NU AT FNAL AT GENOVA

Lea Di Noto

Riunione Referee

7 settembre 2022

ACTIVITIES IN 2022

- **FOR GRAIN design** (L. Di Noto co-chair)

  → Lens detector **prototyping and test**
  - 3 lens detector prototypes were build in order to be tested in water and in LAr
  - 2 prototypes were tested in water
  - **Installation of ARTIC in the DIFILab**

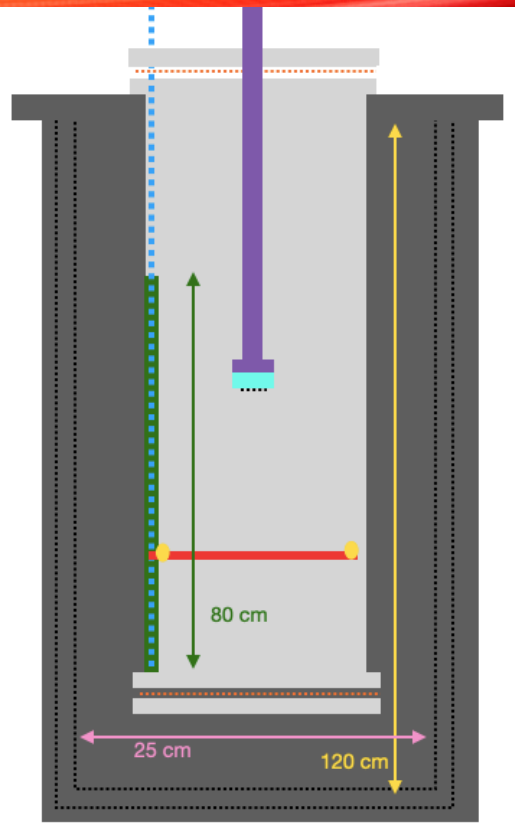
  → LAr **refractive index** measurement

  → Development of **simulations** and **reconstruction algorithms** for ν event interactions in GRAIN

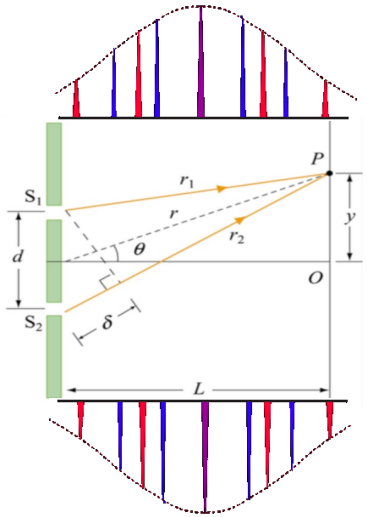
- **Magnet design for ND-GAr** (A. Bersani reference person)

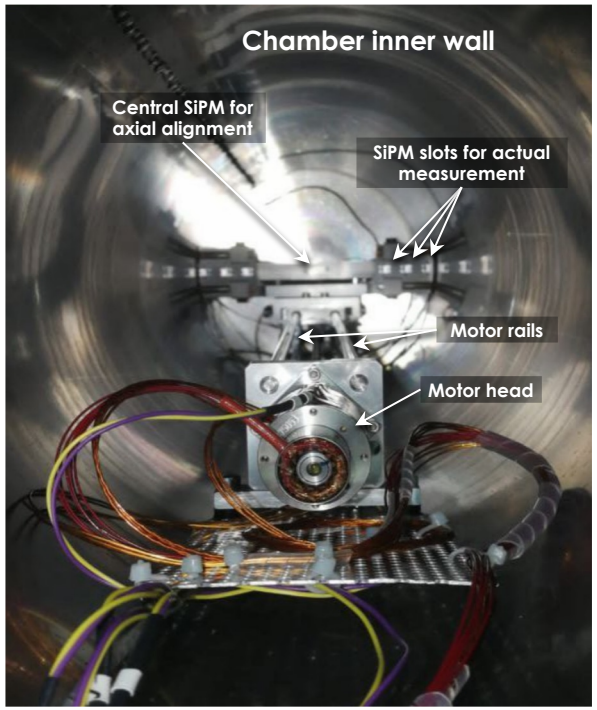
- Started activities **on DAQ & Slow Control** WG (S. Di Domizio co-chair)

LAR REFRACTIVE INDEX MEAS.



by an interferometric method: [https://www.osapublishing.org/oe/abstract.cfm?uri=oe-22-24-29899]
with Hg lamp, diffractive pattern, movable SiPM sensors

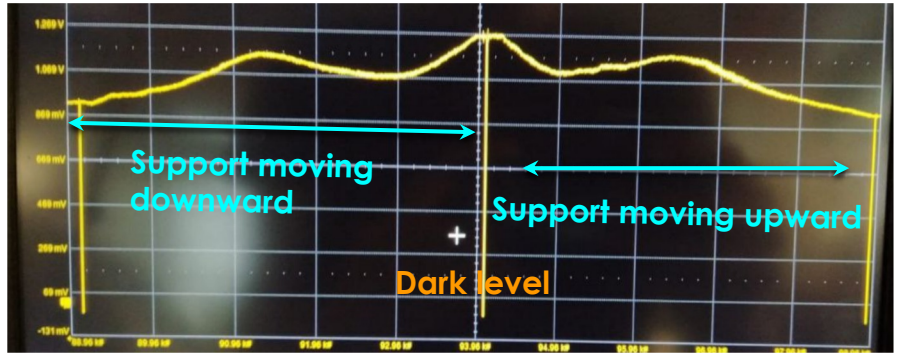




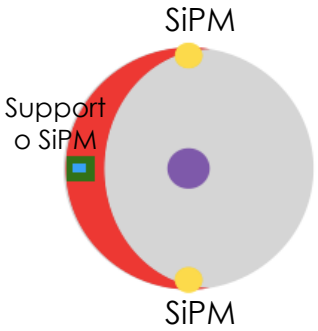
Picture from the top of the chamber

Set up completed!

