

# GRAIN prototype

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on behalf of GRAIN working group

GRAIN Working Group– 16 Jun 2022

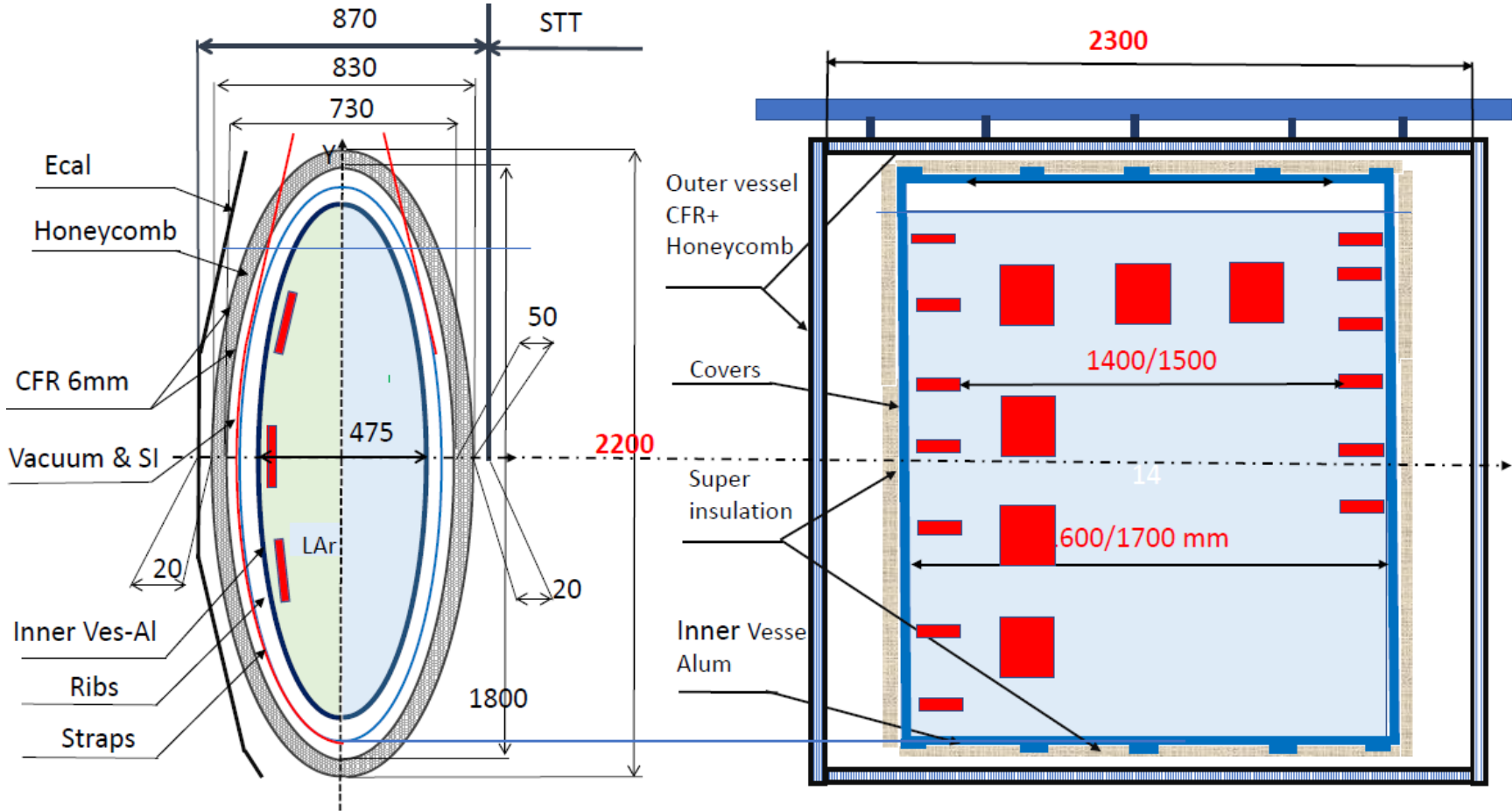
# Report on a first discussion

- *Participants:*
  - Sergio B., Giuliano L., M. Guerzoni, Gianluigi P., C. Guendalini, Ruggero P., Alessandro M.
- *Internal vessel material:*
  - Sergio proposes to study the option of using **Steel** instead of Aluminum: most of radiation length is due to Liquid Argon and the relative contribution of vessel should be negligible
  - Need to verify with simulation
  - 12 mm of Aluminum could probably be replaced by 6 mm steel (Giuliano and mechanics team)
  - Big advantage for mechanics and cryogeny (Giuliano and Ruggero): avoid the use of Al/SS transitions
