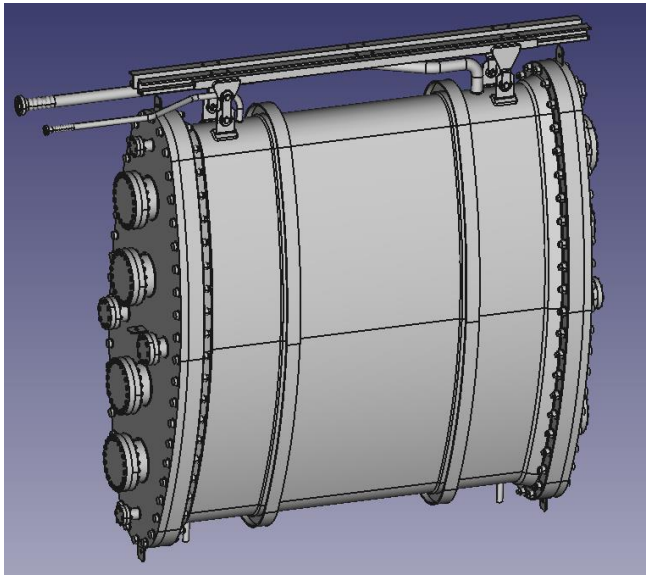
SAND/GRAIN:
Progress report for CNS1 referees

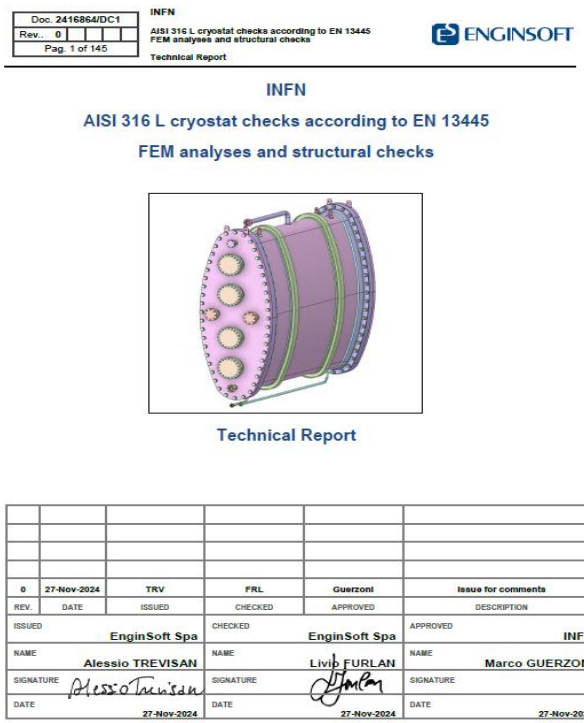
Conveners: Lea Di Noto – Univ. and INFN Genova
Alessandro Montanari- INFN Bologna

July 24th 2025

Mechanics:

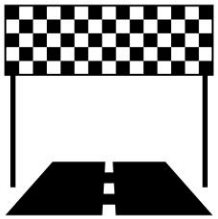
inner vessel





- Final design under review
- Fermilab review is starting soon
- Order in 2025

Milestone 2026 (ottobre):
Costruzione e test di collaudo Inner Vessel



Cryogenics

- **New semplified design**
  - Based on recirculation and filtering in gas

- The order will be finalized by spring-summer 2026

- Expected delivery of the system in Legnaro in 2027

- RICHIESTA nel 2026 S.J. al completamento del dettaglio della proposta economica

  850 kEuro BOLOGNA

DENEB (ASIC) design steps

- **TDC design** : TAC + ADC

  New ADC design validated

- **Digital logic design**:

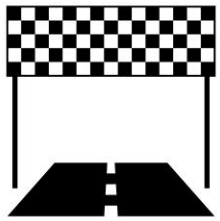
  It is in advanced stage

- **Analog blocks are still missing**

  It needs final validations

- **Pixel design finalization by September**

Milestone 2026 (may-oct)
ASIC design submitted to foundry



Molto probabile la RICHIESTA SBLOCCO dei fondi a settembre 2025 altrimenti la richiesta viene posticipata nel 2026

