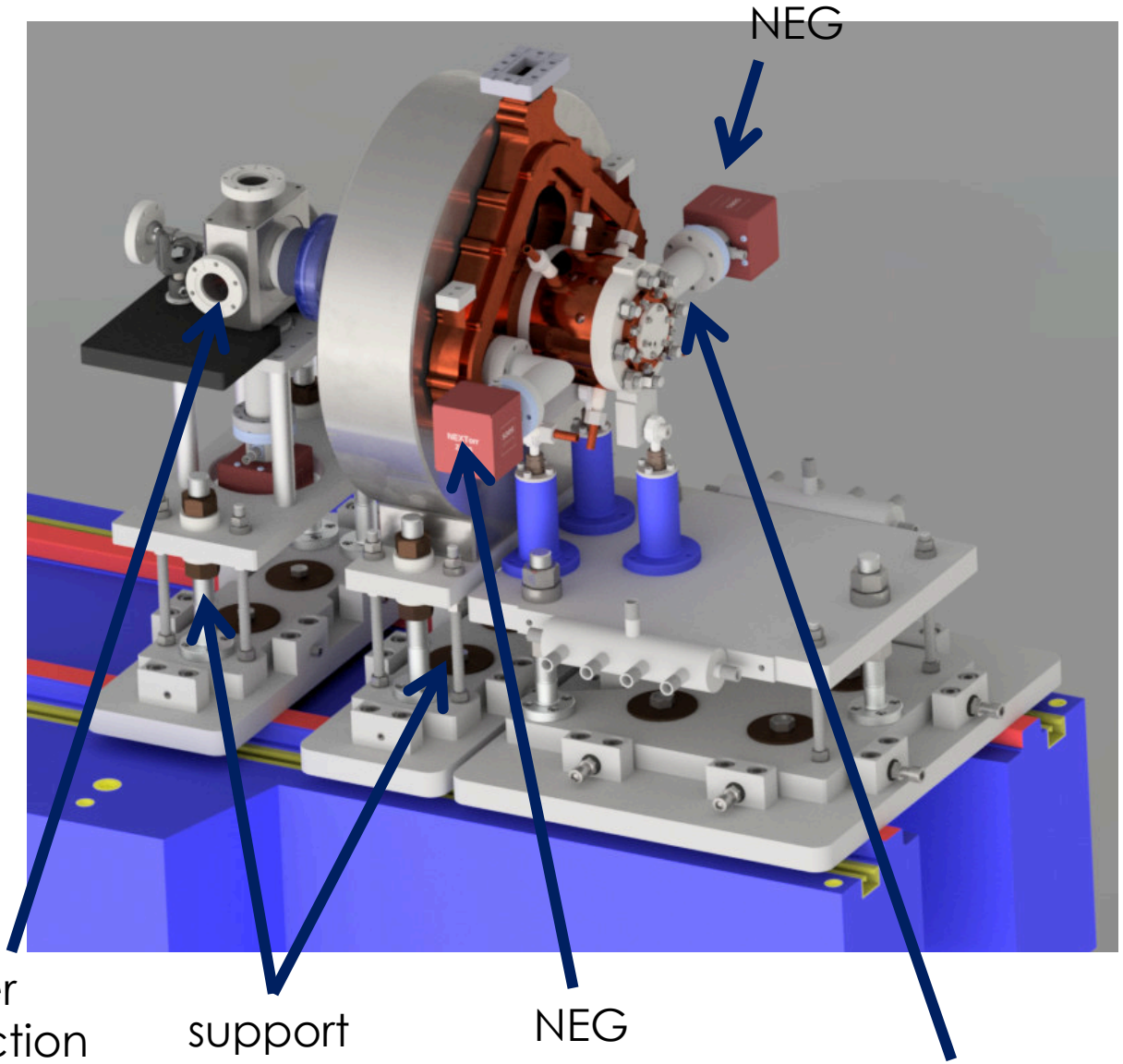
REQUEST FOR ONE YEAR EXTENSION

- **Aluminium prototype** fabricated
- **Low level RF test** done
- **Realization of the final RF gun (copper)** is expected by September 22.
- The **isolator** for high power RF test has been ordered and will be delivered by September 22. This device is a crucial device for the high power test that will be done at PSI (Switzerland) on 2023 (I.FAST project).
- The **solenoid** will be ordered by September 2022