- Optical chamber ready, Cooling and filling successfully done.
- Motor and SiPM support mounted and tested
- Good axial alignment obtained with 405 nm laser



SiPM integrated signal (luminosity) during support movement (40 cm):
signal is constant within ~30% and reproducible in the two directions.



by comparing the measurements in vacuum and in LAr

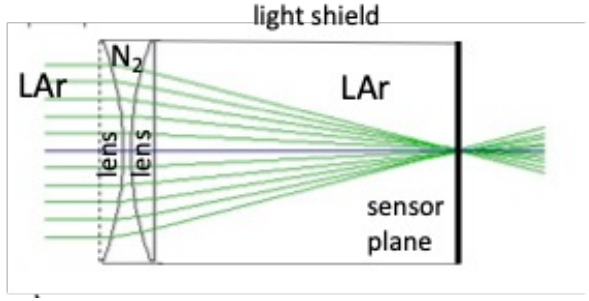
$$n = \frac{\lambda_0}{\lambda_L} = \frac{\sin(\mathrm{atan}(y_0/L))}{\sin(\mathrm{atan}(y_L/L))}$$

First measurements are starting soon!

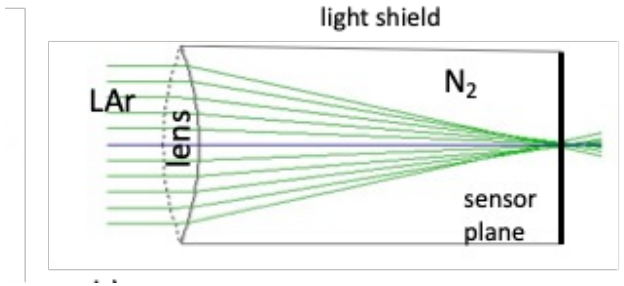
LENS PROTOTYPES

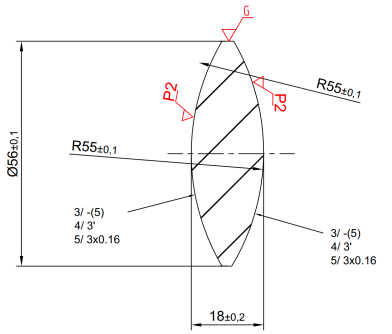
- 3 prototypes:
  - Type A: the same of the simulations (focal lenght 89 mm)
  - Type A: similar (focal 89 mm) but bigger ø = 60 mm
  - Type B: Single bi-convex lens (focal 64 mm)

TYPE A



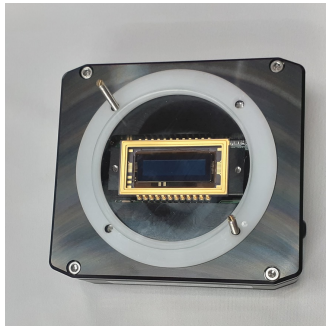
TYPE B





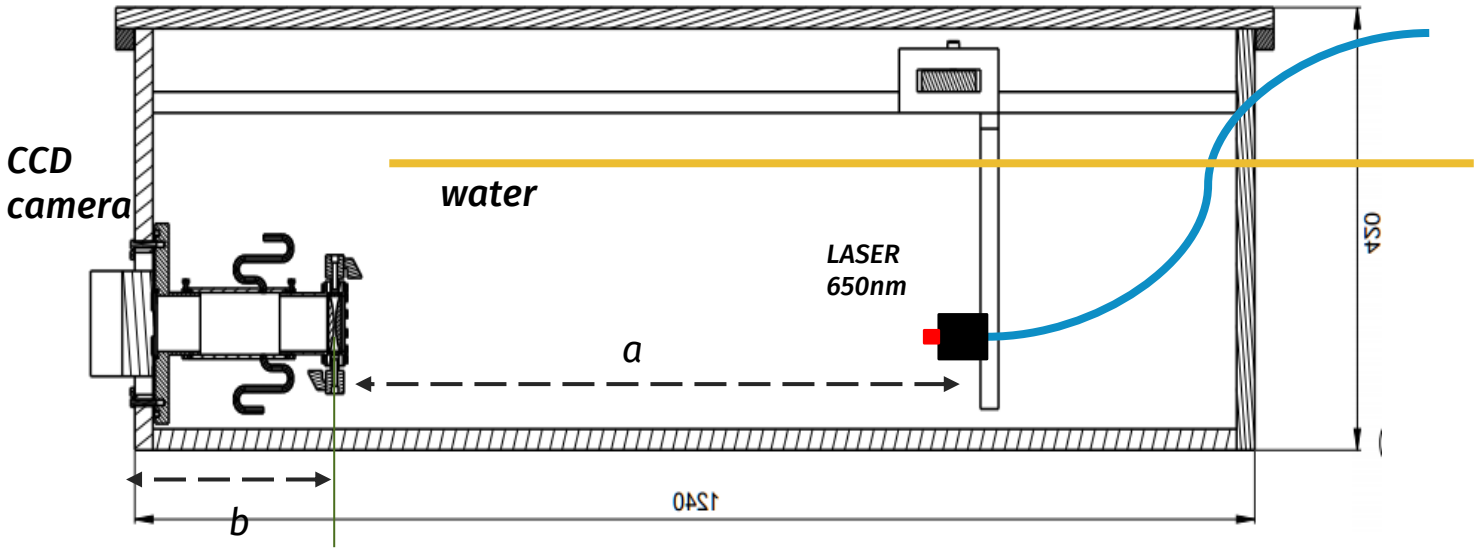
TESTS IN WATER

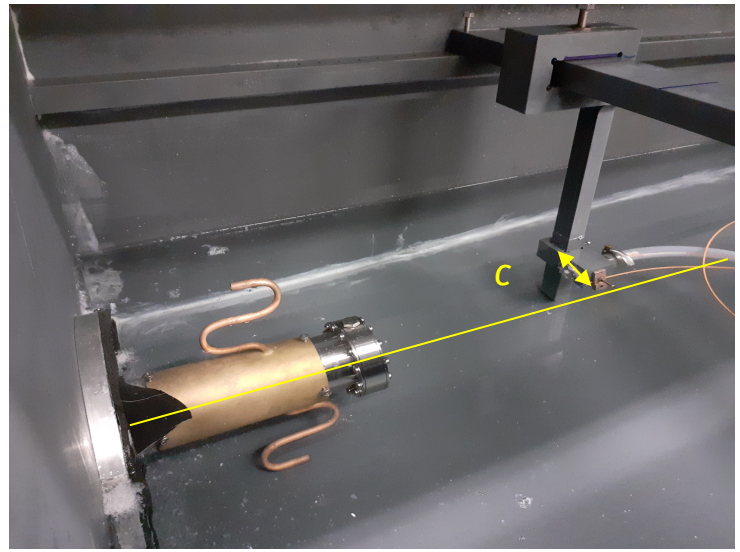
- **Visible light source (650 nm)**
  - trasported on fiber
  - movable position inside the box volume (a, b, c variable)
- **In water** → (n_lens=1.45 n_water=1.33, bigger focal length f=118 mm)
- **with a CCD camera** (sensible to UV or visible light)