268 kEuro TORINO

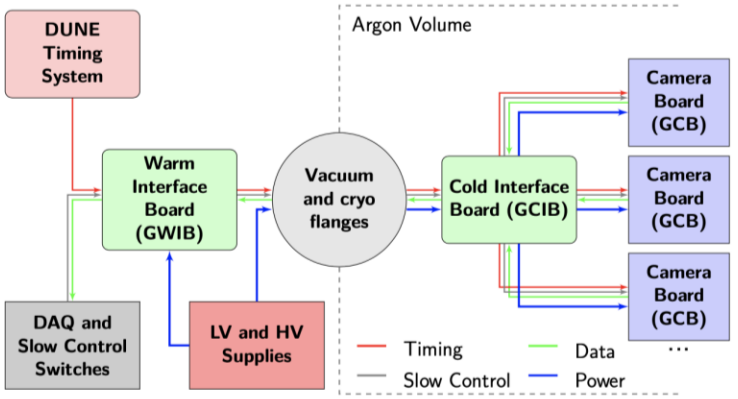
DENEB packaging

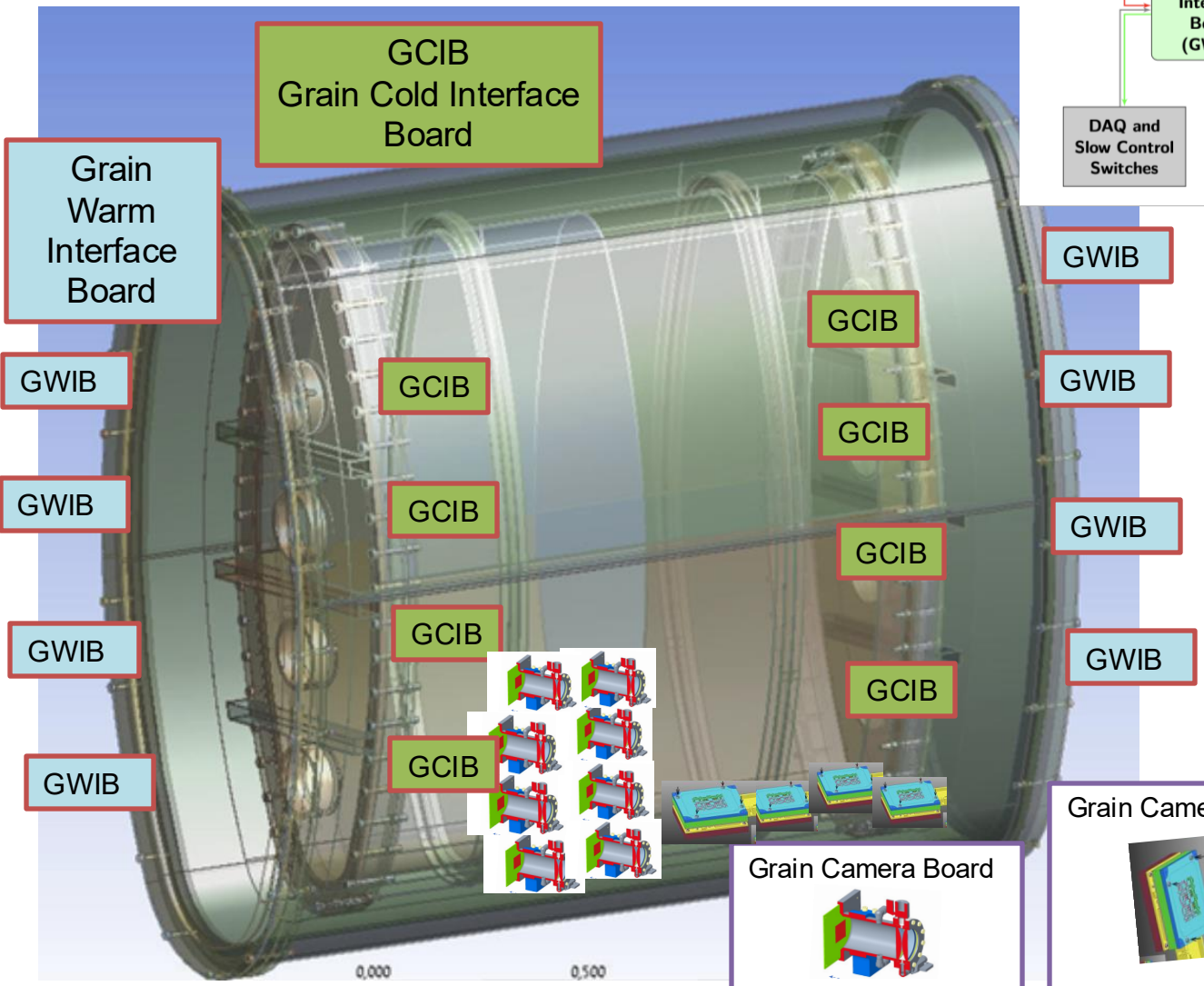
- After the ASIC is produced, it must be packaged for the final assembly on the front-end board
- This process might be critical for costs and timeline
- The company Micon Business Developer Manager was contated on January 2025
  - I-Tronics Pte Ltd (Singapore, https://www.itronicssg.com/):
  - it is a Micon's partner
  - the production requires about **4 months**!
  - The **order must be finalized when the ASIC design is submitted** to the foundry
  - A first **quotation will be available soon** it seems within the estimated cost

