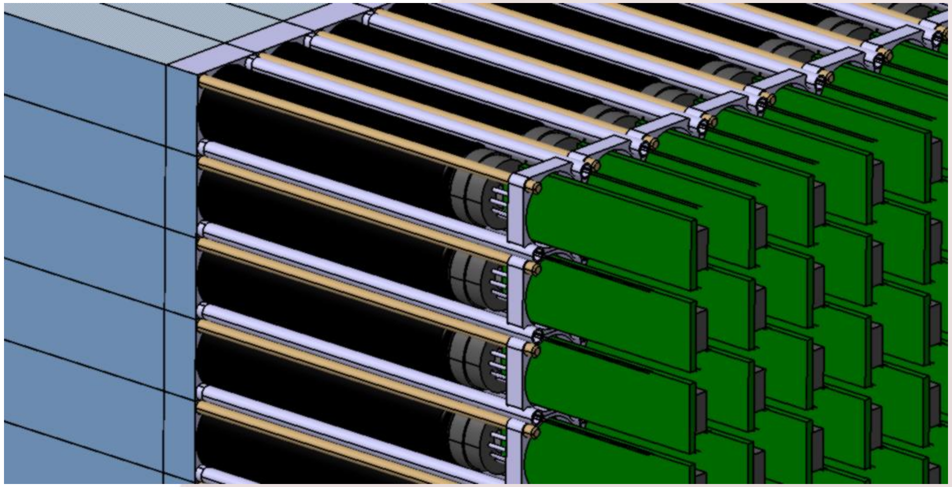
NPS COLLABORATION MEETING



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Tuesday 23th January 2018

Summary

- Study context
- General design
- Components / Details
- Monitoring system
- Radiation curing
- Maintenance
- Mechanic (structure/Tests in progress)
- Shielding
- Cooling
- Cabling / Electronic
- Planning

- **Study context**
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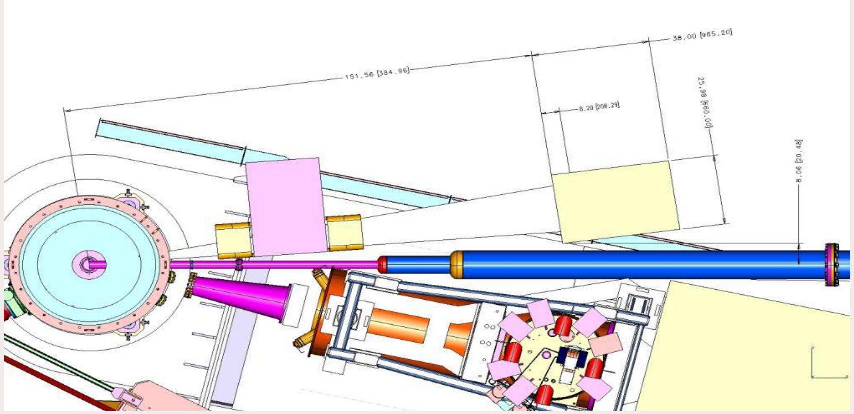
STUDY CONTEXT

Summer 2017: Start of the project (for technical part)

- First discussions and drawings
- First objective: position of the LEDs and the fiber (Front vs Back)

Experiment in the Hall C

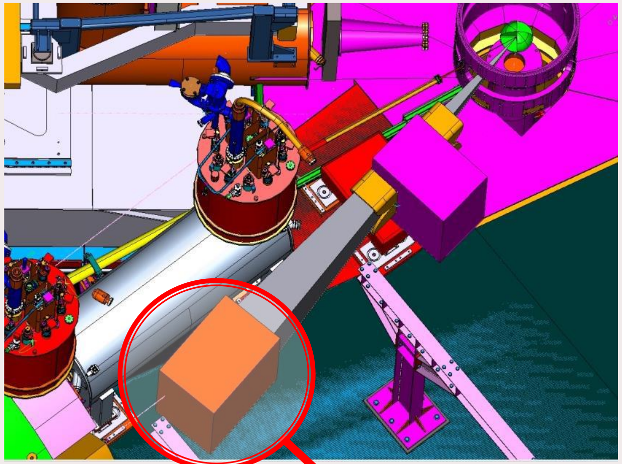


Experimental setup in the hall C

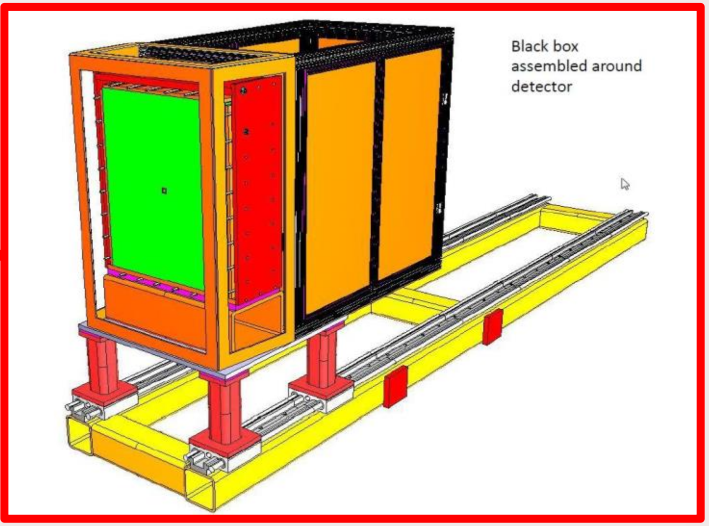
IPNO is in charge of the mechanical design, the instrumental tests, construction and installation at Jlab of the new calorimeter frame.

