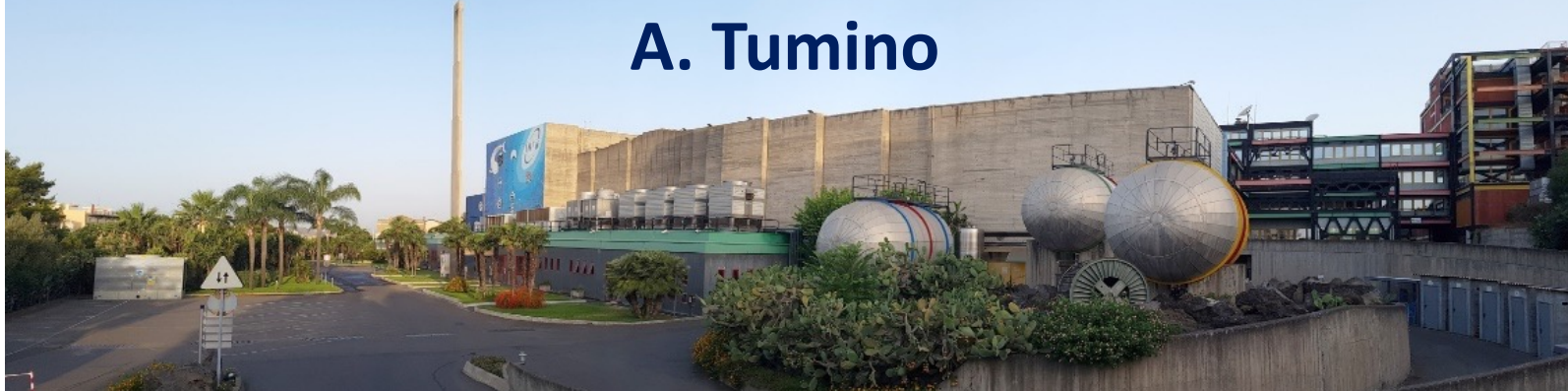




# Activities of the LNS Research Division

## A. Tumino



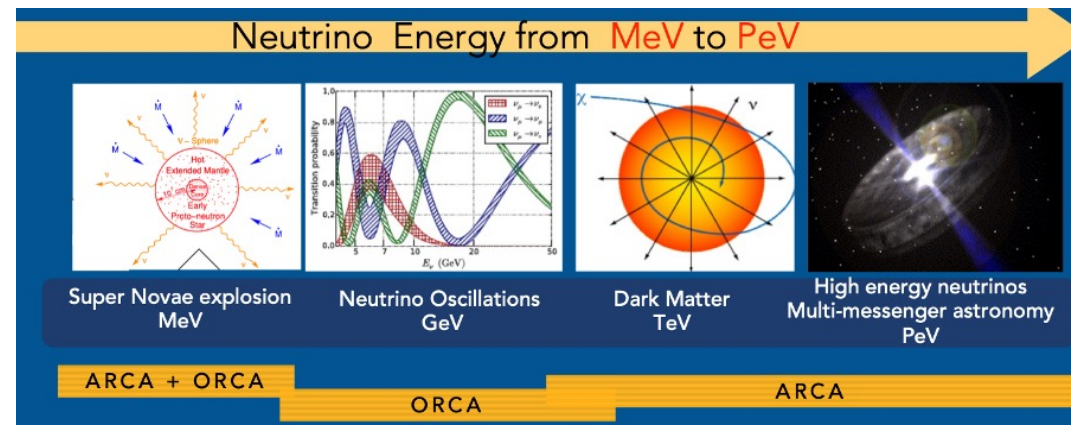
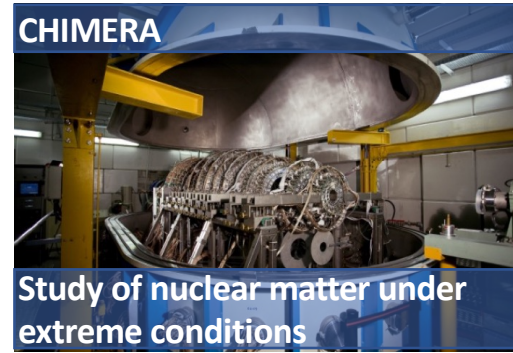
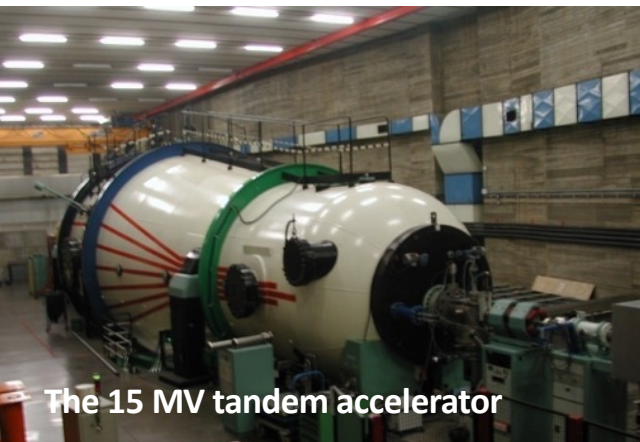
## Outline

- ✓ General introduction on research activities
- ✓ Description of activities within the Research Division and services for the users
- ✓ Perspectives on new beam lines

# LNS past/present facilities

Thanks to the broad range of available beams and beam energies, LNS research spans a correspondingly broad range of physical problems

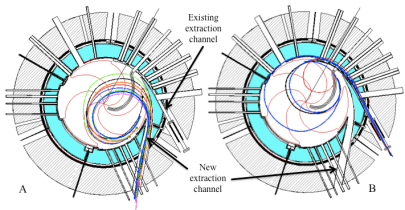
- Nuclear structure and dynamics
- Nuclear astrophysics
- Plasma physics
- Medical physics and biophysics
- Astro-particle physics
- Environmental physics
- Applications to cultural heritage



**KM3NeT second phase** is a research infrastructure housing the next generation neutrino telescopes. KM3NeT will open a new window on our Universe, but also contribute to the research of the properties of the elusive neutrino particles. In 2022 the largest sea campaign so far: great work of people offshore and onshore

# The near future

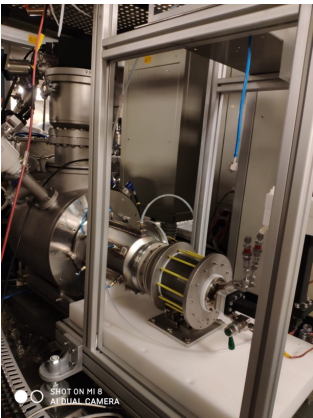
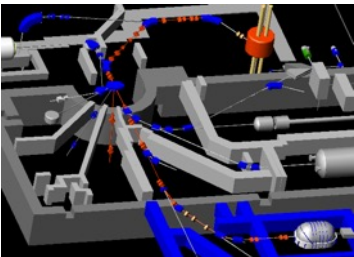
The **POTLNS** project aims at upgrading the LNS CS and beam lines to increase the the intensity by about 2 orders of magnitude for ion beams with mass number  $\leq 40$  and energies between 15 and 70 MeV/amu.