- *Dimension ( two proposals):*
  - 1) Internal vessel tubular geometry (diam. 75 cm), external vessel tubular , both steel (Giuliano L.)
  - 2) Final dimension and geometry: this would be a relevant test for cryogeny ( Sergio and Ruggero). Length 150 cm.  
Need to find an external vessel ( according to Ruggero we could investigate in INFN labs)
- *Location:*
  - Legnaro is the natural place where to build the prototype: experience in cryogenics, facilities, expertise, space.



# GRAIN dimension

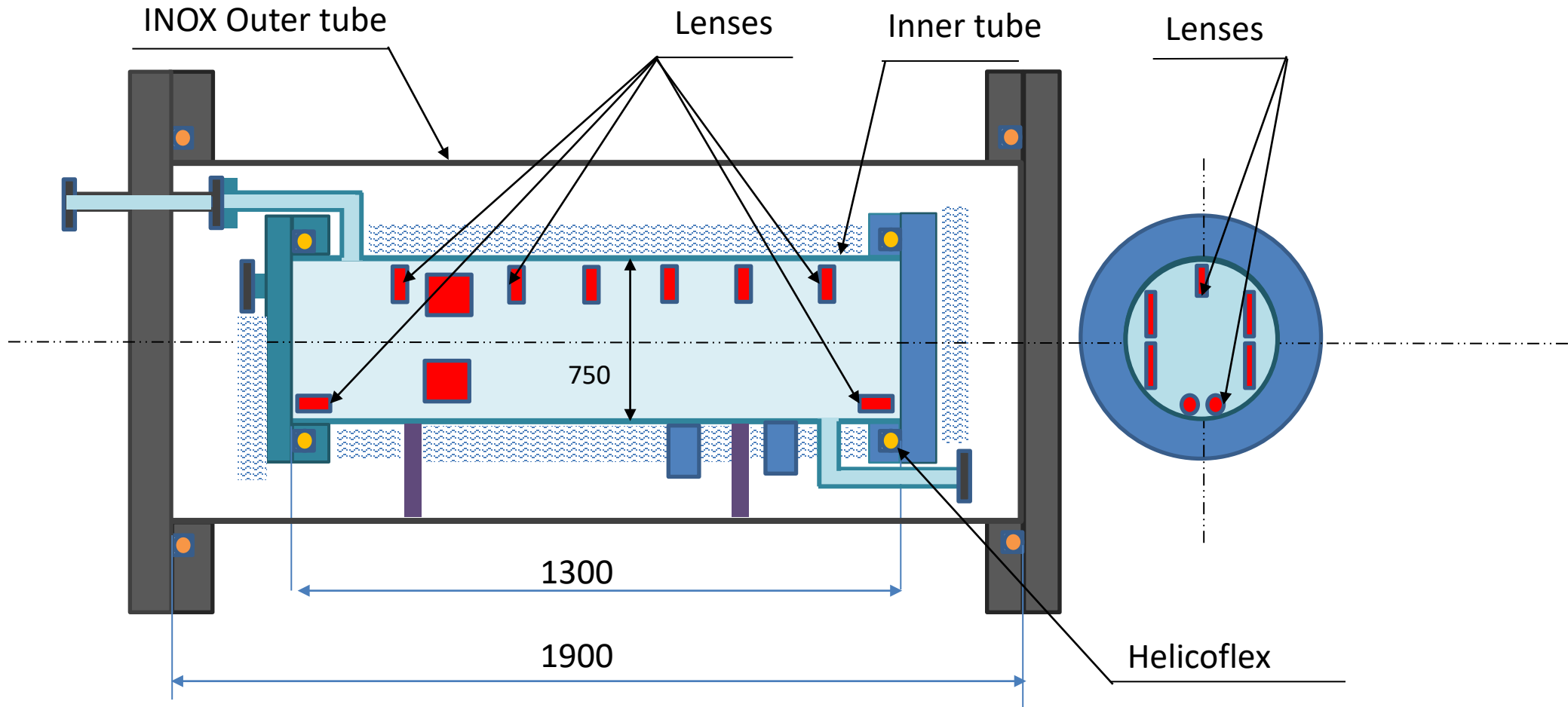
Taking into account the volume occupied by the photodetector, the length should be about 1.6/1.7 m to guarantee 1 T effective mass.