GENERAL DESIGN

Experimental setup in the hall C



The calorimeter should be integrated into the mechanical structure (already designed)

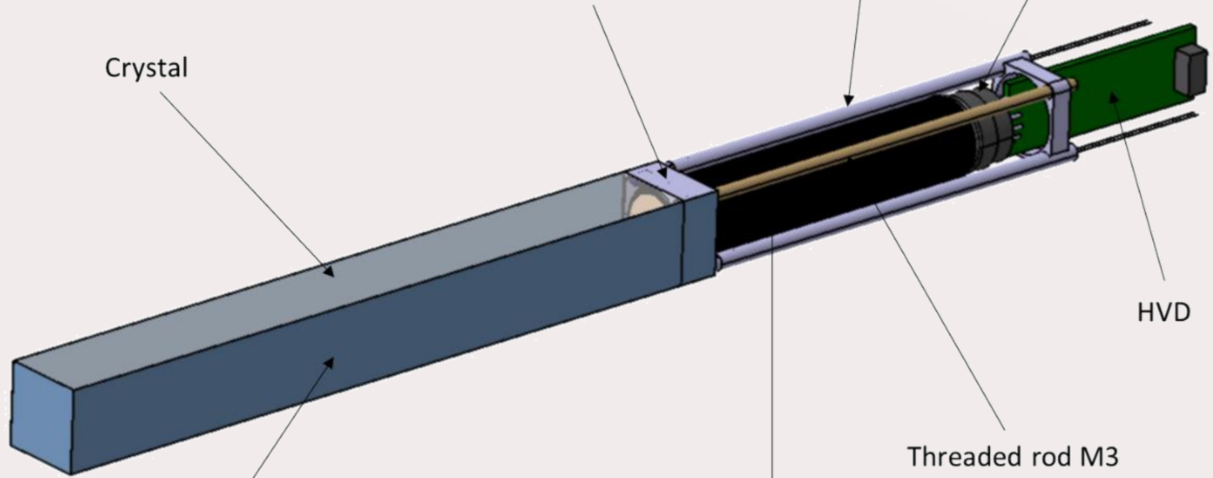


Structure on rails / Design by Mike Fowler

We will modify some parts if necessary (discussion with Mike Fowler).

COMPONENTS / DETAILS

The detector



-> Feasibility study to do

Numbers of crystals :	**1116**
Positioning :	**Horizontal=31 / Vertical=36**
Material :	**$PbWO_4$ (*density= 8,28 g/cm³*)**
Size :	**$20.50^{+/-0.05}$ x $20.50^{+/-0.05}$ x $200.00^{+/-0.15}$ mm^3**
Mass :	**696 g**
Production :	**SICCAS / CRYTUR**

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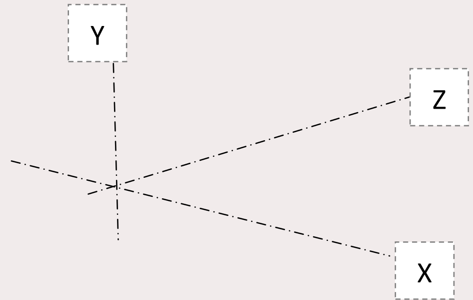
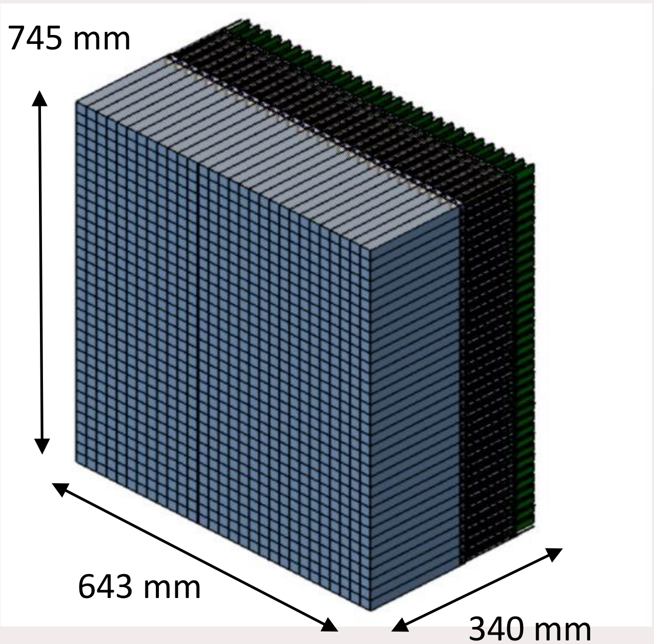
COMPONENTS / DETAILS

The detector





Depend on the mechanical structure (See next slides maintenance).