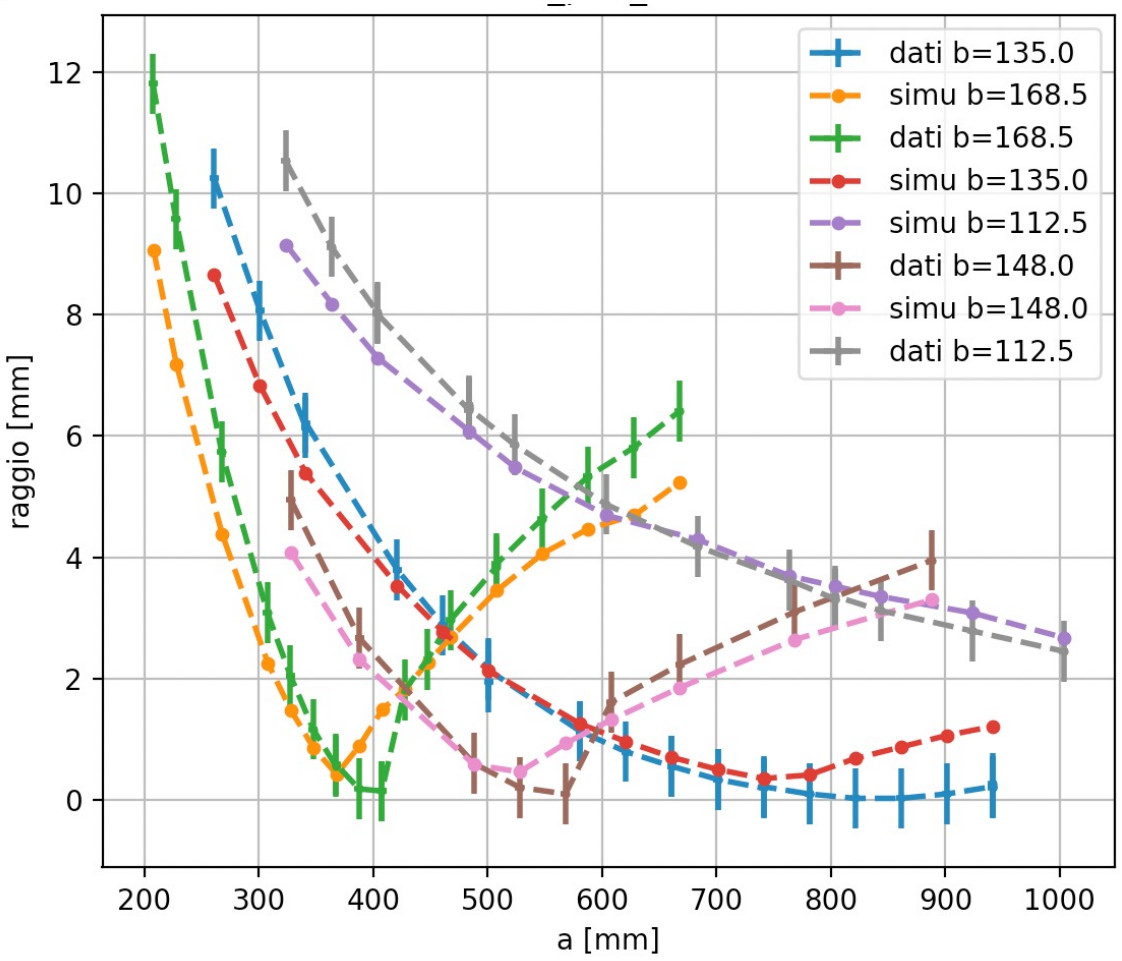
CCD (UV-visibile)
Dim: 24 mm x 12 mm

- **GOAL:** test simulations results in therm of field of view and focusing

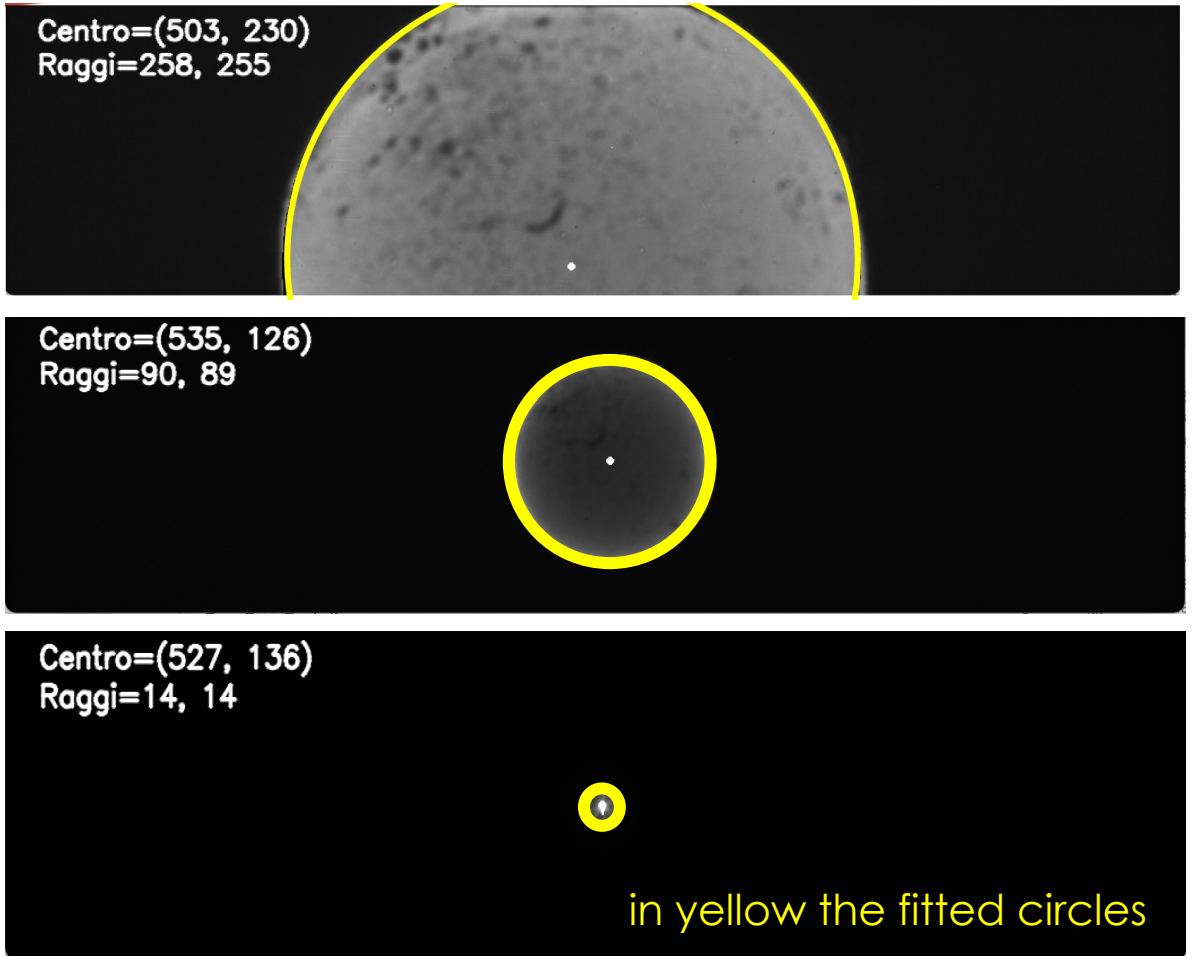




THE FOCUSING EFFECT



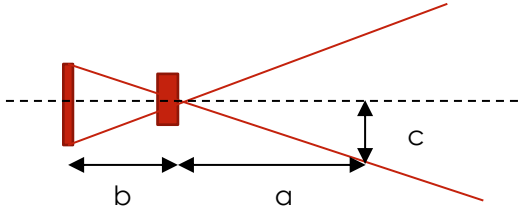
b=148 mm in water is expected to work as
b=10 cm in LAr with UV light