- Da decidere se RICHIESTA di SBLOCCO dei fondi a settembre 2025 o POSTICIPO al 2026
  - la parte tecnica è ancora preliminare
  - dipende anche dalla tempistica dell'ASIC

120 kEuro GENOVA

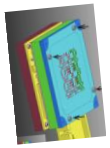
GRAIN readout scheme





Grain Camera Board

Grain Camera Board



The readout design has just started

GRAIN readout

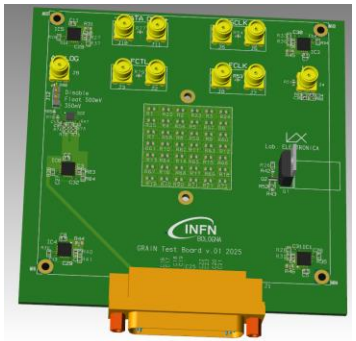
- It is necessary to validate many readout **components** in **cryogenics enviroments** in order to design the complete readout

- during 2026 **many tests** ill be performed at Genova and at Bologna

The mock-up test goals

- Test LDO regulators for ASIC power
- Test power dissipation using equivalent resistors
  - Test LDO response to rapid change in load (ASIC power gating)
- Test signal quality using D-Sub HD connectors
  - Available as cryo/vacuum compatible parts
  - 44 pin
- Test SLVS 1:2 buffers
  - These would be used by the GCIB if necessary

Mockup board from Bo



RICHIESTE nel 2026

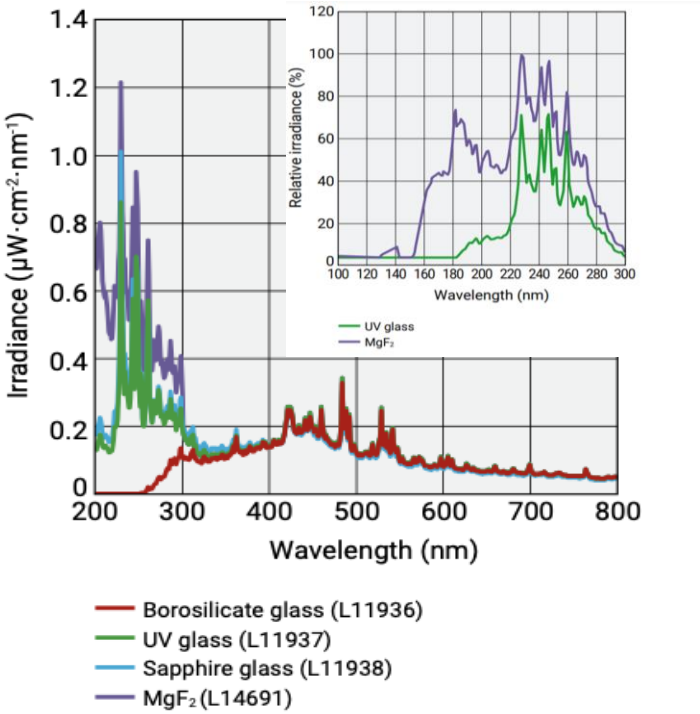
-Per i test: **30 kEuro BOLOGNA – 7 kEuro GENOVA**