Number of crystals:	31(Horizontal X) by 36(vertical Y)
Tolerance :	20.45mm < Crystal < 20.55mm
Sheet copper/brass:	25 µm

IPN
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COMPONENTS / DETAILS

The wrapping

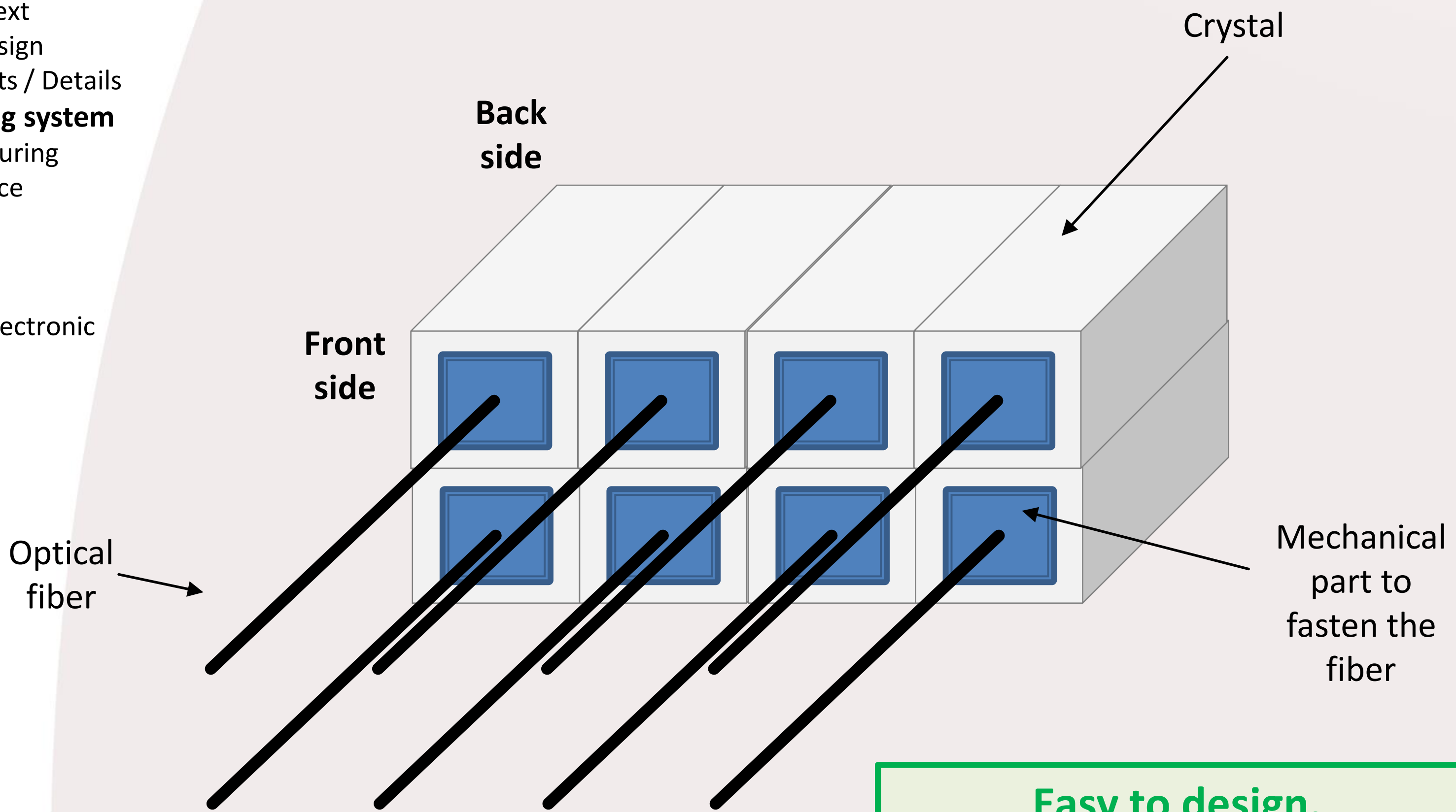
Two options are considered: Teflon and VM2000

	Teflon	VM 2000
Implementation	**Easy**	**Hard**
Efficacy	**Good**	**Very good**
Cost	**Low cost**	**Expensive**
Thickness	**Random**	**65 µm**
Repeatable	**Bad**	**Good**
Radiation damage	**Very bad**	**Good**