THE FIELD OF VIEW

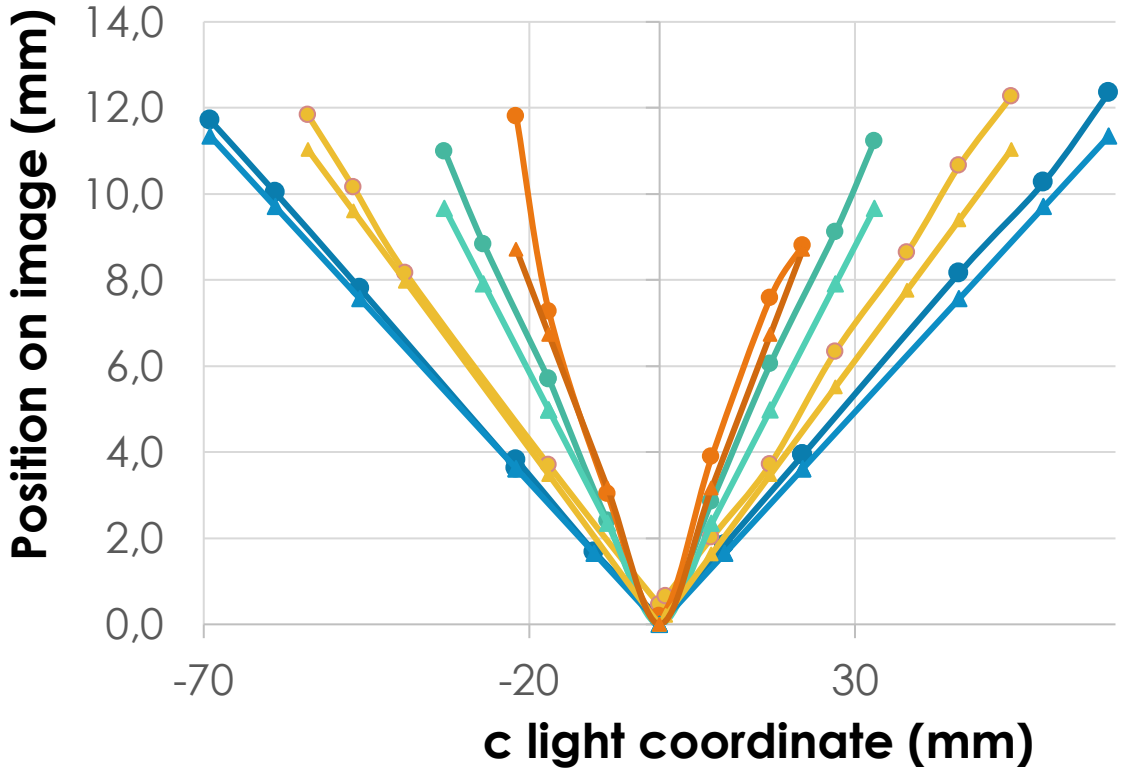
for b= 135 mm

Comparison with the expected (teo) values



Pos_image=a/b*c

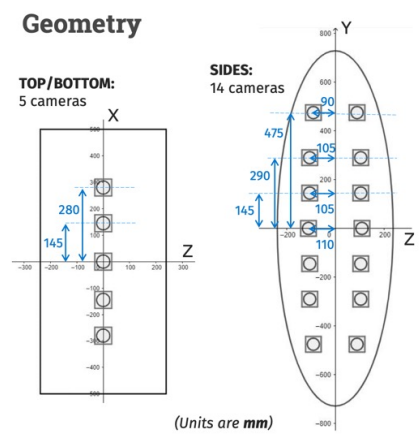
Center position vs c

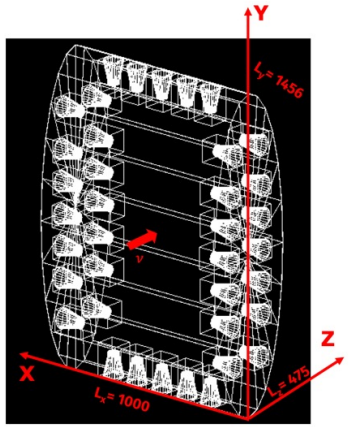


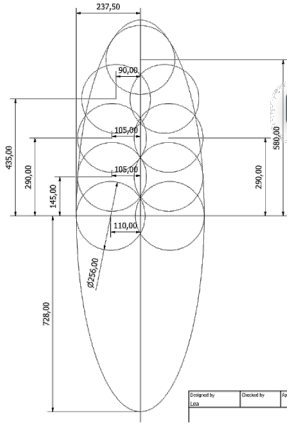
a values (mm)

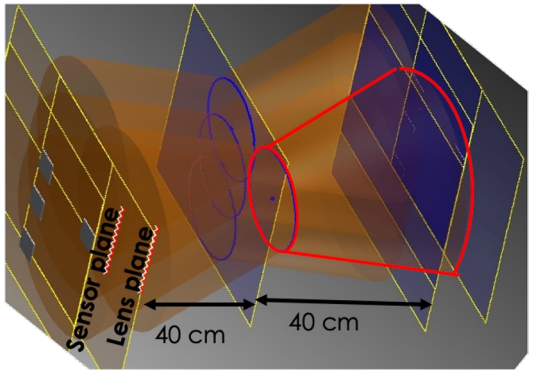
- a=461 mm
- a=821 mm
- a=661 mm
- a=341 mm