Grain Cryo 1 ton Lar fiducial volume - tentative dimensions

# Small

## GRAIN prototipe Cryostat



Inner volume  $570 \text{ dm}^3 = 0,8 \text{ ton LAr}$

## Considerazioni:

La costruzione di un criostato cilindrico non pone problemi meccanici e tutte le norme di sicurezza vengono rispettate senza alcun problema, Sono due tubi flangiati e relativi coperchi.

Il vessel interno di alluminio permette di provare le tenute Helicoflex, Le transizioni AL Acc. sia per i tubi che per i passaggi dei cavi.

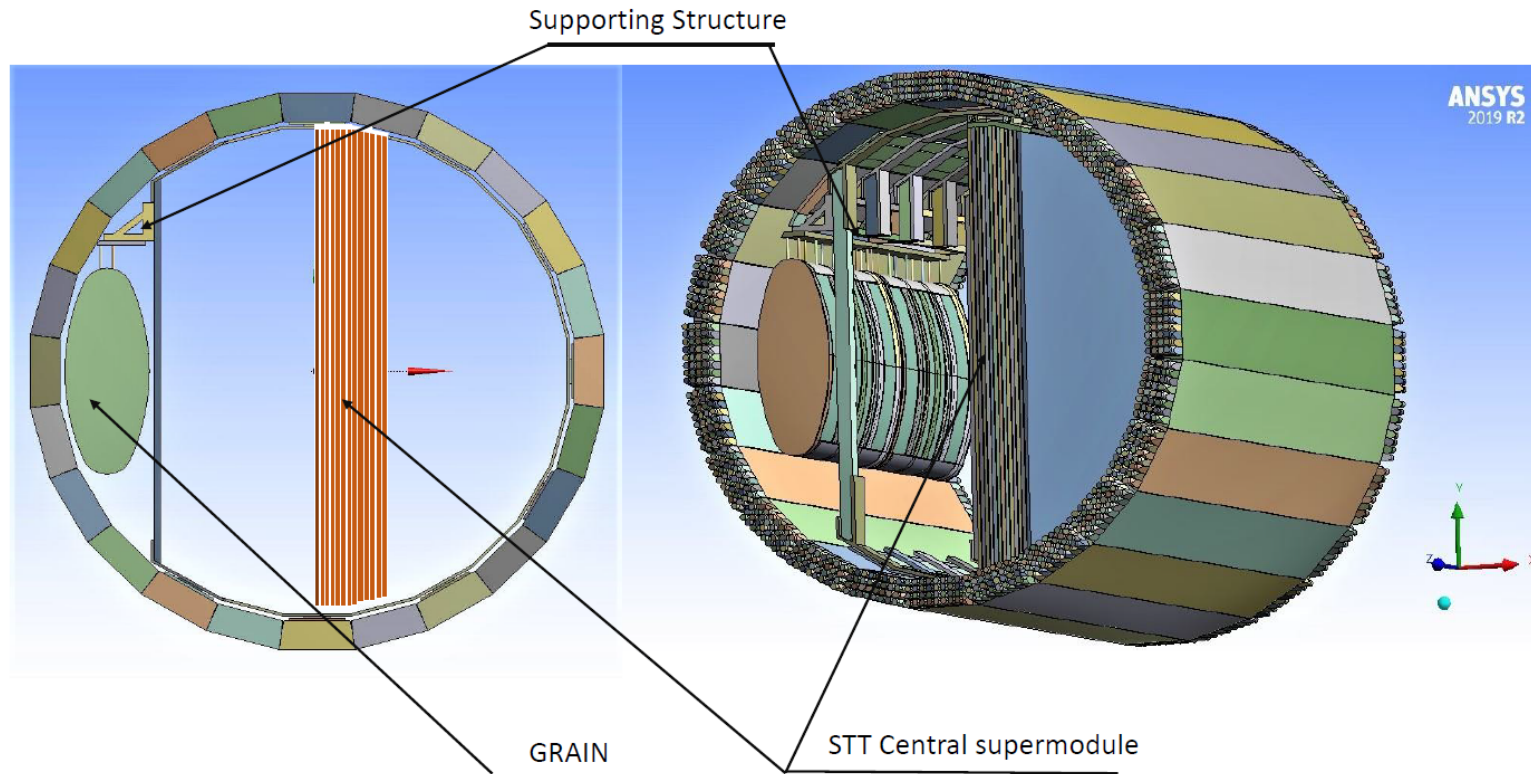
Le dimensioni sono tali da provare sia lenti che matrici di SIPm. Anche contemporaneamente nell'ambiente finale. Con i cosmici e vista la trasportabilità a vuoto anche in qualche beam.