Extraction by stripping

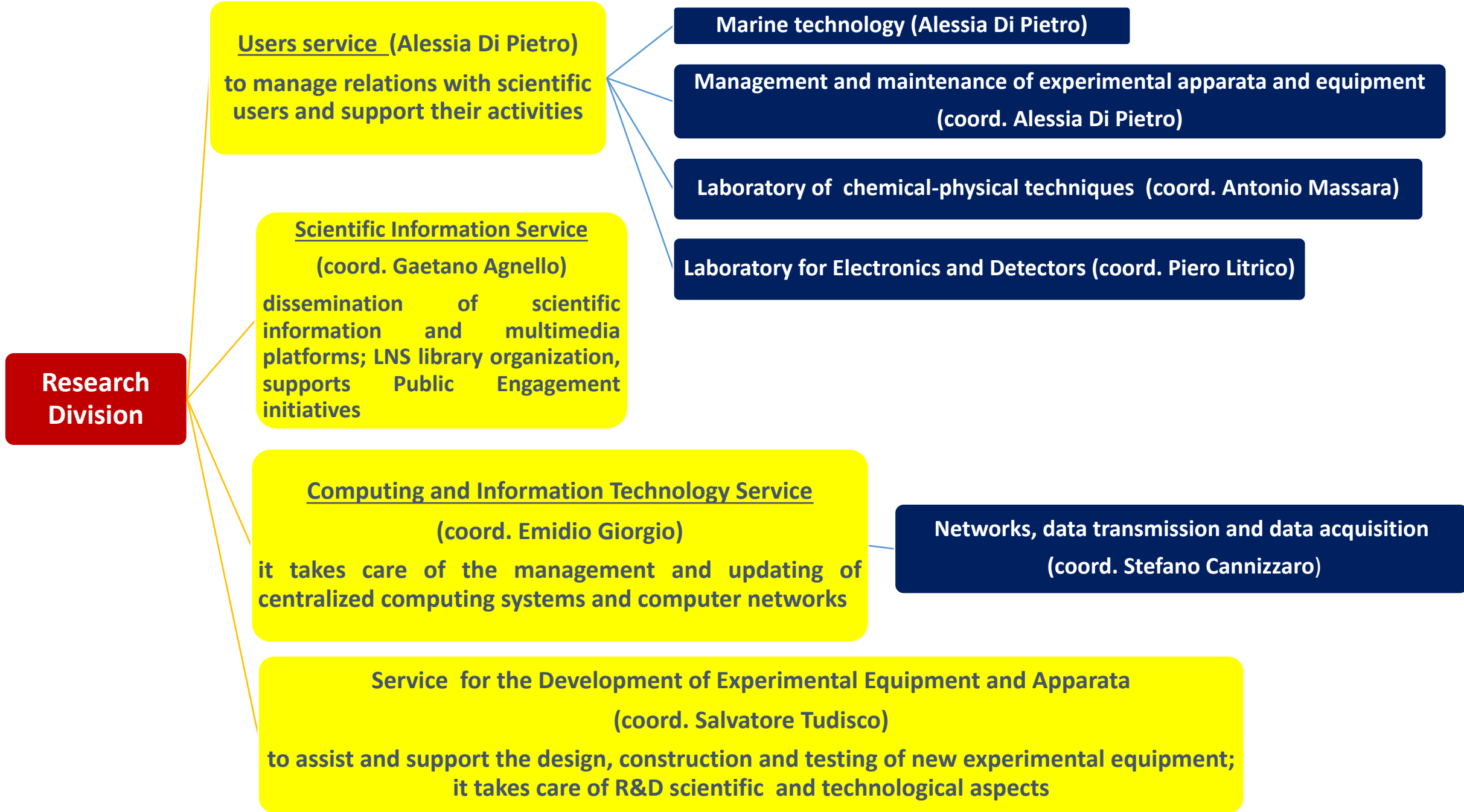
### Applications:

- In flight production of RIBs @ FRAISE
- High intensity beams for the study of  $0\nu 2\beta$  decay (NMEs)



*NESTOR: New beams of  $^4\text{He}^-$  and  $^3\text{He}^-$ ,  $\text{H}^-$ ,  $^{16-18}\text{O}^-$ ,  $^{14}\text{N}^-$  ... (hopefully  $^{20}\text{Ne}^-$ ...)*

PAST	FUTURE
CT2000 @ 60° beam line	CT2000 @ 60° beam line
20° - 40° beam line	40° beam line
CICLOPE	GIRA
CHIMERA	CHIMERA plus FARCOS CORRELATOR
MAGNEX	MAGNEX upgraded
MEDEA – ESS R&D area	
	PANDORA
	BCT + I-LUCE



# Research Division

## Activity in 2021-2022

- Experiments: support to all the experiments and projects
- Maintenance of Laboratories, Boost to R&D, IT improvements
- Planning for reorganization of new and existing experimental areas. More intense work will start soon after the completion of the PoTLNS infrastructural works
- External Users: EUROLABS for next Transnational Access
- Formation (LNS-UniCt): shared Ph.D. programme and participation to Ph.D. teaching activities, Erasmus Mundus Joint Master Degree
- Outreach-dissemination: seminars, national and international events (European Research Night, Quantum Week, INFN-Kids), during 2022 re-opening of the Visitor Centre (guidelines for easy access established in 4Q 2021)

Going into more details ...

Carmelo D'Amato: KM3NeT

Calibration:

Autonomous Acoustic Beacon Tripods – Design, Integration, Deployment, Maintenance of mechanical parts and battery pack

Calibration Base integration

Instrument Line design and integration

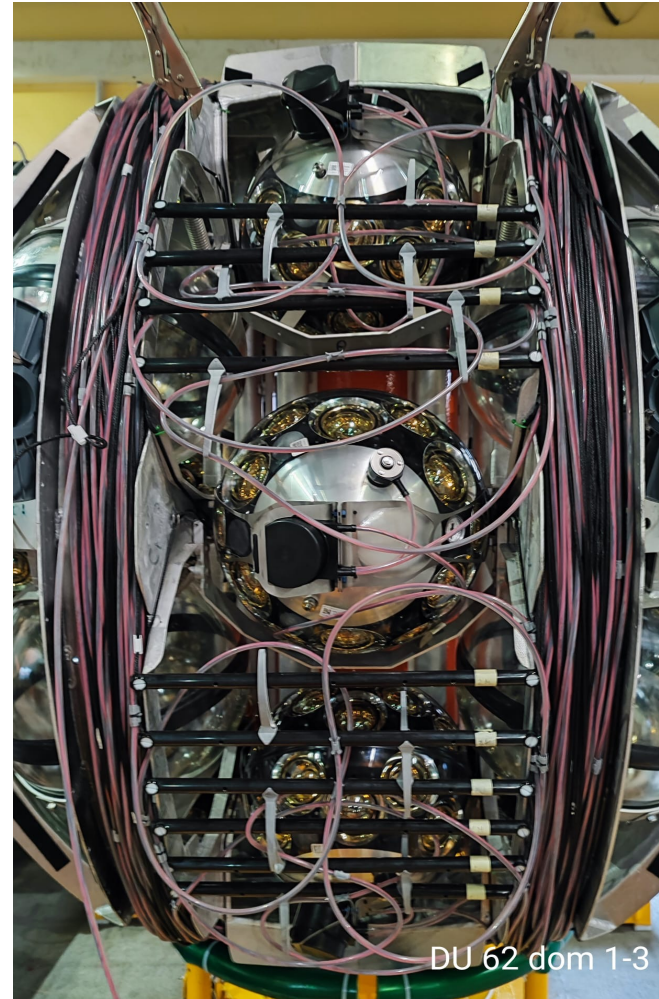
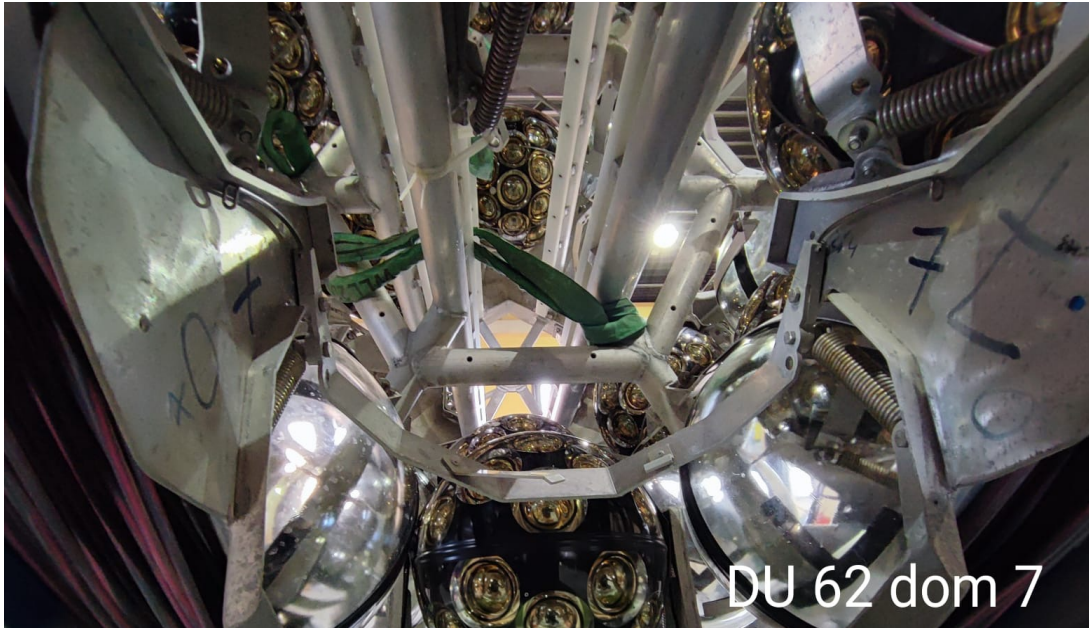
Junction Box internal frame cooling system