- a=461 mm teo
- a=821 mm teo
- a=661 mm teo
- a=341 mm teo

Thinking to GRAIN



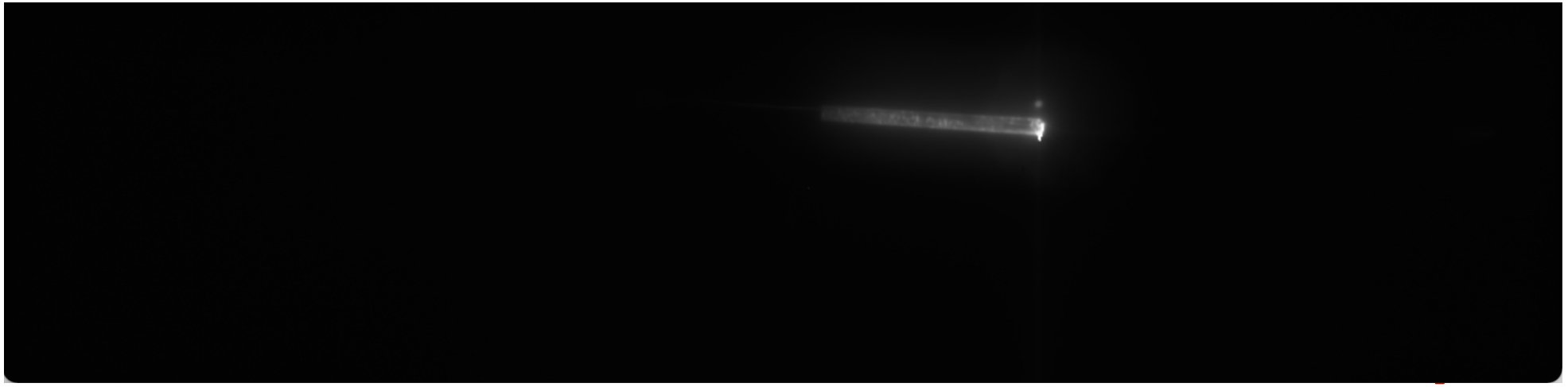


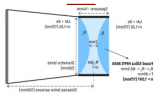


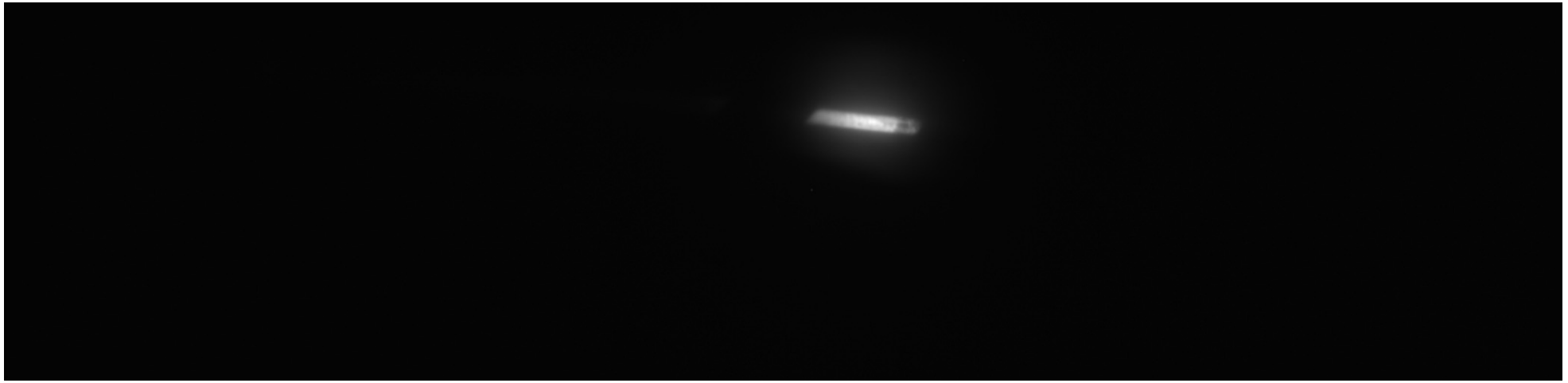


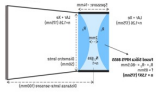
The data are in agreement with simulated/expected values
We can proceed to test in LAr and to optimize the system for GRAIN!