Il costo della meccanica e oggetti associati viene ridotto notevolmente Grazie alla semplicità del design e l'uso di INOX per Out vessel, Oltre che un numero ridotto di componenti.

Naturalmente dovrà essere associata una criogenia adeguata. Questo è necessario in ogni caso.

# GRAIN inside SAND

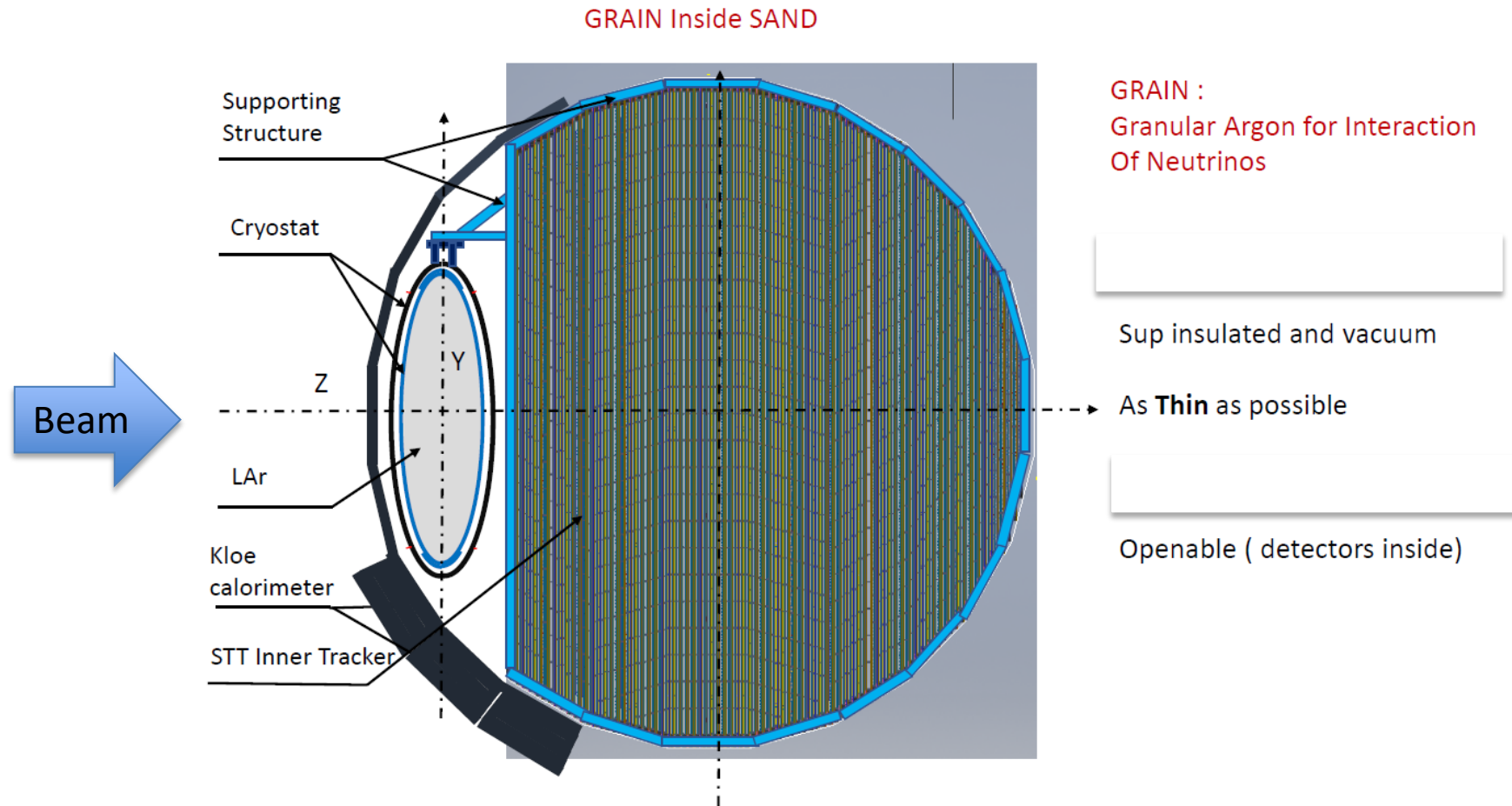
The cryostat hangs on the same supporting structure of the STT