-S.J ai test per acquisto finale di cavi connettori e flange: **280 kEuro BOLOGNA**

Tests with lens prototype at Genova

the apparatus

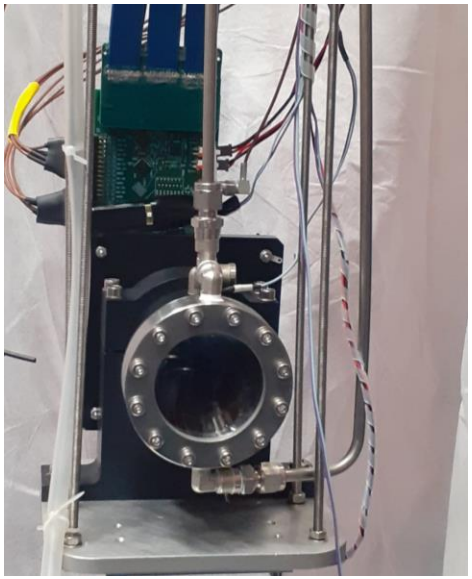
- Artificial point-like light source

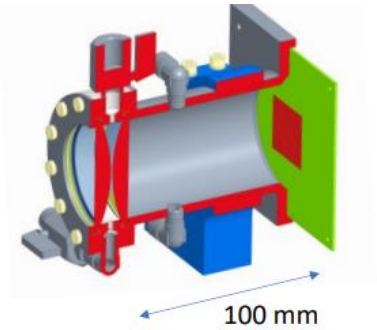


now we are working at 425 nm

(no TPB on SiPM)

- Lens prototype





50 mm diameter

The readout for prototypes

16 x 16 (256 channels) SiPM matrix
with SiPM of 3 mm x 3 mm
without TPB deposition