Wrapping with VM 2000 (Thickness= 65 µm) looks better

MONITORING SYSTEM

Solution 1: Fiber on the front side

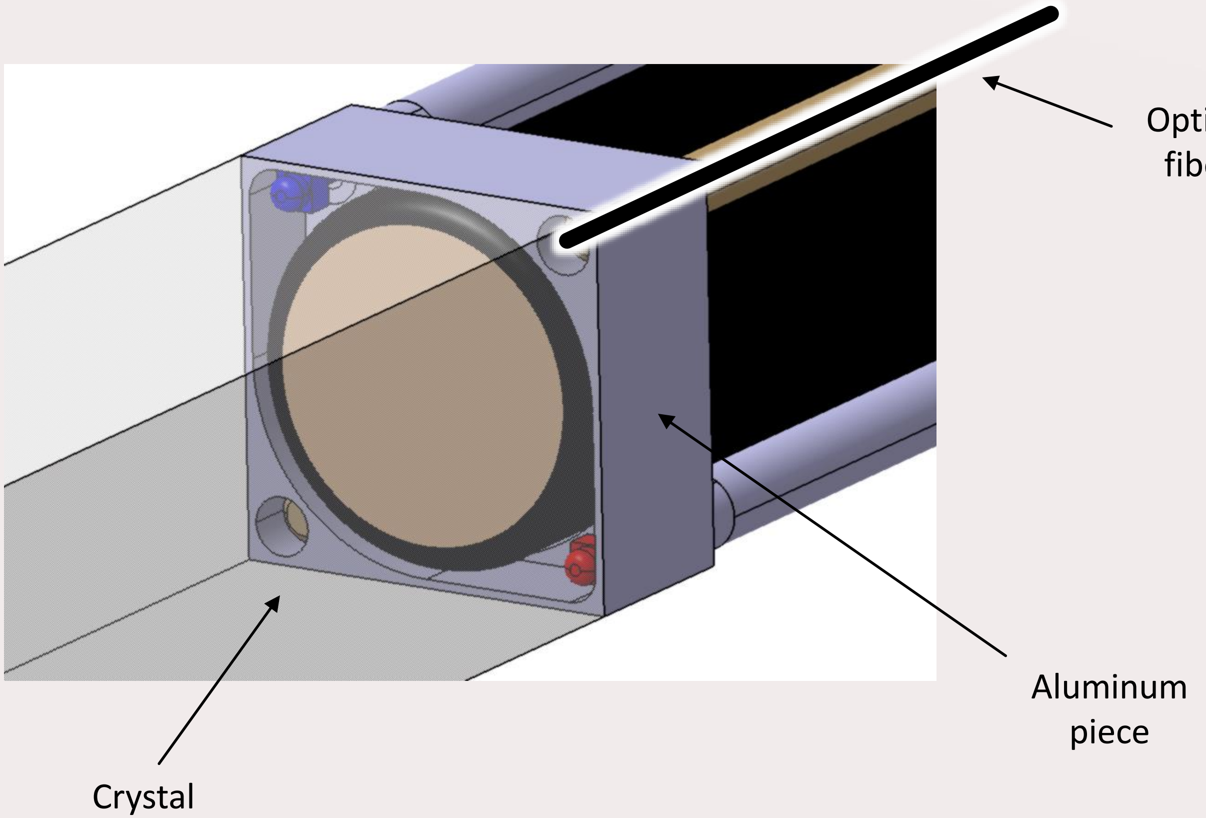


Easy to design.

There is additional material in front of the crystal.

MONITORING SYSTEM

Solution 2: Fiber on the back side



Not necessary to remove the monitoring system.

Increase the difficulty for the design and the implementation. Increase a little the space between the crystals.

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MONITORING SYSTEM

Requirements for the choice

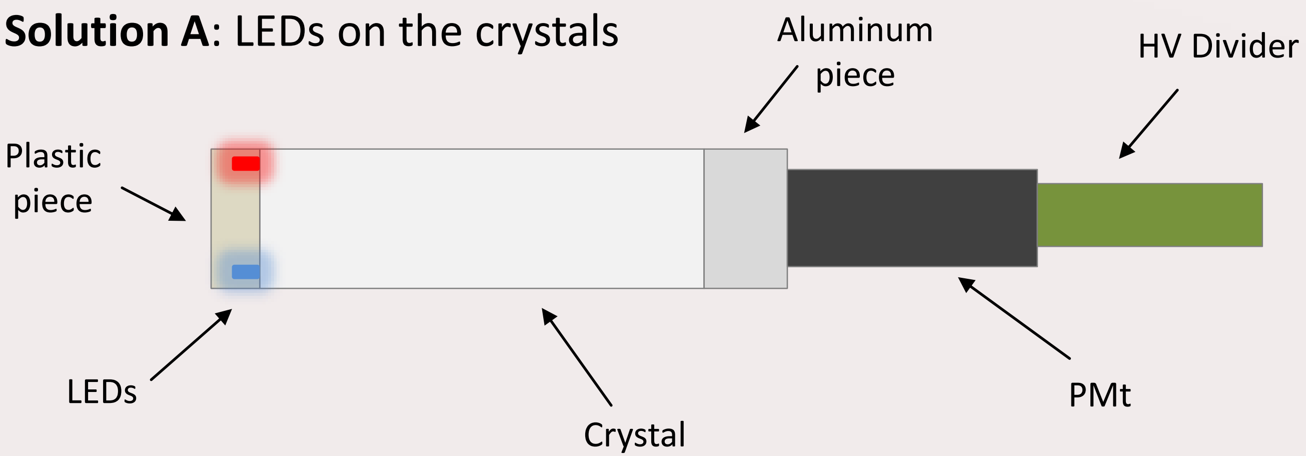
	Solution 1	Solution 2
Space between crystals	Good	Not bad
Implementation	Easy	Not bad
Radiation damage	Bad	Good
Cost	Bad	Good
Cabling	Bad	Good
Maintenance	Good	Not bad
Thickness of material for particle	Bad	Very good