DU Integration:

Process V: DU anchor assembly and DU release system



Antonio Grmek - Servizio Utenti – Marine technology  
DU integration for the Km3net project - Test Side Catania harbor





# Management and maintenance of experimental apparatus and equipment

## Activity in 2022

The Unit has been involved in various support activities for LNS users:

- Definition, design and test of the vacuum system for the TRASMA scattering chamber that will be used in the future laser
- Collaboration in the design of the new beam line to be installed at the Catania physics department.
- RED experiment; carried out vacuum tests. Technical assistance for the experiment that is taking place at the Physics Department
- Sicily Laboratory; restoration of a vacuum chamber for detector tests, with the creation of some flanges with signal passage connectors.
- Electronic laboratory; replacement of the turbo pumping system in one of the test points
- Technical assistance to users during the year
- Disassembly of the entire vacuum system of the Ciclope experimental room



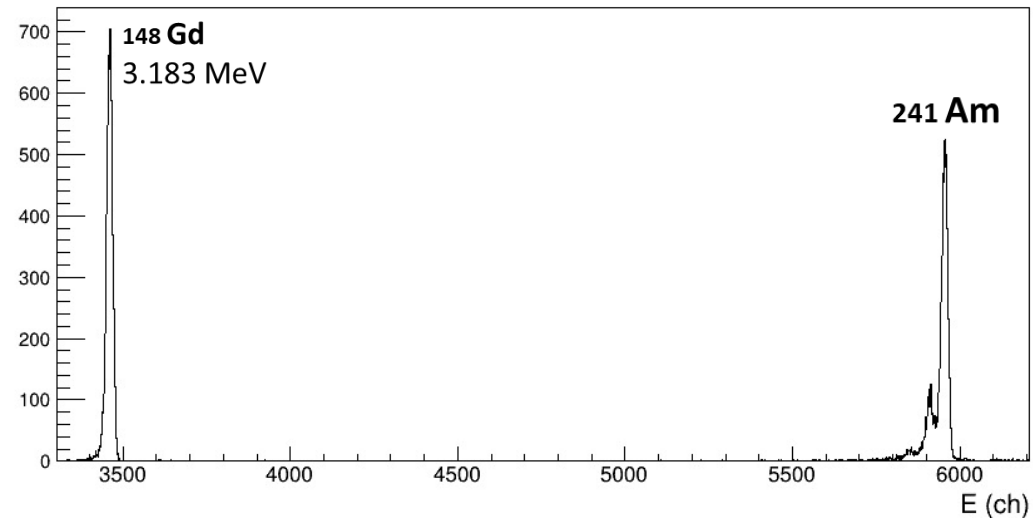
## Laboratory of Chemical-Physical Techniques

### Activity in 2022

- Landis: target with different materials (LNS);
- NEW JEDI: LiF target with thickness between 50 and 300  $\mu\text{g}/\text{cm}^2$ ;
- BCT: acetic acid and sodium hydroxide solutions;
- NUMEN: Collaboration for the realization and characterization of targets of different elements for high intensity beams;
- Pandora: Al target with thickness of 0.8 $\mu\text{m}$ ;
- N-TOF:  $^6\text{LiF}$  targets on Mylar da 1.5 $\mu\text{m}$
- MICADO: development of an alternative deposition method for 6LiF;
- E818:  $\text{CD}_2$  targets with thickness between 500 and 1000  $\mu\text{g}/\text{cm}^2$ ,  $\text{CH}_2$  with thickness between 700 and 1000  $\mu\text{g}/\text{cm}^2$  and  $^{124}\text{Sn}$  with thickness between 300 and 600  $\mu\text{g}/\text{cm}^2$ ;
- ASFIN:  $^{10}\text{B}$  targets with thickness of 60  $\mu\text{g}/\text{cm}^2$ ,  $^{11}\text{B}$  70  $\mu\text{g}/\text{cm}^2$ ,  $^{64}\text{Zn}$  880  $\mu\text{g}/\text{cm}^2$ ,
- ADONIS: Au targets with thickness between 90 and 165  $\mu\text{g}/\text{cm}^2$  e  $\text{CD}_2$  with thickness between 40 and 200  $\mu\text{g}/\text{cm}^2$ ;
- 19F-Orsay:  $\text{CaF}_2$  targets with thickness between 100 and 200  $\mu\text{g}/\text{cm}^2$ ;
- ELISSA $\pi$ :  $\text{CH}_2$  targets with thickness between 30 and 160  $\mu\text{g}/\text{cm}^2$ ;
- pB11-Sal:  $\text{CD}_2$  targets with thickness between 4 and 60  $\mu\text{m}$ ,  $^{63}\text{Cu}$  of 10  $\mu\text{m}$  e  $^{70}\text{Zn}$  fo 23  $\text{mg}/\text{cm}^2$ ;
- Collaboration with the Injector Service

## Laboratory of Chemical-Physical Techniques

- Implementation of the new thickness measuring machine, CACTUS (Chamber with Alpha source to Characterize target Thickness and Uniformity by Scanning). New system for the energy calibration of the Si detector consisting of two alpha sources.