FIRST TRACK IMAGES



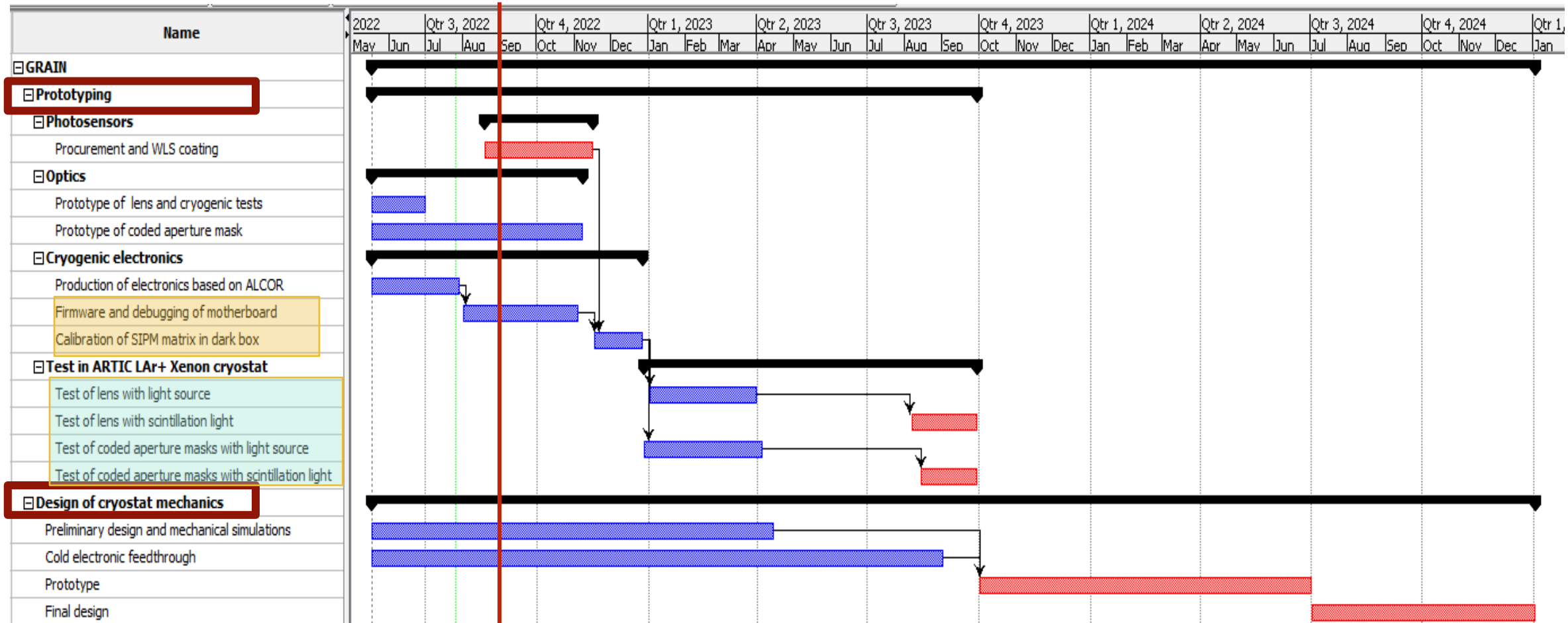




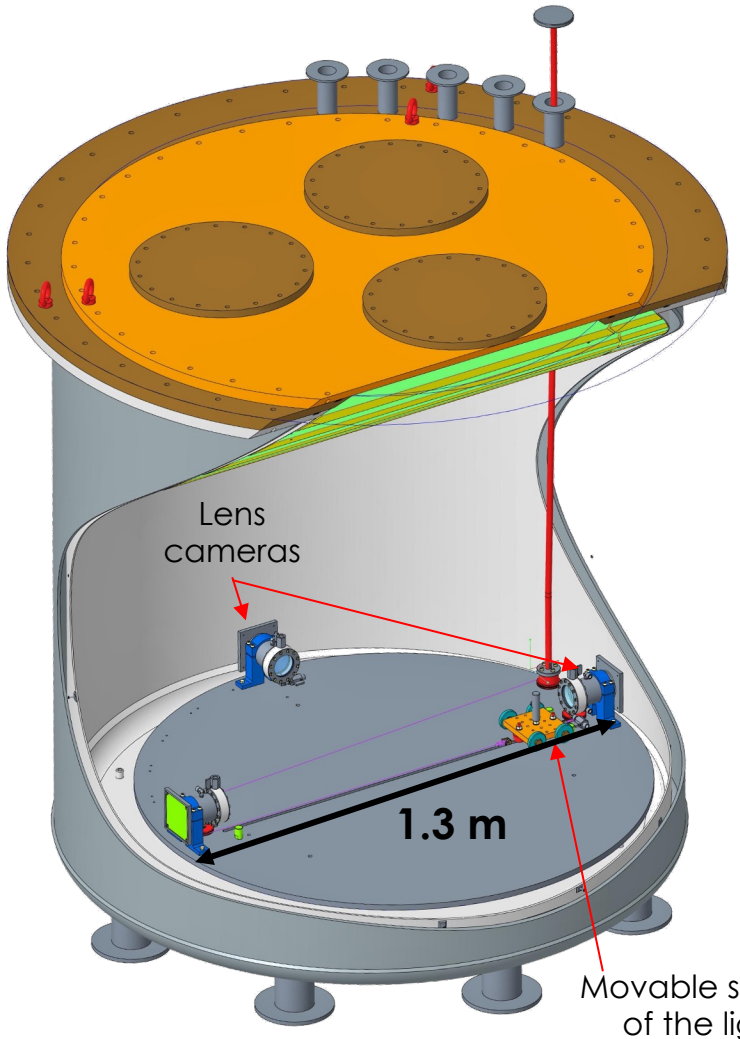


NEXT STEPS FOR GRAIN DESIGN

1. **Prototyping:**
   - →set up a first readout system for SiPM matrix
   - →set up measurements in LAr (two phases)
2. Cryostat and sensor **design** in GRAIN