RADIATION CURING

lundi 22 janvier 2018

Solution 1: LEDs on the front side

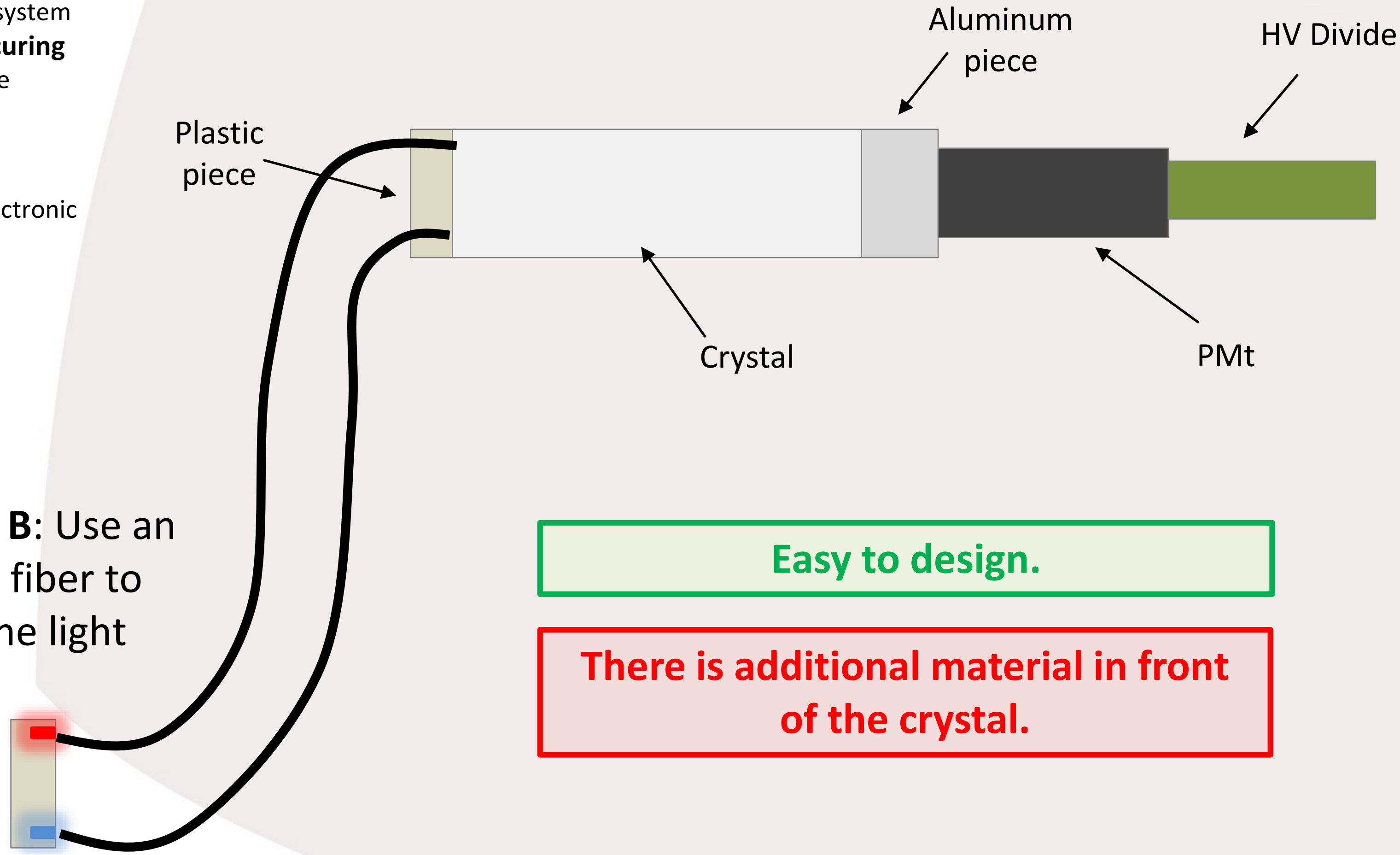
Solution A: LEDs on the crystals



Easy to design.

The LEDs have to be move and remove for each curing.

Solution 1: LEDs on the front side



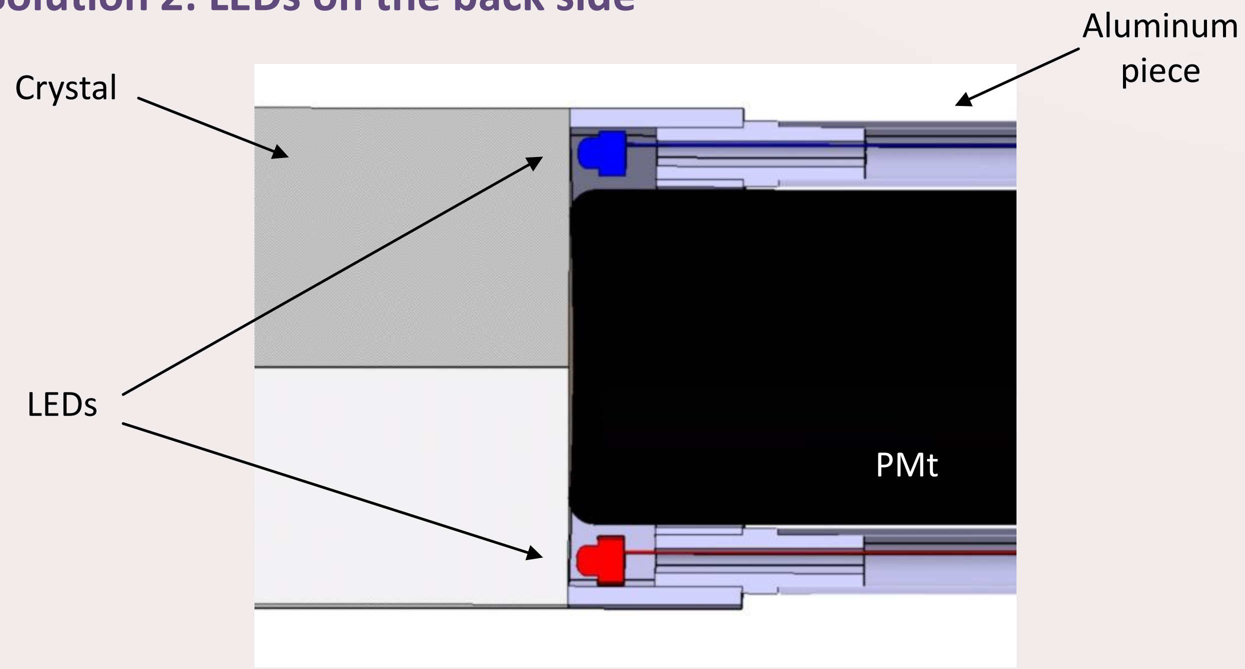
Solution B: Use an optical fiber to give the light