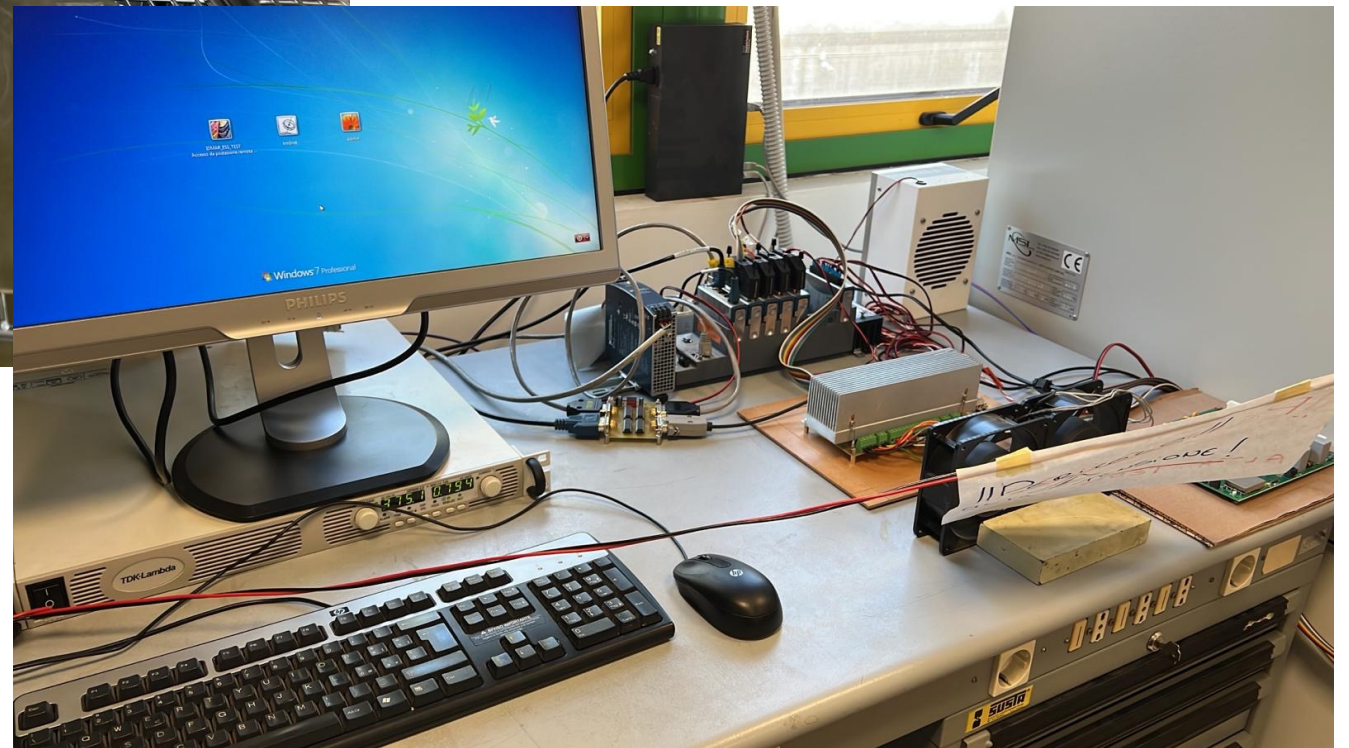
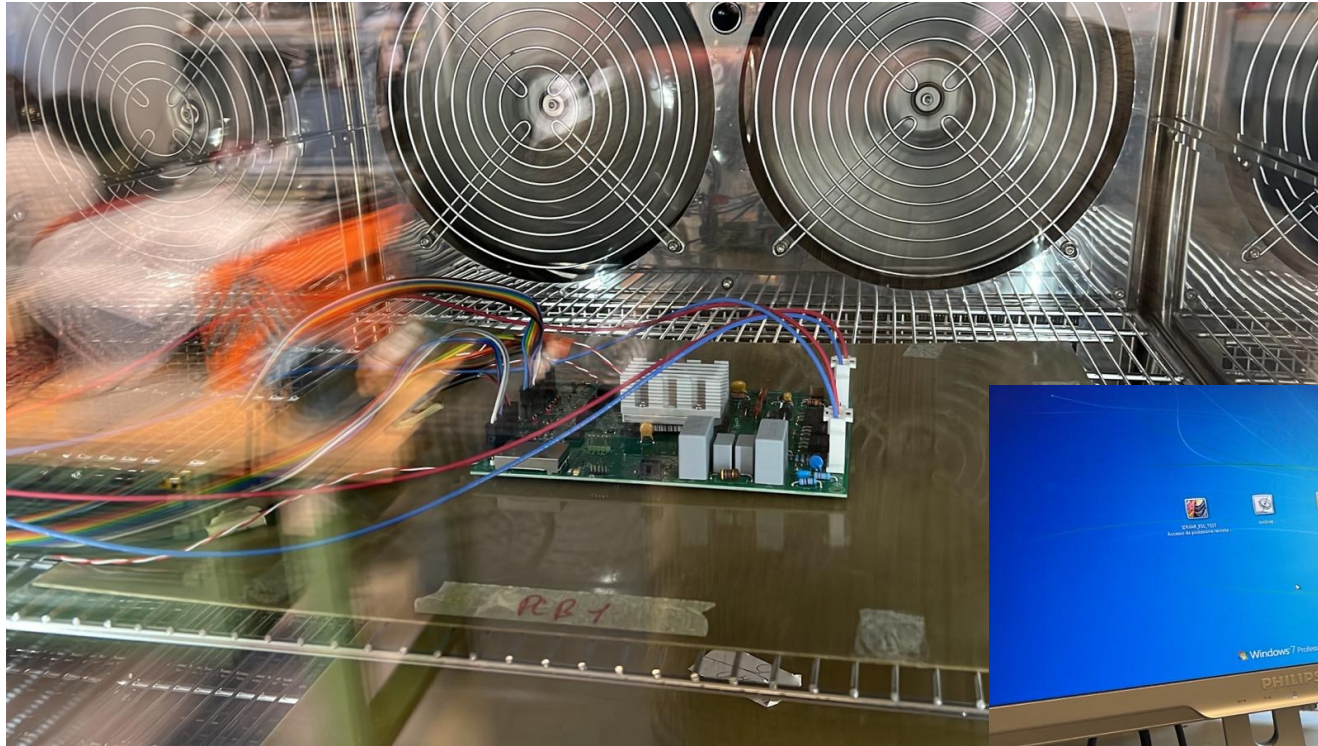
## Laboratory for Electronics and Detectors

- Design and construction of electronic devices control and automation systems upon request of research groups;
- "Environmental Stress Screening" measurements;
- Data base handling of the equipment available to users;
- Supply, limited to experimental needs, of electronic components;
- Managing the detector laboratory and support users during tests;

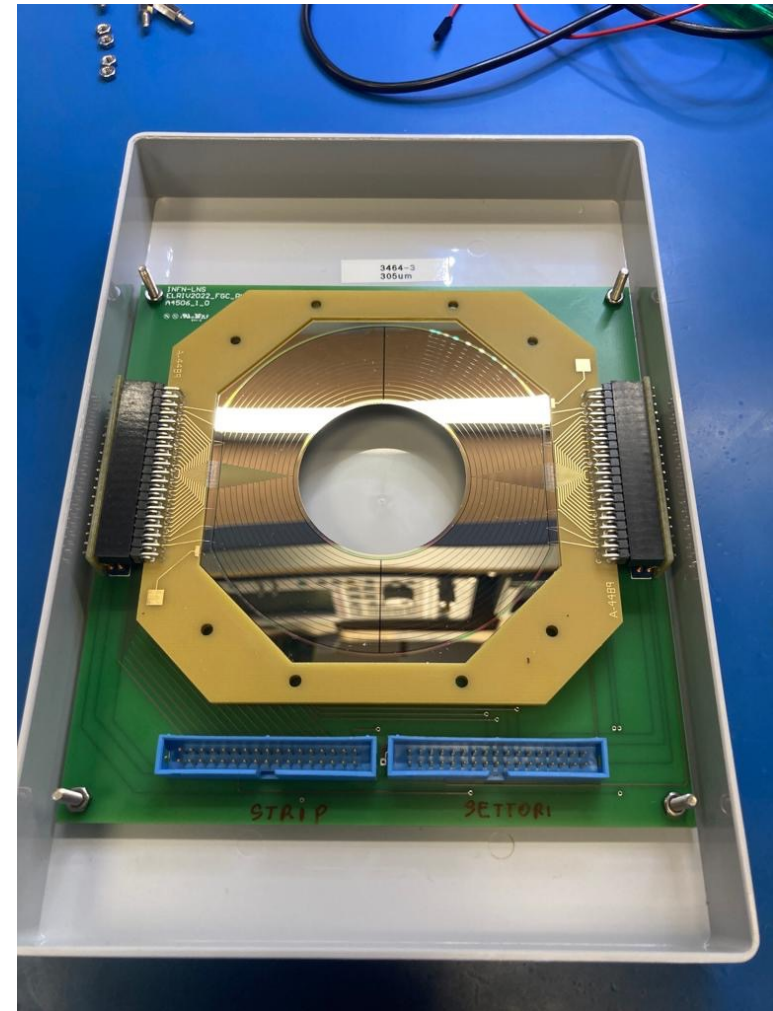
## Restoring detector test stations and assigning devices and stations