- **The realization and high power test of the C band gun** has been selected and inserted in the **I.FAST** proposal funded by the **EU** (WORK TASK 7.4 (Resp D. Alesini) Horizon 2020 Research and Innovation program under GA No101004730.
- I.FAST is a co-funded project, **started on May 2021.**

REQUEST FOR EXTENTION: MOTIVATION

- **The high power test** of the gun will be performed at **PSI in 2023**
- For the high power test **the RF line** has to be implemented: T **pumping units, bends**
- **The gun has to be equipped with pumping system** (compact NEG), **vacuum chambers** (including the laser injection chamber), **supports**



FINANTIAL REQUESTS FOR 2023

(All researchers have confirmed their participation to TUAREG on 2023)

- Vacuum chambers, supports, NEG pumping system, waveguide components: **30 kEuro** (**if possible to be anticipated by the end of 2022**)

- **Missions to PSI** for high power test setup and conditioning: **5 kEuro**

PREVENTIVI: Total 45 kEuro+IVA (50% IFAST+50% TUAREG)

saes

QUOTAZIONE
Nr PQ220500.1-S

SAES Getters S.p.A.
Viale Italia, 77
20045 Lainate (Milano) Italy
Phone: +39 02 93178 1
Fax: +39 02 93178 320

A:	ufficio Acquisti	**Da:**	Fabrizia Furlani
Cliente:	ISTITUTO NAZIONALE DI FISICA NUCLEARE	**Data:**	25-Mar-2022
Cliente #:	0108901	**Tel:**	+390293178678
Nazione:	ITALIA	**Fax:**	+390293178320
Dip:	LAB. NAZIONALI DI FRASCATI DELL'INFN - VIA E.FERMI,40 -CP13 - 0044 FRASCATI (ROMA)	**E-mail:**	Fabrizia_Furlani@saes-group.com
Cc:			
Saes Cc:			

Egregi Sigg.ri,

Come da vostra richiesta d'offerta del 24 Marzo 2022, in allegato vi inviamo la nostra quotazione per i prodotti di vostro interesse.

Prezzi speciali, scontati del 10%, validi per un ordine e per l'acquisto delle quantità menzionate, come da accordi con il nostro Dr Maccallini.

	Descrizione Articolo	Codice	Quantità	Prezzo-EUR
1)	NEXTORR Z 200	5H0199(*)	3 pz	5'007.00/EA
2)	IP CABLE 5MT SHV-FISCHER CONNECTOR	3B0623(*)	3 pz	564.00/EA
3)	NEG CABLE 3P5A 5 MT	3B0565(*)	1 pz	476.00/EA

EA:per unit/unitario TH:per thousand/al 1000

(*) Prodotto fabbricato/commercializzato presso la nostra societa' di Avezzano(AQ). Il vostro ordine deve essere indirizzato ed inoltrato a:

SAES GETTERS S.p.A. Avezzano Unit
Nucleo Industriale, Via Diesel
67051 Avezzano(AQ)
Italia
Fax:++39.0863.495534
E-mail: ave_orders@saes-group.com

T.S.C.

T.S.C. srl
Sede Legale: Via C. Lambruschini, 3
Sede Operativa: Via G. Miraglia, 23 A
00054 | Fiumicino | RM | Italia

Tel: +39 (0)6.6505758
Fax: +39 (0)6.65048095
E-mail: info@tscsrl.net
PI | CF : 09781361002

QUOTE preliminare : 06/2022

Fiumicino 29 /06/2022

Spett.le:
INFN LNF
VIA E. FERMI 40
00044 FRASCATI (ROMA)
All'attenzione di David Alesini

LINE	ITEM DESCRIPTION	N.	PREZZO UNITARIO	PREZZO TOTALE
	CURVA C BAND LATO E FLANGIA DASY	2	€ 1.650,00	€ 3.300,00
	CURVA C BAND LATO H FLANGIA DASY	2	€ 1.650,00	€ 3.300,00
	CAMERA DA VUOTO PER INIEZIONE LASER GUN COME DA DISEGNO 100-02-00	1	€ 10.000,00	€ 10.000,00
	PUNP PORT CF 63 IN GUIDA D'ONDA C BAND L 200 MM	2	€ 2.400,00	€ 4.800,00

IMBALLO : COMPRESO
TRSPORTO: COMPRESO
DELIVERY: 60 gg DRO
PAYMENT CONDITION: 30GG DRF
VALIDITA' OFFERTA: 60g.g.