Easy to design.

There is additional material in front of the crystal.

RADIATION CURING

Solution 2: LEDs on the back side



Not necessary to remove the monitoring system.

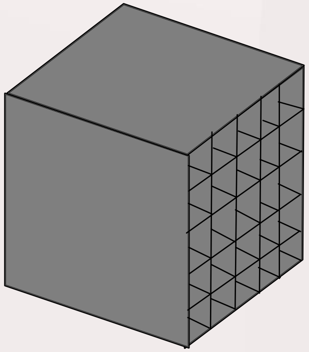
Increase the difficulty for the design and the implementation.
Increase a little the space between the crystals.

Requirements for the choice

	Solution 1	Solution 2
Efficiency of the curing	Test in progress	Test in progress
Implementation	Easy	Not bad
Radiation damage	1A- Very bad 1B- Good	Good
Cost	Bad	Good
Cabling	Bad	Good
Maintenance	Good	Not bad
Thickness of material for particle	Bad	Very good
Space between crystals	Good	Not bad

MAINTENANCE

This point impact the mechanical design.



Question:
-> What is the problem if one PMt doesn't work?

To change a PMt or an electronic components (LEDs):

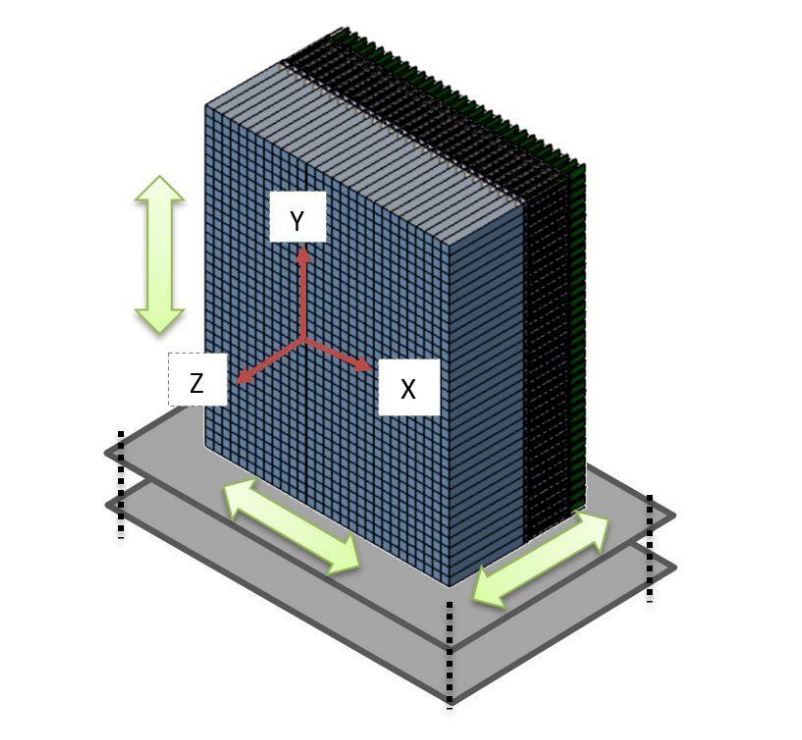
1- With mechanical structure (example on the next slide)
-> Possibility to remove any detector (Crystal/PMt/Electronic)
Advantage: maintenance convenient and quick
Problem: Increase the distance between the crystals

2- Without mechanical structure
-> Necessary to remove all the detectors on the top of the calorimeter
Advantage: Minimize the distance between crystals
Problem: Increase time to change a deficient part and make the maintenance hard

MECHANIC

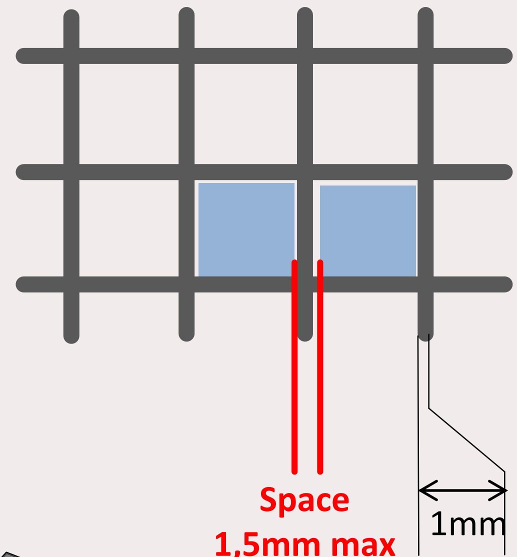
Adjustment

General tolerance for the positioning of the calorimeter is about 3mm.