## ESS system upgrade with the addition of a galvanic insulation



# PCB (printed circuit board) design and construction for nToF annular detector and related cabling



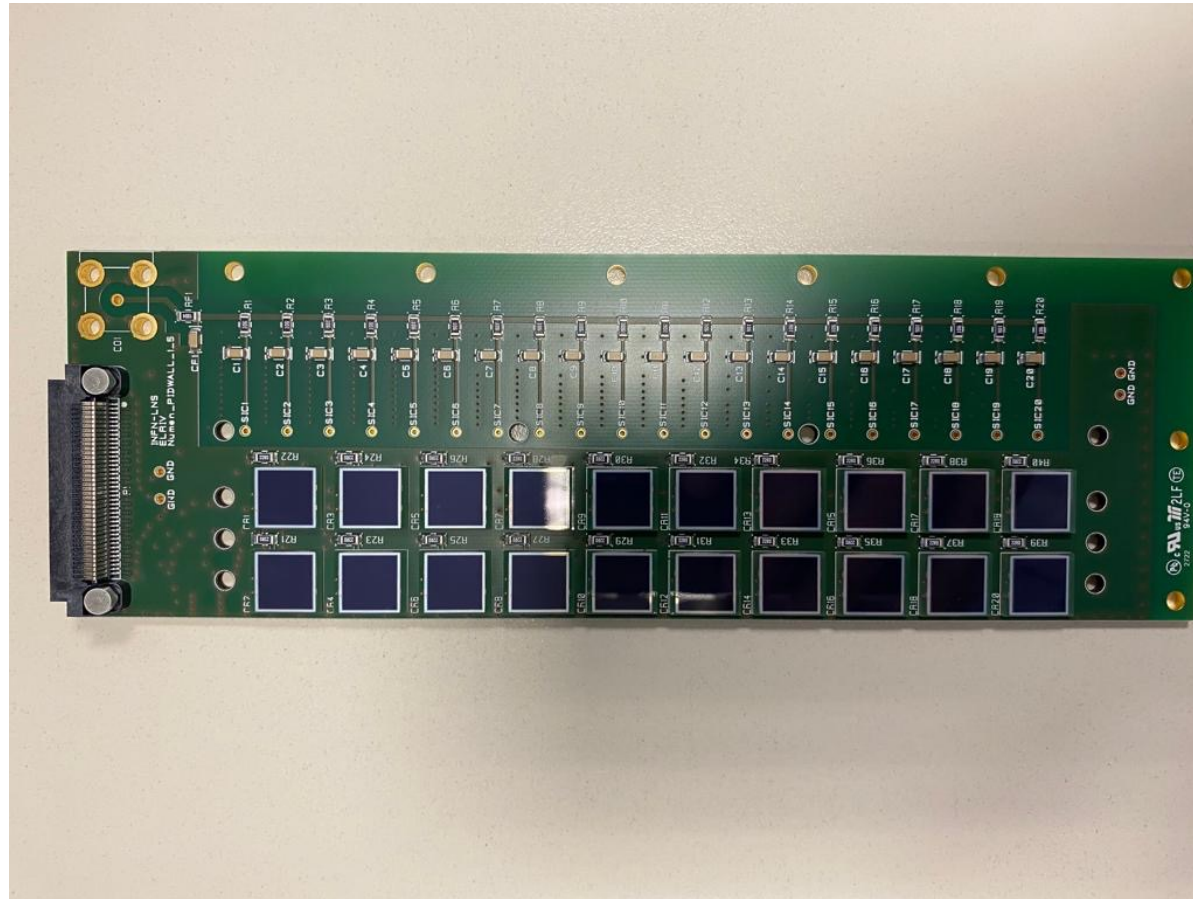
## Preparation of the Km3net bases integration laboratory for the forthcoming phase 2



- KM3NeT activities
- Support for the integration of the Detection Units at the Test Site at the port of Catania;
- Creation of a specific environment for the integration activities of the base modules;
- Board Thermal analysis

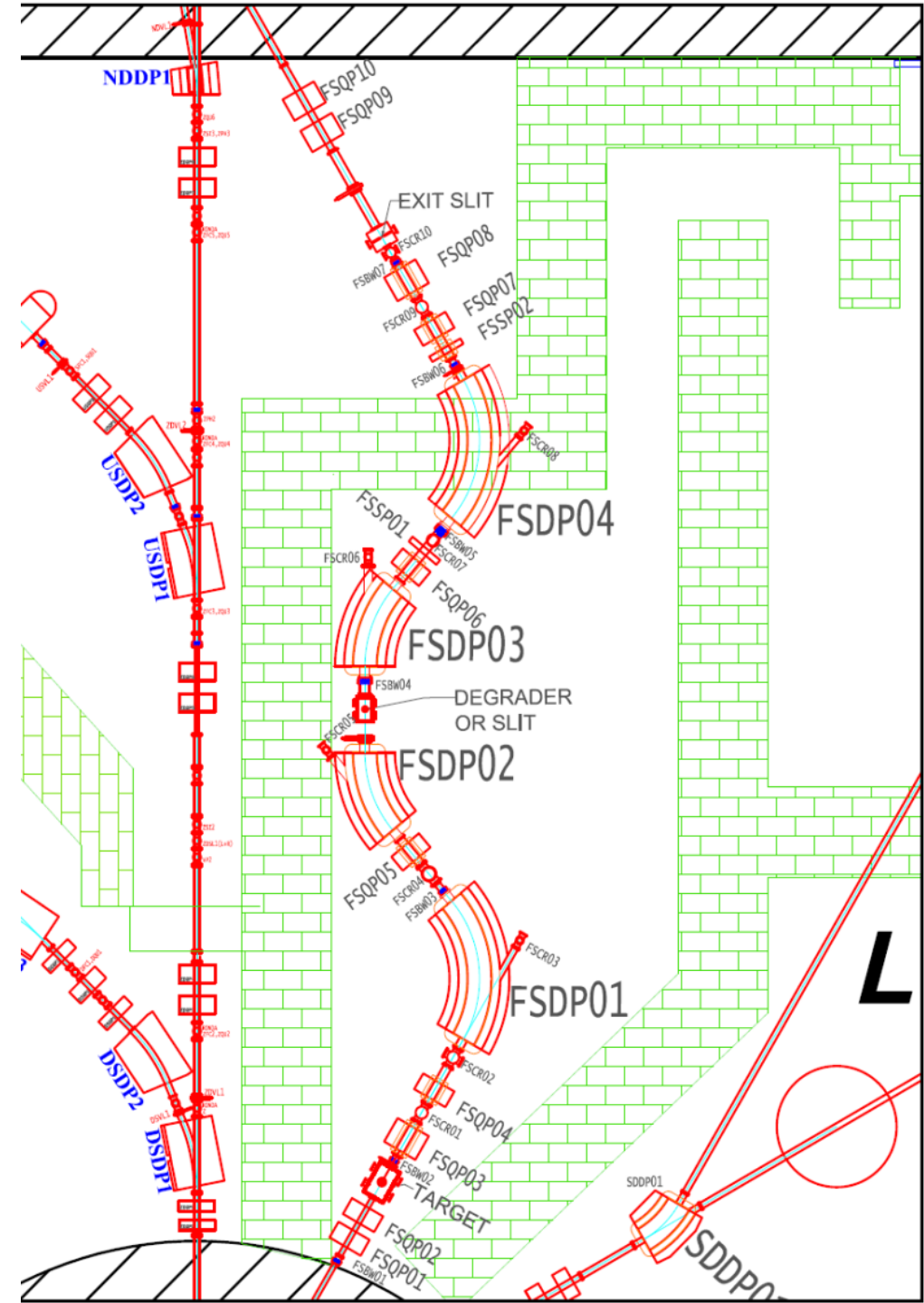
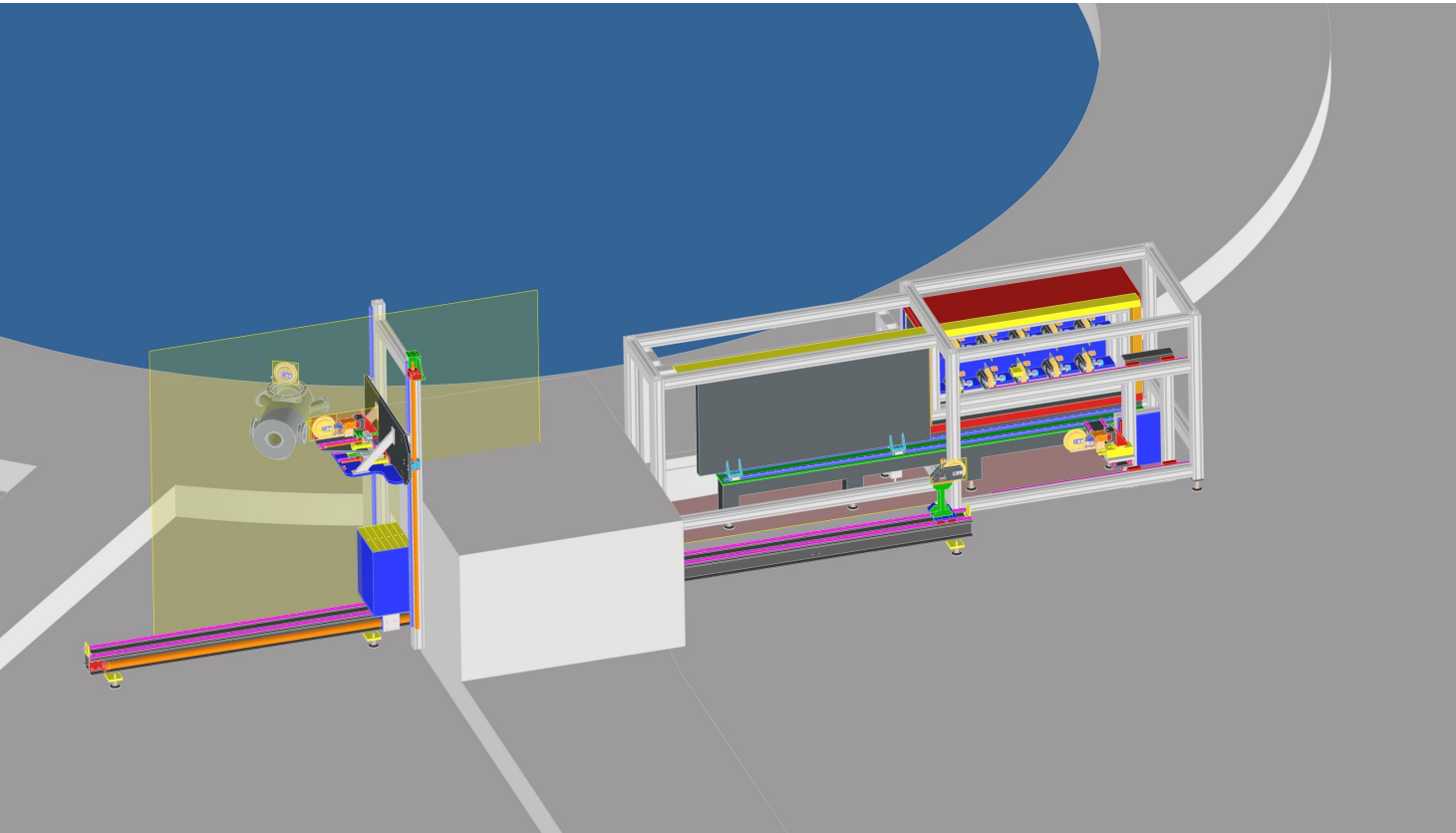