Cold board with 8 ALCORs

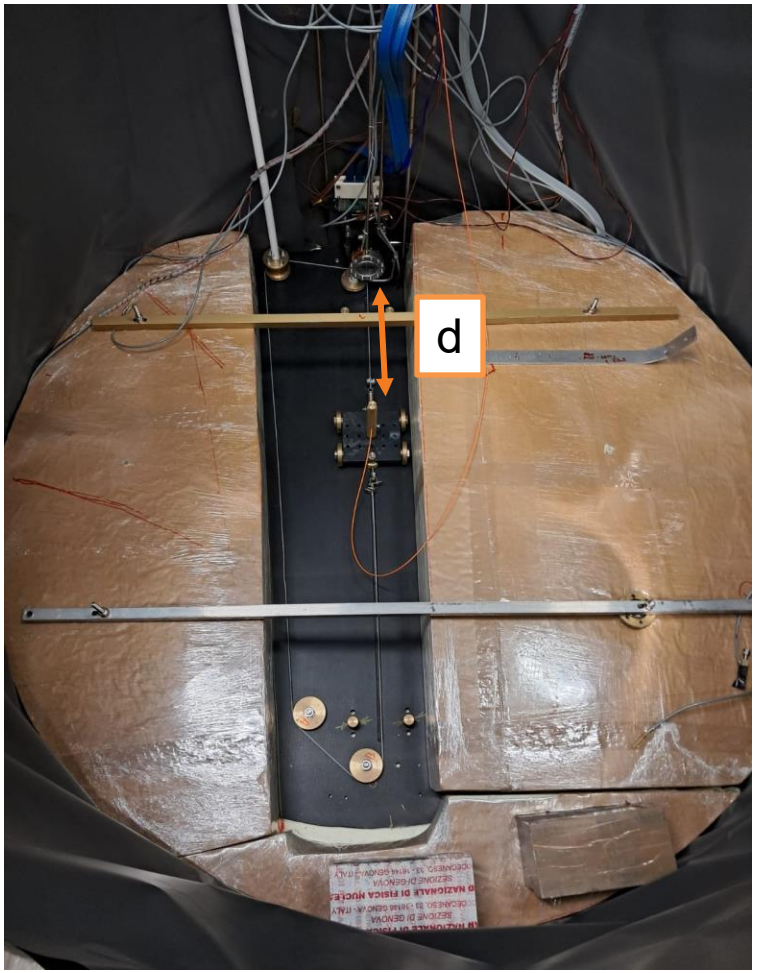
Warm interface Board

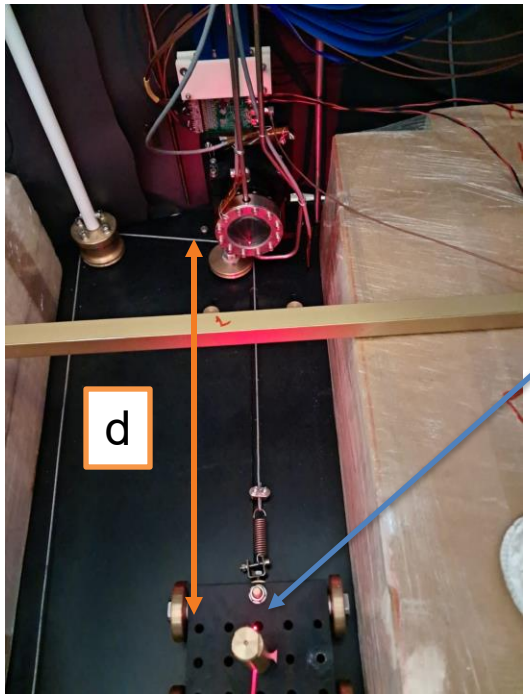
Xilinx FPGA

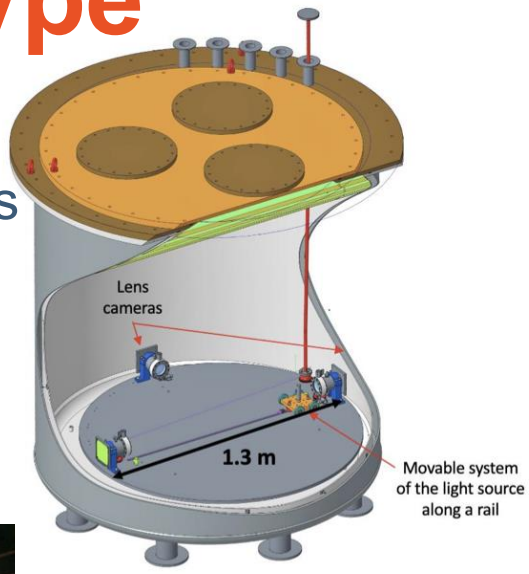
First tests with lens prototype

- We want to study the focusing effect:

we change the distance *d* between the fiber and the lens

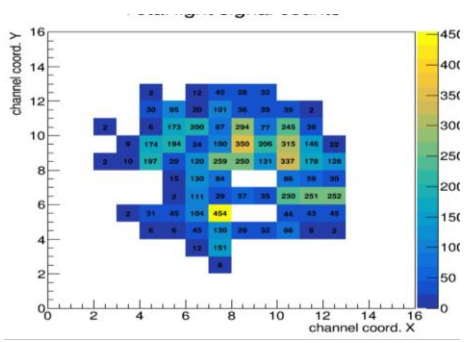


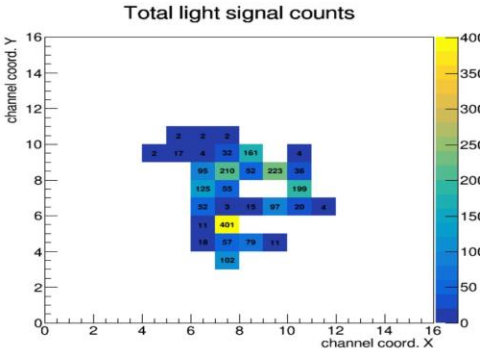


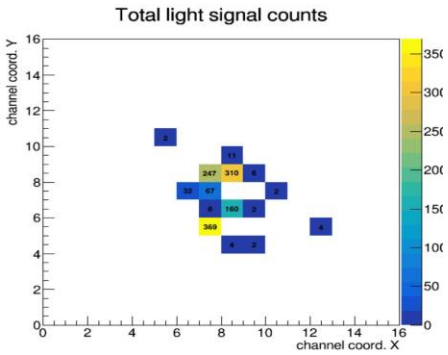


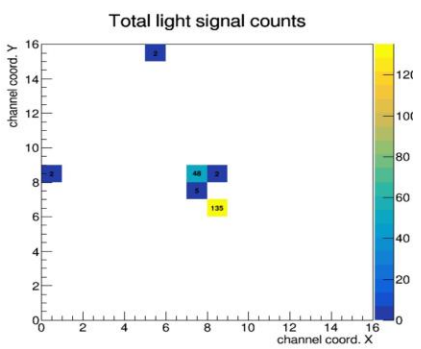
Fiber on a movable trolley

First results in liquid nitrogen







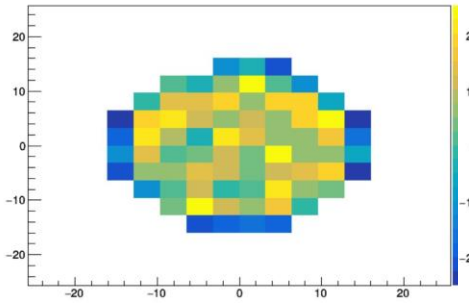


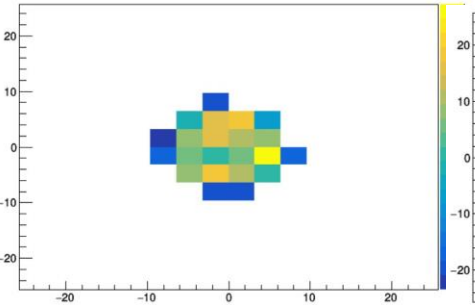
20 cm

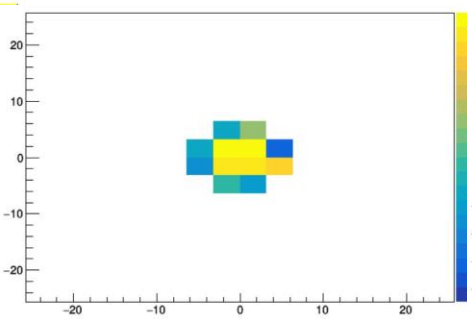
40 cm

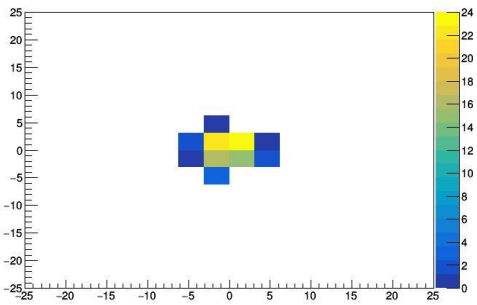