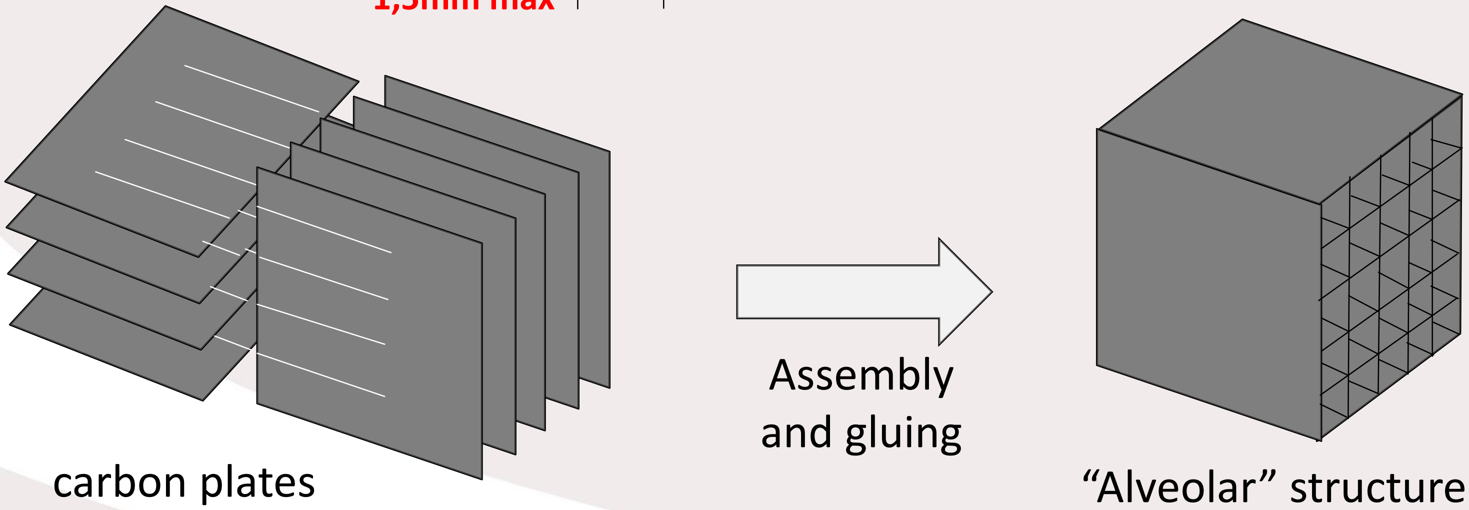
It is better to have an adjustment and a way to control the position of the calorimeter (laser or theodolite).
Discussions with Mike Fowler.

Mechanical structure



Carbon structure

- 1mm carbon plate thickness
- Additional space around the crystal to make easier the mounting
- **Ensure a good positioning of the crystals**
- **Make easier the maintenance**
- **Increase the space between the crystals**



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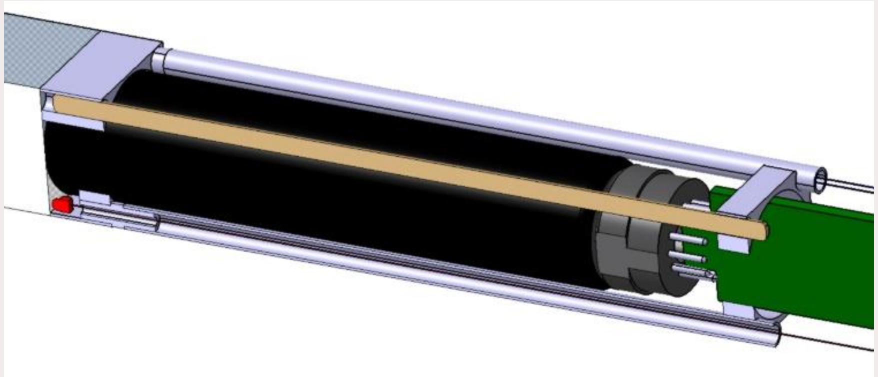
MECHANIC

Tests in progress



Simulation (resistance of materials)
To optimize the size of the carbon structure to reduce the space between crystals

Production
3D printing (plastic) of the junction part to test the assembly
Results: little surface for the assembly of the mechanical part

PROBABLY NECESSARY TO INCREASE THE SIZE OF THE PIECE IF WE WANT TO PLACE THE LEDs ON THE BACK SIDE

SHIELDING

Magnetic field : 25 Gauss

Kind of shielding : Passive (Mild steel and mu-metal)