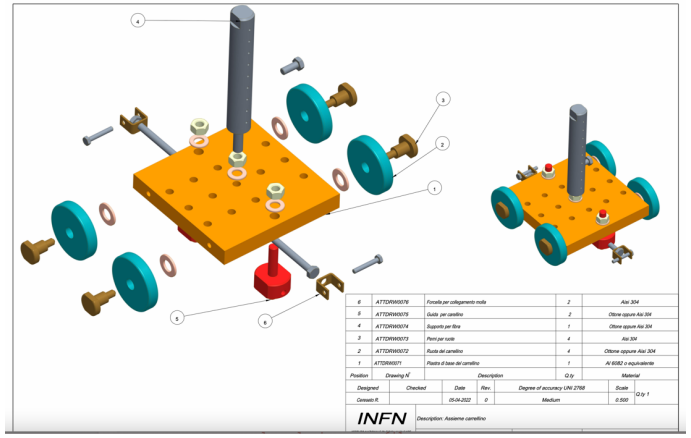


NEAR TERM TESTS IN LAR
END 2022



Tests in **LAr** (150 l) with an **artificial light source** at 180 nm

The set up will be used **both for lens based** or **coded mask** based detectors

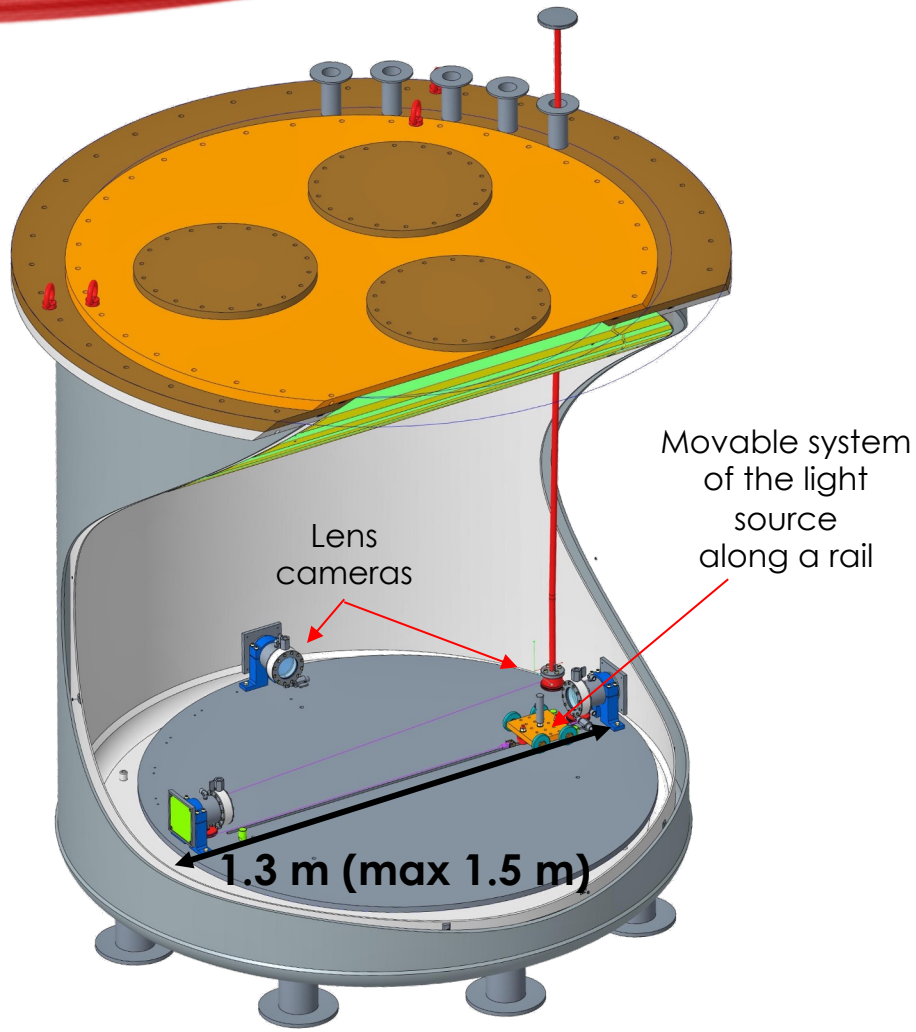


The design is completed

- mechanics production in the Genova workshop
- electronics under test in Bologna

We plan to complete the installation and to start first tests **by the end of 2022**

TESTS IN LAR IN 2023



- **Cosmic ray detection in LAr (+Xe) triggered by an external cosmic ray system**

- In ARTIC we have **to install a LAr recirculation** (+ Xe doping system if necessary)

- **We are finalizing the design of the system:**
  - minimum system
  - 150-200 liters
  - for purifying Ar for light yield

We are planning to complete the design by Nov 2022

These tests:
- will validate the possibility to use the new detectors in GRAIN
- will allow us to design and test the final detectors and electronics
- will provide additional measurement of LAr properties

SISTEMA DI RICIRCOLO

Estratto dall'offerta che ho allegato alle richieste

Scopo di fornitura

La presente quotazione include:

- Scambiatore di calore per la condensazione dell'Argon gassoso;
- Compressore di circolazione;
- Tubi flessibili per il collegamento dei diversi componenti d'impianto;
- Pannello di controllo;
- Quadro elettrico e di controllo.

Dati tecnici

Capacità media di condensazione in modalità purificazione a circuito chiuso	1.5 l/h
Capacità media di condensazione in modalità purificazione a circuito chiuso	~ 2 l/h
Capacità di condensazione massima durante riempimento iniziale a circuito aperto o circolazione in bypass a circuito chiuso	~ 3 l/h

Esclusioni

Sono da considerare esclusi dalla fornitura:

- Cryocooler per la condensazione dell'Argon;
- Scambiatori di calore per il recupero termico;
- Getter SAES PS4 MT15-R2 Getter Rare Gas purifier;
- Getter aggiuntivo meno performante in parallel al Getter SAES PS4 MT15-R2;
- Bombola di Argon gassoso;
- Criostato e relativa strumentazione a corredo (trasmettitore pressione, livello, ecc.);
- Pompa da vuoto;
- Tutto quanto non espressamente indicato in offerta;

TUTTO GIA' ACQUISTATO con fondi UNIGE!