# Grain specs

LAr: fiducial mass of about 1 T

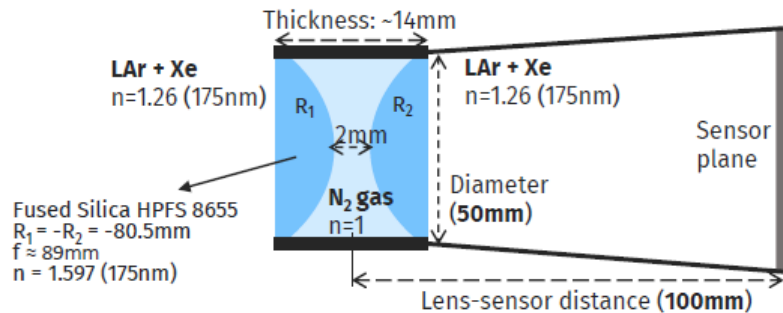
Accessible on the sides to insert photodetectors



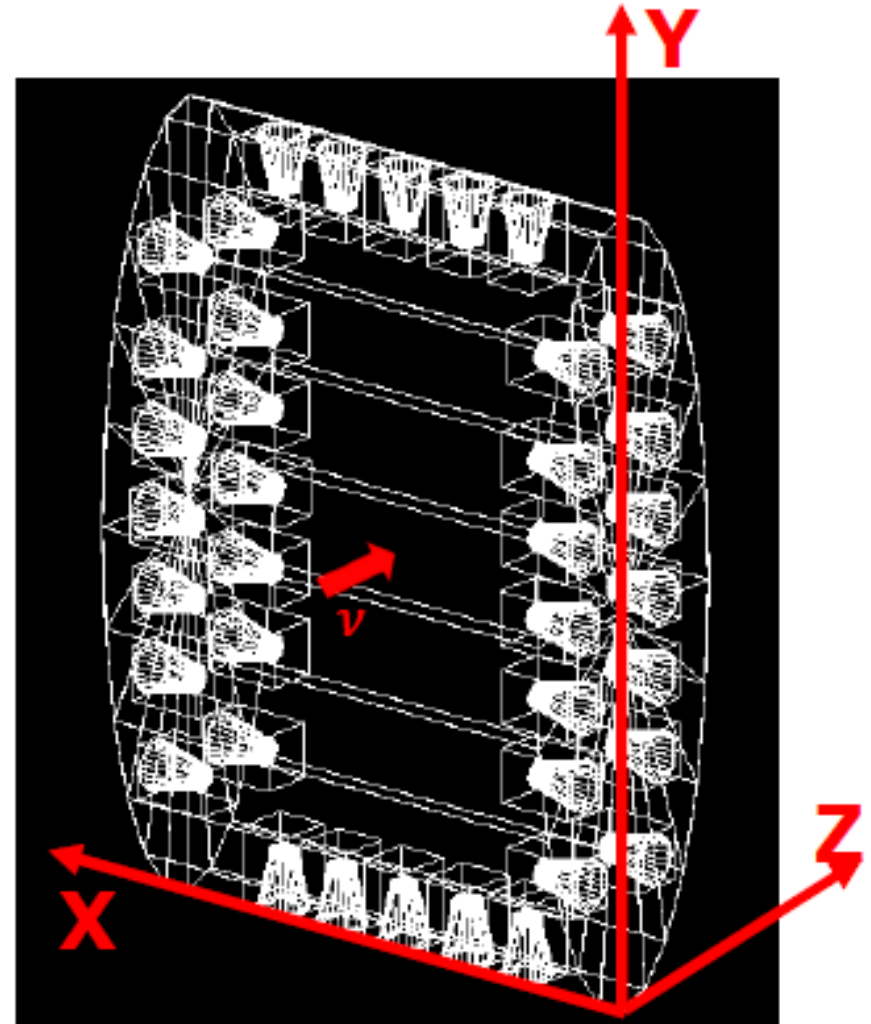


# Lens geometry

- GRAIN geometry:
  - but  $L_x = 1000\text{mm}$  (to be updated to new dimension)