Cordiali Saluti
T.S.C. SRL
L'Amministratore Unico e Legale Rappresentante
Massimiliano Cesarini

TOTALE: € 21.400,00 + IVA

T.S.C. Srl | Capitale sottoscritto € 20.000,00 | Cap. Sociale € 20.000,00 i.v. | REA ROMA 1188852

CO.ME.B. S.R.L.
R.E.A.: ROMA n. 1089208
Via Emiliano Sarti 36/38
00124 ROMA RM
Tel: 065652505
P.IVA: 08338281002
amministrazione@comeb.it comeb@pec.comeb.it

Spett.le
Infn - Frascati - Rm
Via Enrico Fermi 40
00044 FRASCATI RM

Codice Destinatario: 0000000

PREVENTIVO n° 31 del 28/06/2022 — Preventivo del 28/06/2022 N.ro 31 — Pag 1

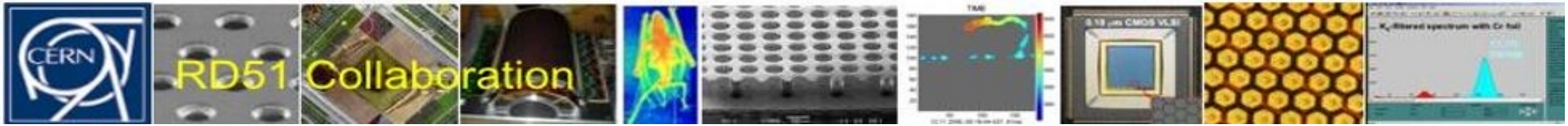
DATA: **28/06/2022** PAG: **BONIFICO 30 GG D.F.** BIC: **BAPPIT21B07**

BANCA: **B.P.M. 3976 AG 14** ABI: CAB: IBAN: **IT05Y0503403215000000003976**

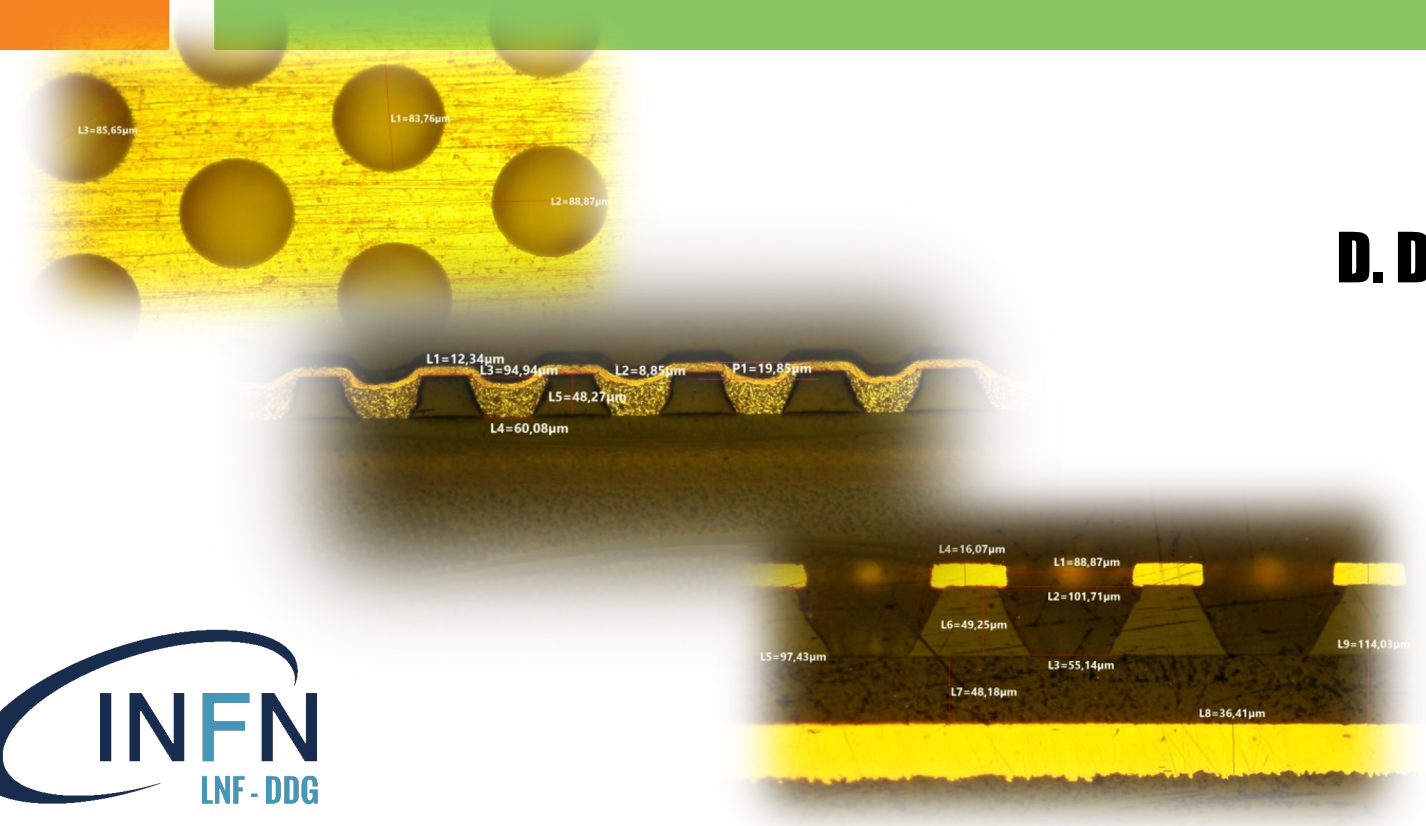
DESCRIZIONE	Q.TA'	U.M.	PREZZO	%SC	IMPORTO	IVA
Realizzazione di n. 1 supporto solenoide gun in banca C (dis GUN_C_BAND_01_00	1,00000	NR	5.000,00000		5.000,00	22
Realizzazione di n. 1 supporto camera di iniezione laser gun in banca C (dis GUN_C_BAND_02_00	1,00000	NR	5.000,00000		5.000,00	22