Prezzo:

Condensatore Argon per cryocooler	**20.000,00 €/cad.**
Pannello di controllo	**35.000,00 €/cad.**
Quadro elettrico e software di controllo	**15.000,00 €/cad.**
Piping/supporti/collegamenti vari	**5.000,00 €/cad.**
Progettazione e design dell'assieme	**5.000,00 €/cad.**

TOT: 80 000 € + IVA

RICHIESTE 2023

Capitolo	Descrizione	Parziali (k€)		Totale (k€)	
		Richieste	SJ	Richieste	SJ
apparati	SAND/GRAIN: Ordine Criotec per sistema di liquefazione e ricircolo dell'Argon liquido nella facility di Genova ARTIC, necessario per i test dei prototipi con i cosmici.. I test sono fondamentali per la validazione dei prototipi dei rivelatori da installare in GRAIN. La cifra deriva dall'offerta allegata (80k+iva) - 12 k su fondi SJ di Genova 2022- Anticipabili nel 2022	85.00	0.00	85	0

Capitolo	Descrizione	Stanziato	Variato	Subjudice e Cong.	Preimpegno	Impegni	Disponib.	Proposta in corso	Disp. Teorica
U1030102008	Strumenti tecnico-speci	8.000,00	-200,00	5.000,00	0,00	2.513,41	286,59	0,00	286,59
U1030202001	Rimborso per viaggio e	28.500,00	0,00	0,00	0,00	9.240,60	19.259,40	0,00	19.259,40
U1030207006	Licenze d'uso per softw	3.000,00	-1.500,00	0,00	0,00	0,00	1.500,00	0,00	1.500,00
U1030213003	Trasporti, traslochi e	0,00	200,00	0,00	0,00	65,76	134,24	0,00	134,24
U2020104002	Impianti	12.000,00	1.500,00	2.500,00	0,00	7.778,12	3.221,88	0,00	3.221,88
U2020105001	Attrezzature scientific	0,00	231,27	0,00	231,27	0,00	0,00	0,00	0,00
Totale:		**51.500,00**	**231,27**	**7.500,00**	**231,27**	**19.597,89**	**24.402,11**	**0,00**	**24.402,11**

RICHIESTE 2023

Capitolo	Descrizione	Parziali (k€)		Totale (k€)	
		Richieste	SJ	Richieste	SJ
apparati	SAND/GRAIN: Ordine Criotec per sistema di liquefazione e ricircolo dell'Argon liquido nella facility di Genova ARTIC, necessario per i test dei prototipi con i cosmici.. I test sono fondamentali per la validazione dei prototipi dei rivelatori da installare in GRAIN. La cifra deriva dall'offerta allegata (80k+iva) - 12 k su fondi SJ di Genova 2022- Anticipabili nel 2022	85.00	0.00	85	0
consumo	CONSUMABLES: Liquidi criogenici (Azoto e Argon) per i test dei prototipi di lenti e matrici in ARTIC	7.00	0.00	18	0
	CONSUMABLES: Acquisto lenti per nuovo prototipo ottimizzato dopo i test del 2022	6.00	0.00		
	CONSUMABLES: Cablaggi, flange, connettori per test dei prototipi in ARTIC	5.00	0.00		
inventario	SAND/GRAIN: Cryocooler dimensionato per la liquefazione di Argon liquido in ARTIC necessario per i test dei prototipi con luce di scintillazione- Anticipabili nel 2022	30.00	0.00	30	0

Bisogna ancora definire il modello e le specifiche finali

stima ottimistica

RICHIESTE 2023

Capitolo	Descrizione	Parziali (k€)		Totale (k€)	
		Richieste	SJ	Richieste	SJ
missioni	ICARUS TURNI: permanenza di 4 mesi al Fermilab per attivita'Â di run coordinator per l'esperimento ICARUS. Il gruppo di Genova non ha contribuito nel 2022 e sara'Â obbligatorio contribuire nel 2023	30.00	0.00	57	0
	DUNE MEETING: per la partecipazione ai collaboration meeting di DUNE. Al CERN 4 persone (4 k), al Fermilab 2 meeting x 2 persone (8 k),	12.00	0.00		
	DUNE MEETING: Missioni dedicate alle attivitÃ di coordinamentoÂ dei Working Group di GRAIN e di DAQ + workshop del ND organizzati dalla collaborazione (4 settimane x 1 persona)	6.00	0.00		
	ICARUS TURNI: missioni al Fermilab (2 settimane x 3 persone) per tutorial e sviluppo di codici di Larsoft e Pandora organizzati dal TPC reconstruction WG	9.00	0.00		

ACTIVITIES IN ICARUS 2022-2023

- **Reconstruction optimization for track and shower by TPC signals**
  (A.Campani, L.Di Noto, S. Di Domizio)

  Improvement of reconstruction algorithms in LArSoft e in Pandora

- **Visual scanning, data analysis for neutrino event selection**

(A.Campani, L.Di Noto, B.Bottino, S. Copello)

- **Shifter helper (M.Vicenzi)**

Anagrafica

FTE: **3.7 (+1.0)**

Lea Di Noto	RTDA	Resp.loc.	0.7
Andrea Bersani	Tecnologo		0.3
Bianca Bottino	Post-Doc		0.3
Alice Campani	Post-Doc		0.4
Marco Pallavicini	PO		0.8
Matteo Rossi	dottorando		0.2
Matteo Vicenzi	dottorando		1.0
+ Post-Doc da autunno 2022	Post-Doc		1.0

Tecnici della sezione coinvolti:

Giuliano Sobrero
Massimo Cariello
Progettazione meccanica: Roberto Cereseto
Officina Meccanica

- **TPC reconstruction Working Group**

(A.Campani co-chair, S. Di Domizio, L. Di Noto,)

  - Development and optimization of the reconstruction chain from the TPC signal to the neutrino event
  - study of track and shower reconstruction efficiency in MC and data
  - identification of the pathologies occurring in the track and shower reconstruction
  - improvement of Pandora algorithms for track and shower reconstruction
  - tuning of BDT argorithm in Pandora for the track/shower identification