- Lens cameras inside the LAr volume
- 38 cameras, for maximum coverage
  - 14 pairs on the sides
  - 5 pairs on top/bottom
- Assume  $32 \times 32$  matrix sensor, with 2 mm pixels and 20 % QE

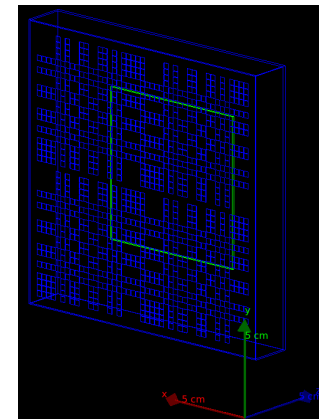
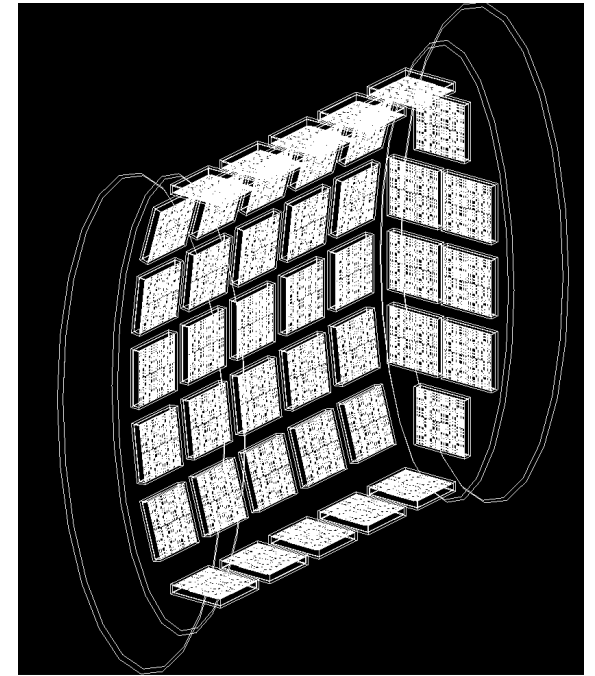
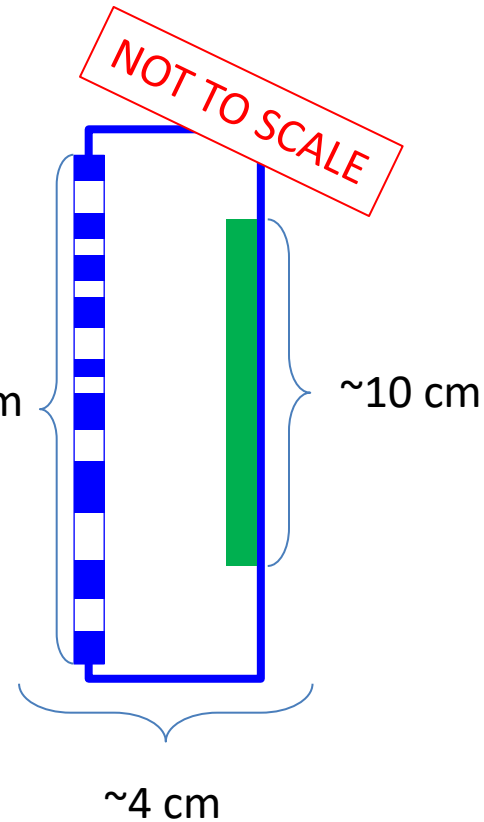