60 cm

80 cm







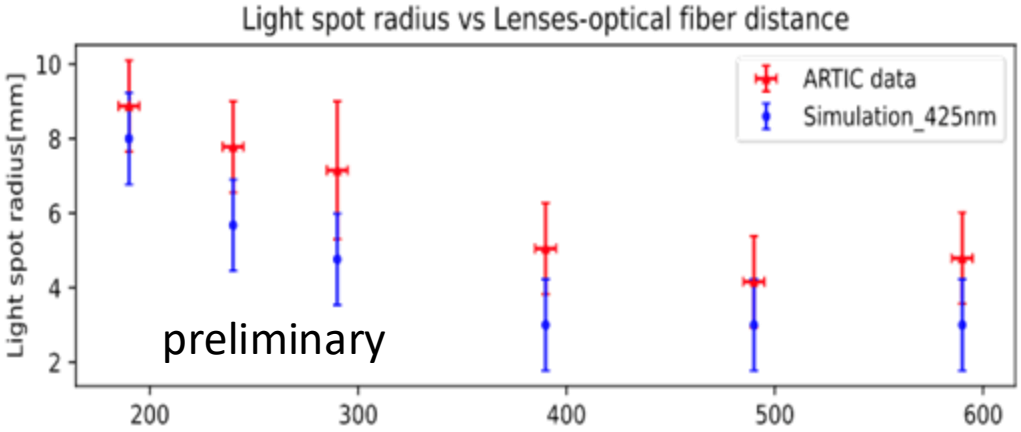


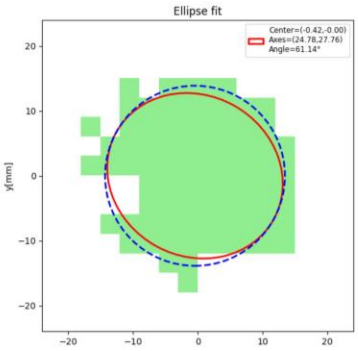
The simulations were performed with n_{LN}=1.200+-0.005 ($\lambda = 425\,nm$)

The focusing effect is clear!!

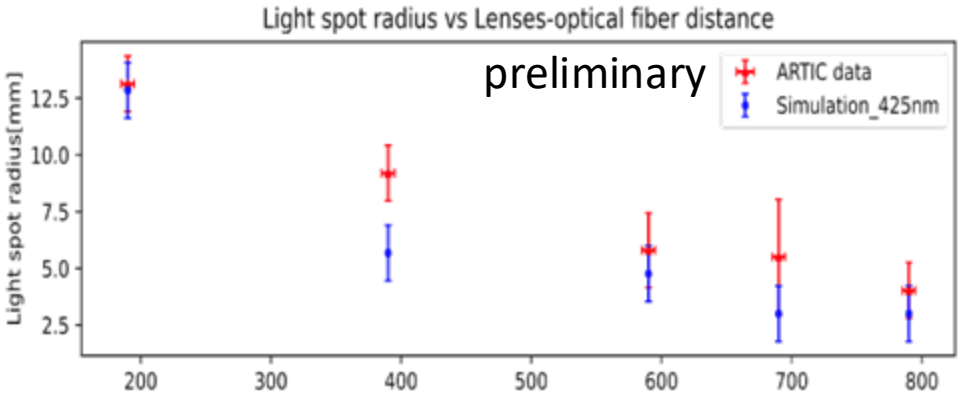
Data – MC comparison

- In air





- In liquid nitrogen

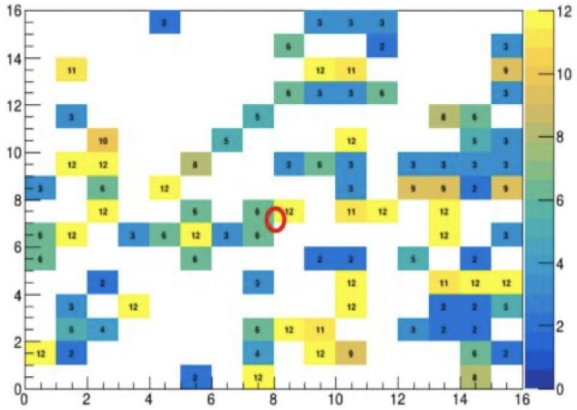


with 425 nm light

Better evaluation of systematics and tuning of simulations parameters is on going