# PIDwall Numen PCB definition and implementation



## FRAISE project

- Remote handling system design for the targets: Project completed
- Awaiting construction at an external company
- Remote control software in the design phase



## SERSE 2021 project

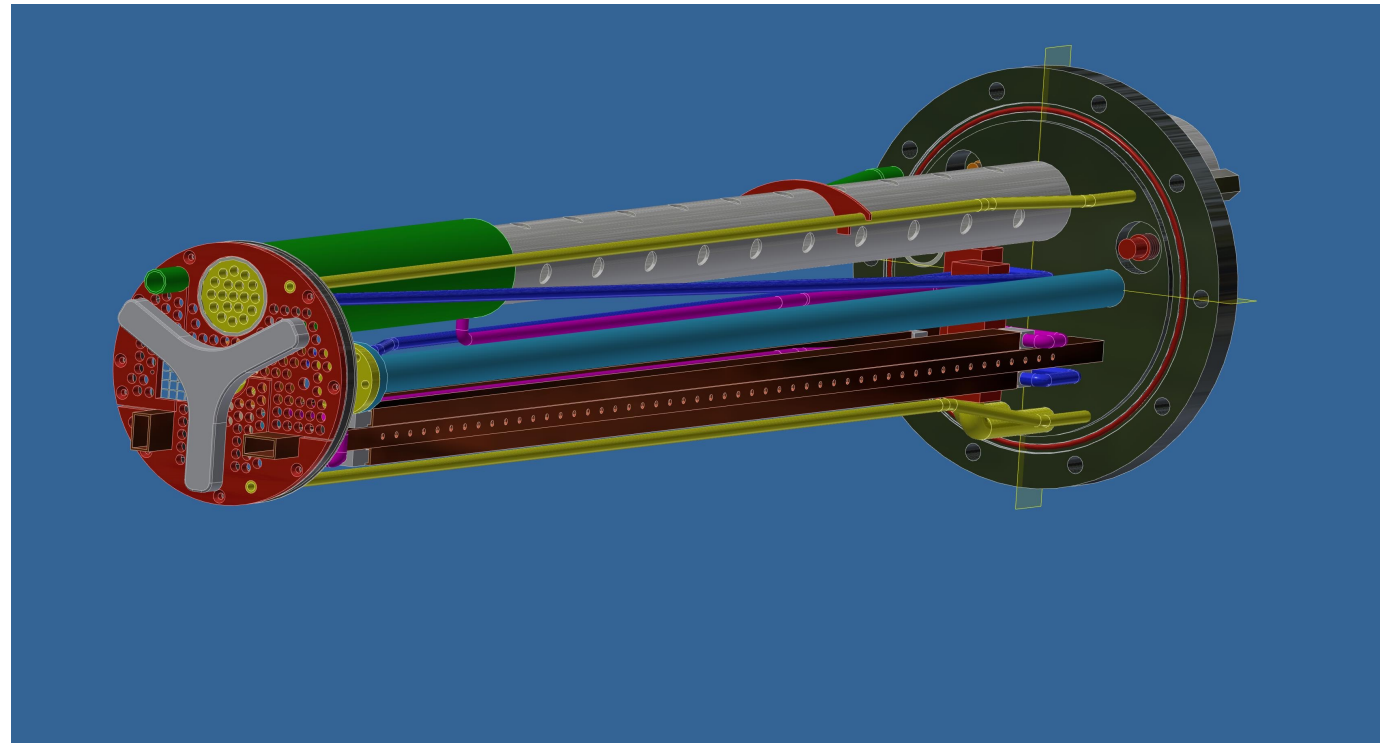
New injection system design:  
project completed and ready to be built

The most significant improvements are:

- New cooling system
- Oven chamber cooled
- Bias water cooled, with improved geometry

-Integrated diagnostic system: unique in the world, it will allow for simultaneously addressing the tuning of the machine and its behaviour (in particular the stability of the parameters of plasma) during routine operation.