GDML:

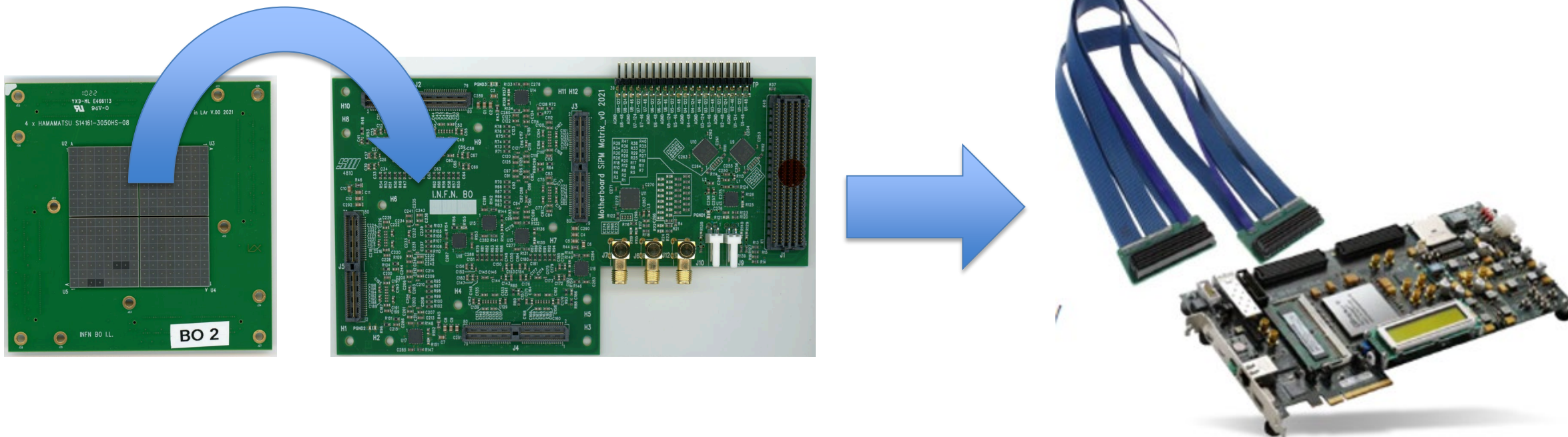


# Mask geometry in GRAIN

- Old GRAIN geometry (to be updated):
  - $x, y, z = 130 \times 146 \times 48 \text{ cm}^3$
- 76 cameras, covering most of the available surface:
  - 25 cameras on each curved (YX) face arranged in a 5x5 grid
  - 5 cameras on top/bottom
  - 8 cameras on each side (YZ) face
- 32x32 matrix sensors, 3.2 mm pixels and 25% QE