RIEPILOGO IVA	ALIQUOTA	IMPONIBILE	IMPOSTA
22 - Aliquota al 22%	22,00	10.000,00	2.200,00

Totale imponibile	10.000,00
Importo IVA	2.200,00



uRANIA-V: development of RGD for thermal neutron detection



G. Bencivenni,
D. Di Bari, G. Felici, M. Gatta, M. Giovannetti,
G. Morello, G. Papalino, M. Poli Lener

DDG – LNF - INFN

INFN
LNF - DDG

uRANIA-V

- **GOAL: development of thermal neutron detectors based on Resistive-Gaseous Detectors (uRWELL + sRPC)** for applications in **homeland security & radioactive waste monitoring**
- **Project duration: 2021 - 2023**

uRANIA — **micro esistive dvanced eutron maging pparatus**

INFN - Ferrara (1.1 - FTE) - tbc

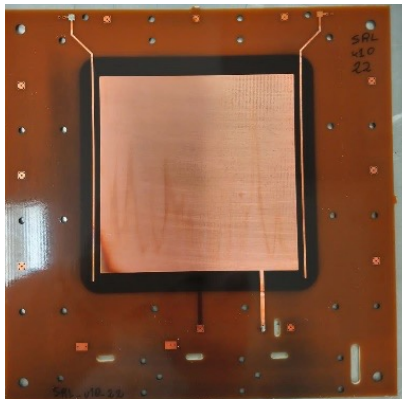
G. Cibinetto (resp.loc)		**0.15**
I. Balossino	**0.2**	
R. Farinelli	**0.1**	
I. Garzia	**0.25**	
M. Scodeggio Marco	**0.2**	
A. Cotta Ramusino	**0.1**	

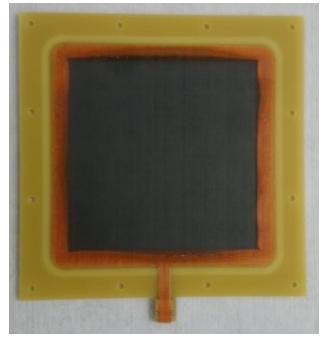
+ **0.1** FTE dal servizio meccanico

INFN – LNF (1.15 FTE)

G. Bencivenni (resp. Naz)	**0.4**	
G. Felici	**0.2**	
G. Morello		**0.2**
M. Poli Lener	**0.2**	
M. Giovannetti	**0.15**	

The pillars



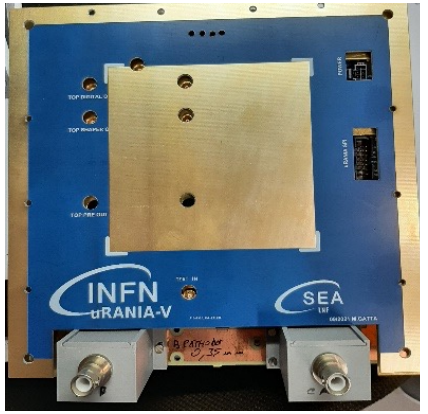


- **Resistive Gaseous Detectors (μ-RWELL + sRPC)**
- **Neutron Boron-Converters**
  - **Boron** coated **planar cathodes/electrodes**
  - **Boron** coated **metallic meshes**
  - **Boron** coated **grooved-cathodes**