... tens of project designs completed (thanks to the activity of Santi Passarello)



# Computing and Information Technology Service

## Highlights 2022

- Management of internal and external connectivity services
  - Mailing: 500+ mailbox
  - Wifi: (INFN dot1x, eduroam, wlans, INFN-Guests)
  - Firewall, VPN
  - LAN interna : DHCP, indirizzi fissi, dorsale di connettività
- Management/Administrative user support (**GA**)
  - Installazione e configurazione Sistema Operativo
  - Supporto software sistema informativo
  - Storage condiviso dedicato, con replica su Alfresco
  - Troubleshooting
  - **Supporto telematico procedure concorsuali**
- Support and consultancy for IT purchases
- IT consultancy for Technical/Scientific users (**TS**)
  - Installazione e supporto software finanziato CCR
  - Supporto informatico video conferenze
  - Troubleshooting (malfunzionamenti hw/sw, perdita-recupero dati)
  - Servizio cloud storage (**owncloud**)
  - Hosting fisico e virtuale di servizi utenti
- Data acquisition support  
Supporto informatico e interfacce con il sistema di acquisizione LNS

## Computing and Information Technology Service

### Highlights II semester 2022

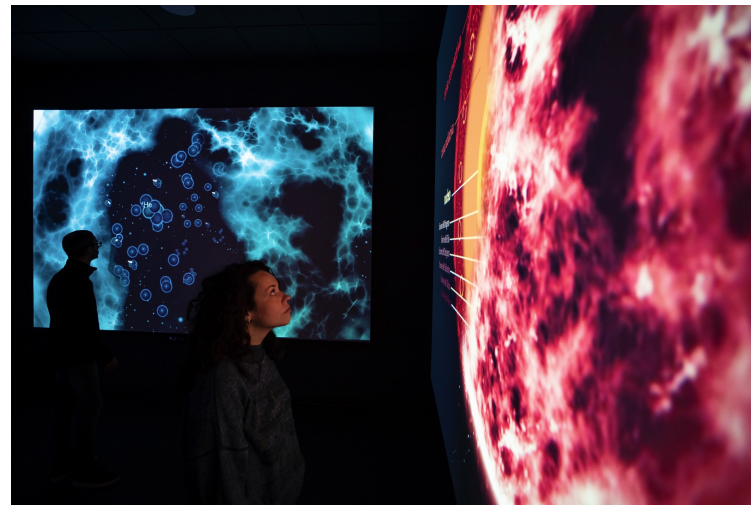
- Network analysis and network segmentation planning in VLAN
- Logical separation of networks
  - performance improvement
  - Possibility of dedicated networks (video surveillance, technical division systems)
- Implementation of a vulnerability scanning system for computer systems
- DAMP user migration to Alfresco system
- Development of a centralized authentication system for network services (mail, VPN, wifi):
  - a single password for all services
  - production scheduled for spring 2023

## INFN – LNS Scientific Information Service

- Remote access to electronic resources (e-books, journals, etc.) to help researchers at INFN LNS with their research through the access to the scientific journals published by AIP APS IOP ELSEVIER IEEE
- Editorial project and realization of the Scientific Activity Report related to the scientific activities performed at LNS
- Management of the LNS web pages concerning the section of events and news
- Social Media Management
- Media Communications to provide specific contents to journalists (press releases, copyright-free pictures, press contacts)
- Scientific Education and Outreach Activities takes several forms, school presentations, workshops, public talks and lab visits, etc. The objective of outreach is to explain the benefits of research to a larger public
- Dissemination material of research activities design and editorial production of brochure
- Public Engagement the set of activities involving educational institutions and the society for the dissemination and promotion of scientific culture through events, exhibitions and demonstrations. These activities are carried out with a committee of young researchers appointed by the LNS director

# THE VISITOR CENTRE

The Visitor Centre is a permanent institution open to the public since 2019. Some results of the research carried out at LNS are exhibited and enhanced through multimedia and technology as a means and tool to capture the attention and involve the observer through interaction and an immersive experience.





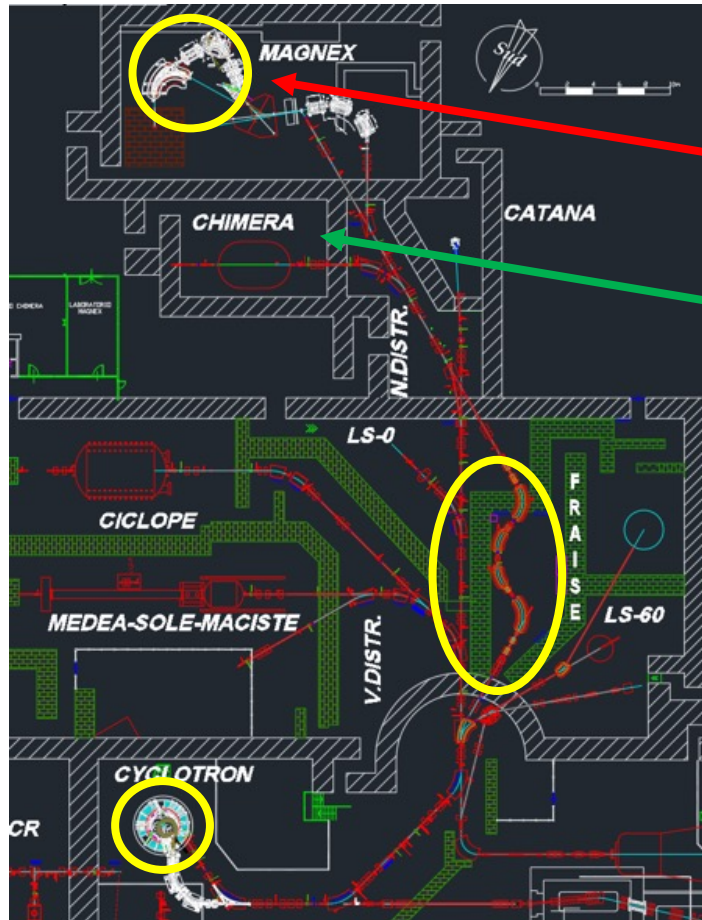
**Secondary School**  
more than a thousand  
students since March 2022





# POTLNS – Beam lines goal

Currently, the POTLNS project plans to install **new beam lines** suitable to transport the beam extracted from the new exit channel of the K800 to the beam-dump.



Experimental hall served by beam extracted using the stripping method:

- **MAGNEX**  
Study of cross sections for double charge exchange nuclear reactions
- **CHIMERA**  
Study of exotic species produced and selected by FRAISE line;

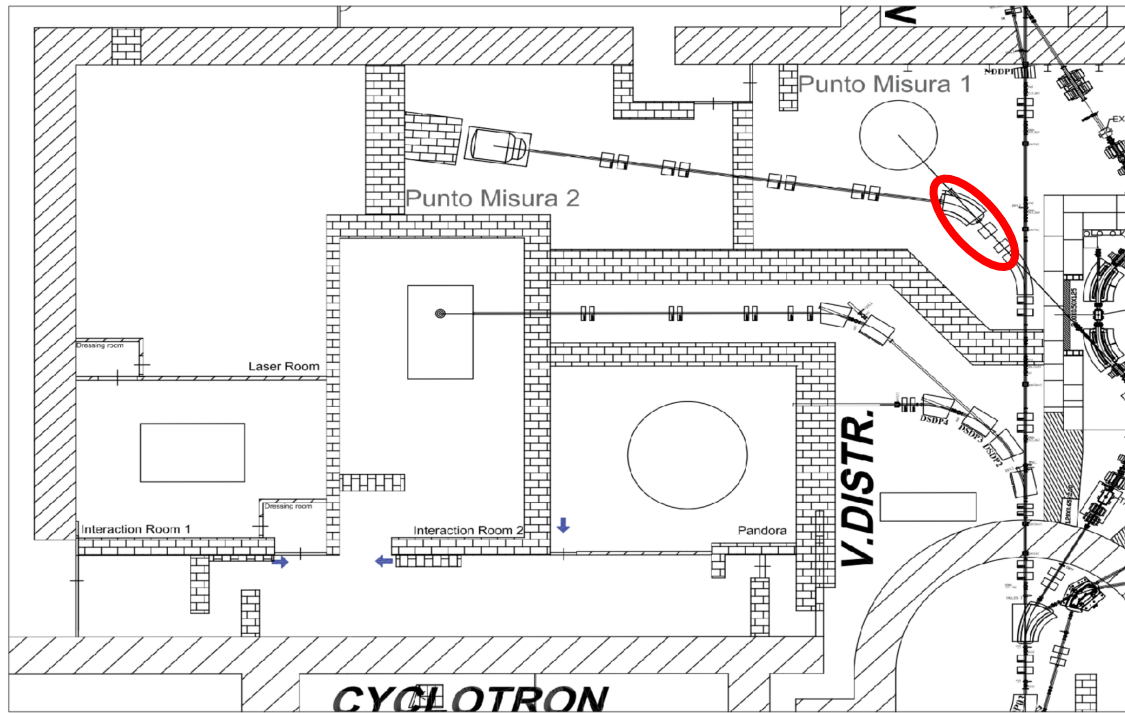
An intense activity is currently in progress for the upgrade of the Magnex focal plane detector, for the development of diagnostic/tagging sensors for RIBs produced by FRAISE and for new detection systems to be used with the new intensities.