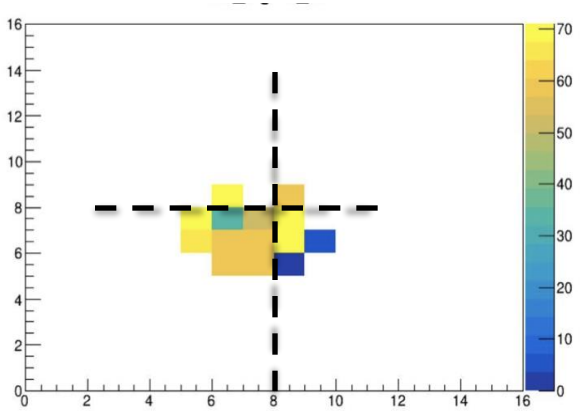
First results with TPB matrix

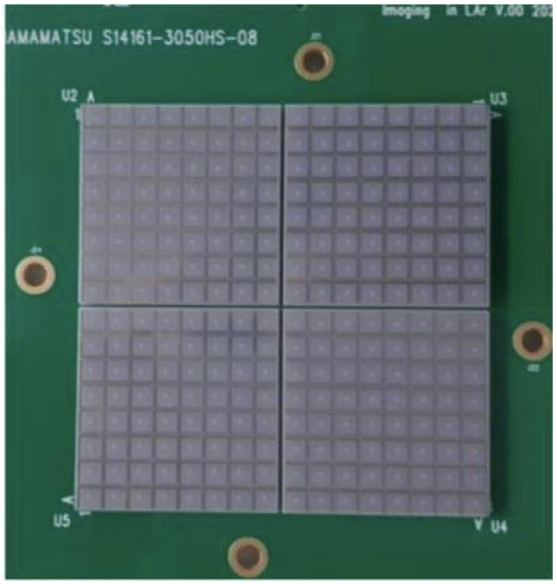
- Old data with uniform deposition



The light is propagated everywhere

- New data with deposition with grid

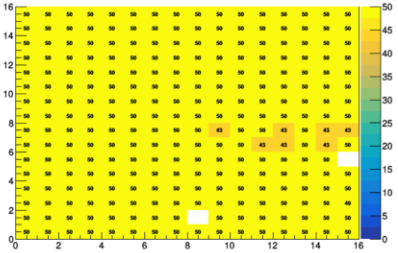




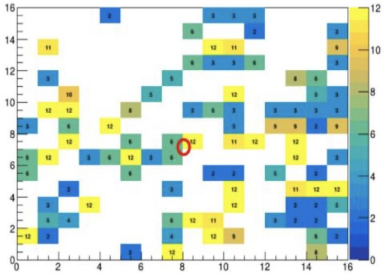
compatible with what is expected!

Past timeline

- Genova Front-end board **released** from To
- DAQ **released** from BO



DAQ optimization for test pulse



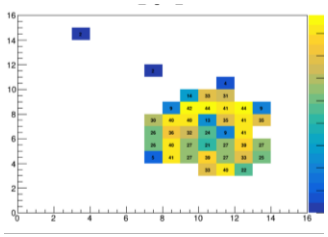
TPB tests not successfully

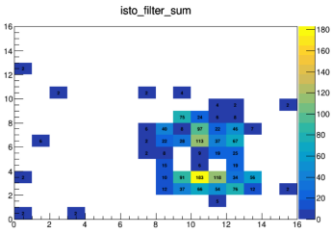
Oct-Dic 2023

Jan-Jul 2024

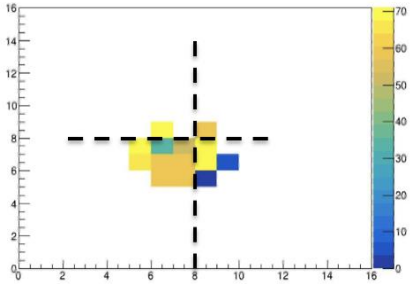
DAQ optimization for light signal detection

at room and at cold temperature

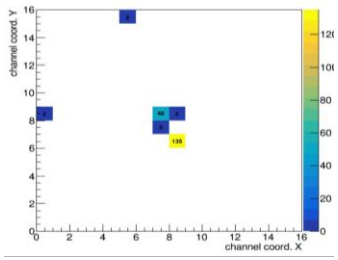




TPB tests successfully



First test with lens in ARTIC



Sep-Dic 2024

Jan-Jul 2025

Future timeline

- New TPB deposition
- Tests in Liquid Argon

  at 400 nm & at 230 nm

Sep-Dic 2025

- Tests with different lens prototypes
- ARTIC recirculation system installation

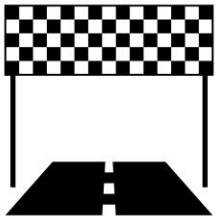
Jan-Jul 2026

Test with scintillation light

-cosmic and from radioactive source

Jul-Dic 2026

Milestone 2026:
lens design completed



- RICHIESTE nel 2026 - per i test: **21.5 K GENOVA**

Conclusioni

- 3 milestones nel 2026

- Richieste nel 2026 per:
  - Criogenia
  - Test prototipi e readout

  - ASIC e/o packaging (se non nel 2025)