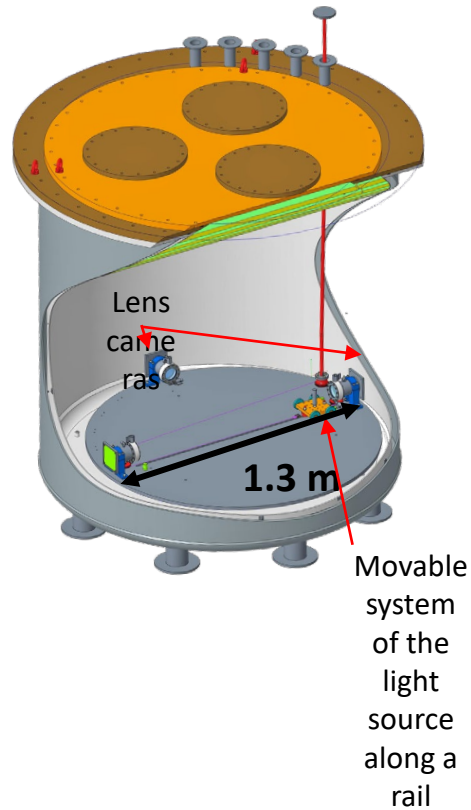


# Camera demonstrator



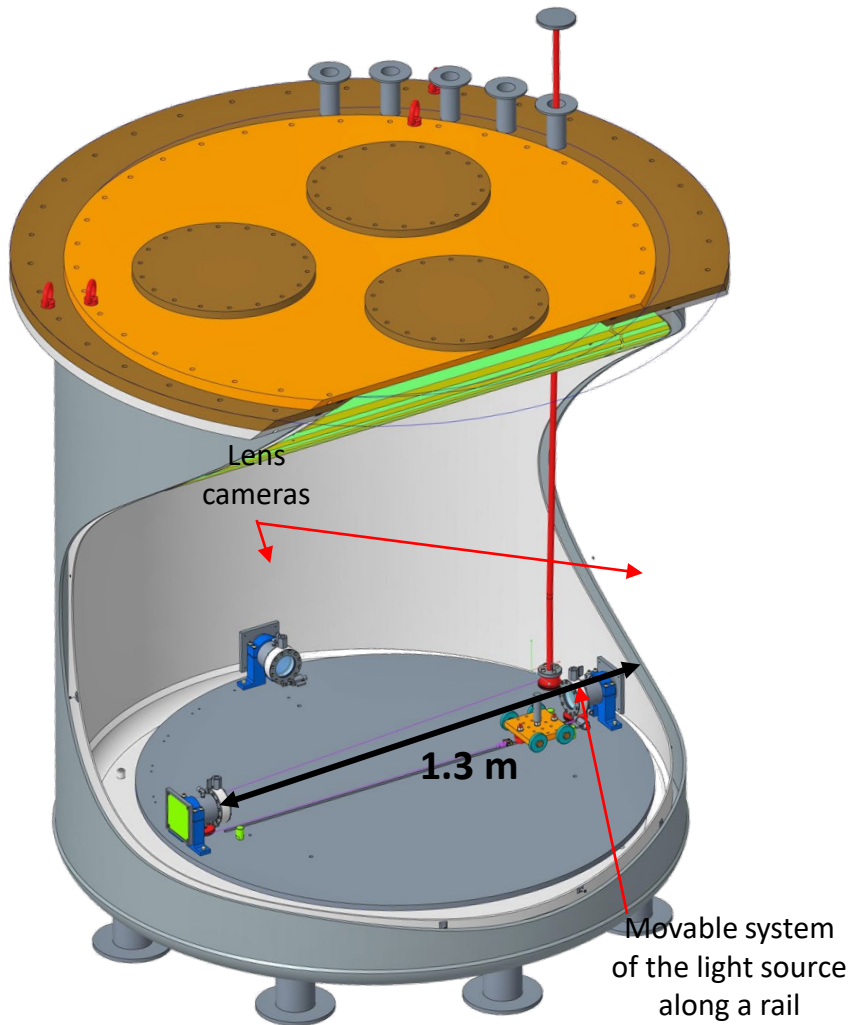
- Matrix of SiPMs mounted on a mezzanine board
- Motherboard contains 8 ASIC (256 ch in total)
- DAQ with FPGA on demo board

# Test in ARTIC (artificial light source)



- Build a first simple working set up (readout, reflections, cryogenics)
- Tune simulation parameters
- Check current simulation results
- Evaluate:
  - the Point Spread Function by point source light
  - the reconstruction capability by using two faced detectors

# Test in ARTIC (in Lar+ Xenon)



- Test with cosmics
- with more detectors (3 or more?)

...many things to be done...

-- NOT BEFORE SUMMER 2023 --

# Timeline