[Activity to exploit the new beam features for the users](#) →

## New layout

The possibility to offer new experimental halls is being investigated at INFN-Laboratori Nazionali del Sud

With the decommissioning of the Ciclope chamber it is possible to obtain enough space to host a new experimental point and the part of the BCT project



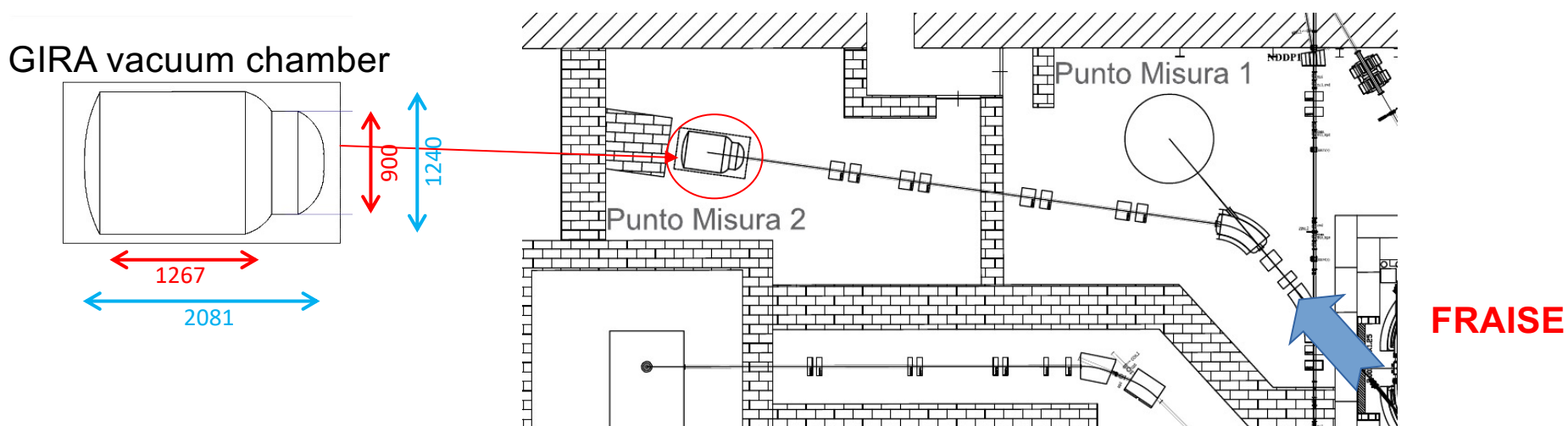
A zero degree exit of the second dipole of FRAISE line allows to connect the FRAISE line to new experimental halls.

This allows both K800 beam extracted by stripping method and the fragment ions produced using the in-flight technique to reach the new measurement point.

This layout opens new scenarios and opportunities for the users, avoiding any interference with CHIMERA and MAGNEX setup.

## Experimental requirements

- Large and well-equipped scattering chamber (2500 mm length, 1000 mm wide)
- Good stable and radioactive beam quality at the measure point
- Beam diagnostic

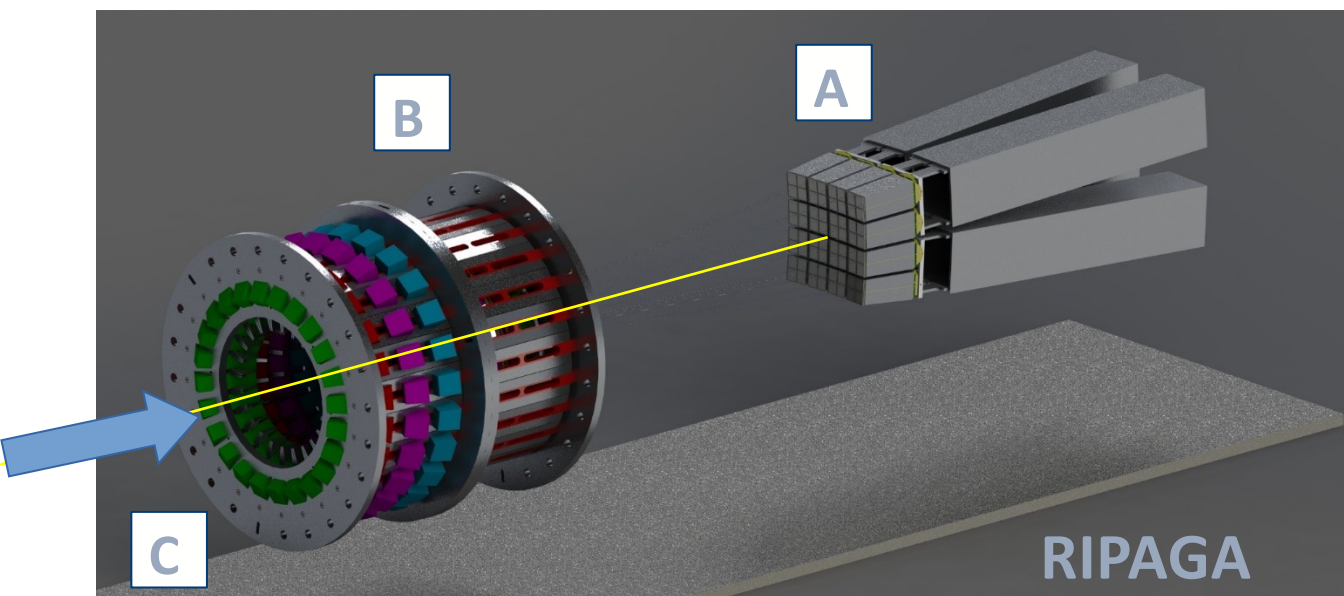


Multipurpose experimental hall (**Punto Misura 2**) in which FRAISE beams will be delivered. Needs for a large scattering chamber for hosting the detectors

- **GIRA** scattering chamber

**PROPOSAL (also for CSN3)** : The GIRA chamber may be too small for the RIPAGA detector and the future developments. **Is it possible to equip a larger scattering chamber?** (including vacuum system, remotely controlled target holder, beam diagnostic, etc.)

# RIPAGA (Rivelatore per PArticelle e GAMMA): A new array for charged products and hard gamma rays



## A Charged particle detector at very forward angles

- Based on **FAZIA** three stage telescopes (Si + Si + CsI)
- Reasonable granularity
- Good charge and mass resolution
- Possibility to **measure at 0°** with low intensity exotic beams
- Possibility to use **SiC** detectors

## B Light charged particles ( $Z \leq 4$ ) detectors at larger angles

- Based on **Garfield CsI** crystals
- CsI crystals (low cost, versatility)

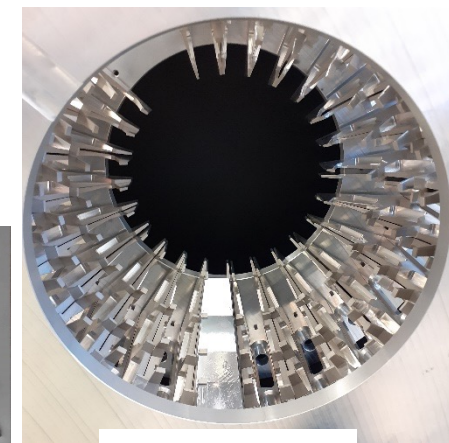
## C Gamma detector array

- Based on **MEDEA BaF<sub>2</sub>** crystals
- Good energy resolution and efficiency up to 30 MeV
- **SiPM** readout instead of PM



## Monitor detector for the cross section normalization

- Plastic scintillators



GARFIELD

Thank you for your attention!