$$\mathrm{n}+{}^{10}_{5}\mathrm{B}\begin{cases}{}^{7}_{3}Li(1.02MeV)+\alpha(1.78MeV) & 6\% \\ {}^{7}_{3}Li(0.84MeV)+\alpha(1.47MeV)+\gamma(0.48MeV) & 94\%\end{cases}$$

- detection of thermal neutrons (E_k ~ 25meV) with $^{10}B_4C$ deposition on detector electrodes/cathodes
- neutron conversion in ionizing particles (α/^{7}Li back to back → mutually exclusive events)
- not negligible α/^{7}Li cross-section with $^{10}B_4C$ → thickness optimization.

- **Counting-mode electronics** - read-out of the induced signals on HV electrodes or external pick-up pads



2022 status of the project

1 - Construction and test of **neutron devices based on µ-RWELL technology** with suitable **converters & integrated counting-mode electronics**

- ✓ Finalizing the design of the **detector** PCB-RWELL (10x10cm^2)
- ✓ Finalizing **converters** design (planar/grooved cathodes – metallic mesh …)
- ✓ Finalizing **electronics** based on CREMAT CR110 (discrimination + counting)

2 - Preliminary test of a **neutron device based on mono-gap sRPC technology** in **hybrid configuration (DLC + ^{10}B4C electrodes):**

- ✓ Design/construction of kapton electrodes w/DLC and ^{10}B4C coating
- ✓ Design/construction of detector mechanics
- ✓ PCB readout
- ✓ Electronics readout board based on CREMAT CR110 (preliminary)

→ **Three configurations:**
DLC(cathode)+B4C(anode)
B4C(cathode)+DLC(anode)
B4C(cathode)+B4C(anode)

Milestones 2022

M1: costruzione e test del prototipo di detector-tile (10x10cm^2) su **tecnologia uRWELL** con **convertitori *a mesh e grooved-cathode*** ed **elettronica *counting* integrata [m12]** → **100% DONE**

M2: costruzione e test di prototipi basati su **tecnologia sRPC [m12]** → **Construction completed**
Test to be done

Milestones & Fund requests (preliminary) 2023

M1: costruzione di prototipo **μ-RWELL tile di grande area (20x20 cm^2)** strumentato con elettronica finale **[m12]**
M2: costruzione e test di **sRPC tile (10x10 cm^2)** con elettronica counting integrata **[m12]**

WP1 - consumable		cost (k€)	LNF	Ferrara
uRWELL	detector tiles PCB 20x20 cm2(incl. cathode support x4)	10,00	10,00	
	converters/mesh (x2 + …)	3,00	3,00	
	frames in peek (x6)	1,50	1,50	
sRPC	sRPC electrodes 10x10 cm2 (x4 + a couple of spare electr.)	4,00	4,00	
	sRPC mechanics (x2)	2,00	2,00	
	strip/pad readout PCB (x3)	1,00	1,00	
Gas	pre-mixed gas bottles RWELL (Ar+CO2+CF4)	2,00	2,00	
	pre-mixed gas bottles sRPC (C2H2F4 + Iso-C4H10+SF6)	2,00	2,00	
		25,50	25,50	
WP3 - consumable				
uRWELL	electronics PCB + discr + counting (x2 det+1 spare)	10,00		10,00
sRPC	electronic board proto for sRPC	5,00		5,00
		15,00		15,00
Mission				
	contacts with manufacturers (ELTOS + CERN/Rui)	3,00	3,00	
	Test beam ENEA - HOTNES	4,00		4,00
	Detector characterization at ENEA CASACCIA	4,00	2,00	2,00
		11,00	5,00	6,00
		51,50	30,50	21,00

Services requests 2023

SEA

- Progettazione PCB-RWELL/sRPC detectors **[2 mu]**
- Progettazione board elettronica RWELL **[1 mu]**
- Montaggio elettronica **[1 mu]**

SPAS

- Progettazione meccanica RWELL/sRPC **[1 mu]**

Servizio assistenza apparati

- Assemblaggio detectors **[2 mu]**

THANKS FOR YOUR ATTENTION