Location of the shielding:
AROUND EACH PMt vs AROUND THE CALORIMETER

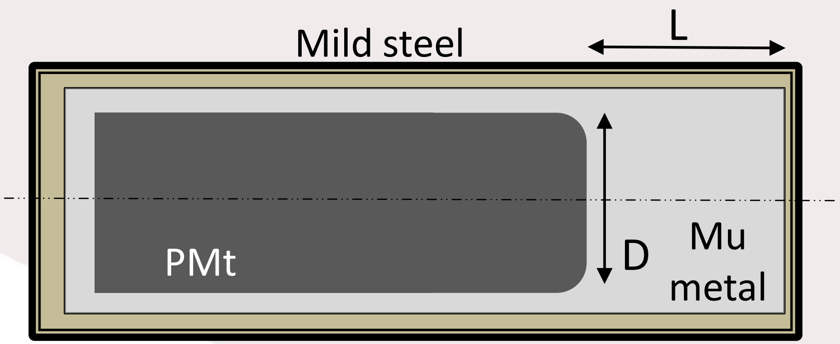
- ❑ Mu metal (rolled sheet) around the PMt:

Probably enough but The front part of the PMt is not shielded

-> Necessary to check the direction of the magnetic field

- ❑ Mild steel can't be around each PMt (increase the space between crystals)

-> Mild steel all around the calorimeter (3mm thick)



Recommended by Hamamatsu
("PMT_handbook_v3aE" etc...)

Discussions in progress. (already done by Jlab)

COOLING

- Study context
- General design
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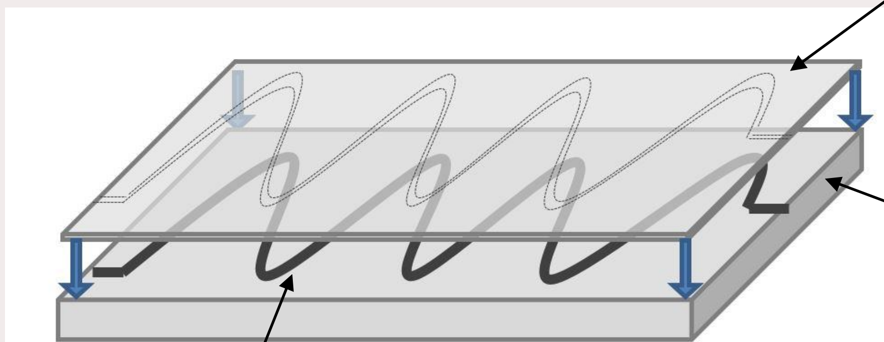
- Monitoring system
- Radiation curing
- Maintenance
- Mechanic
- Shielding
- **Cooling**
- Cabling / Electronic
- Planning

Power to dissipate :	600 W max (0,5 W/channel)
Temperature :	18 °C
Stability :	+/- 0.1 °C

Technical solution considered:

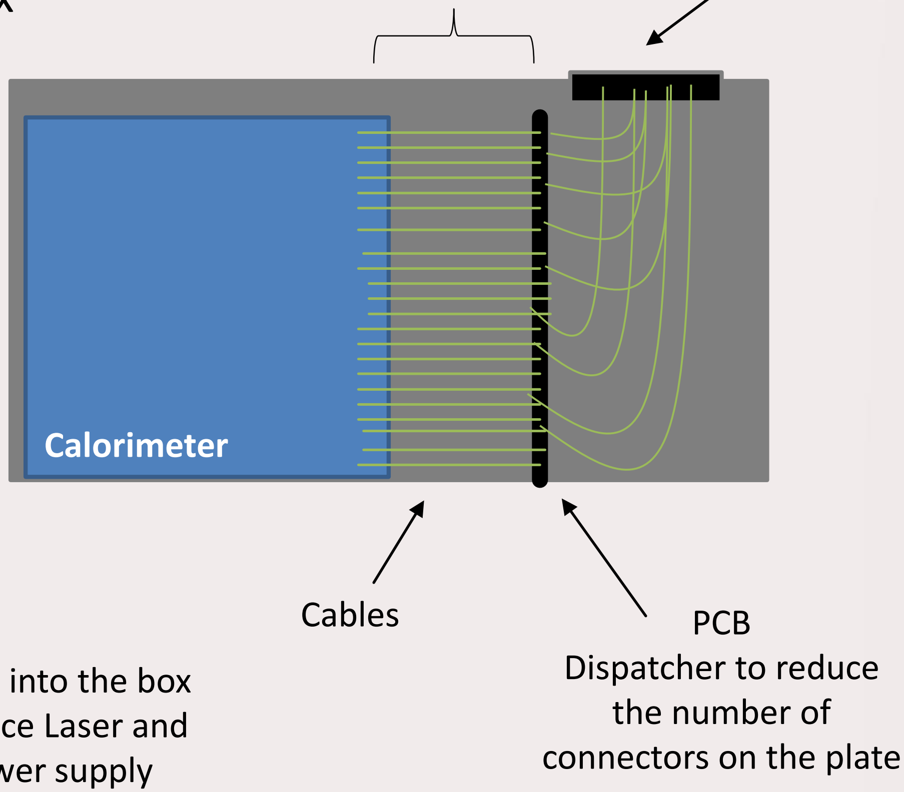


Thin copper plate welded (by « transparency ») on the copper plate machined

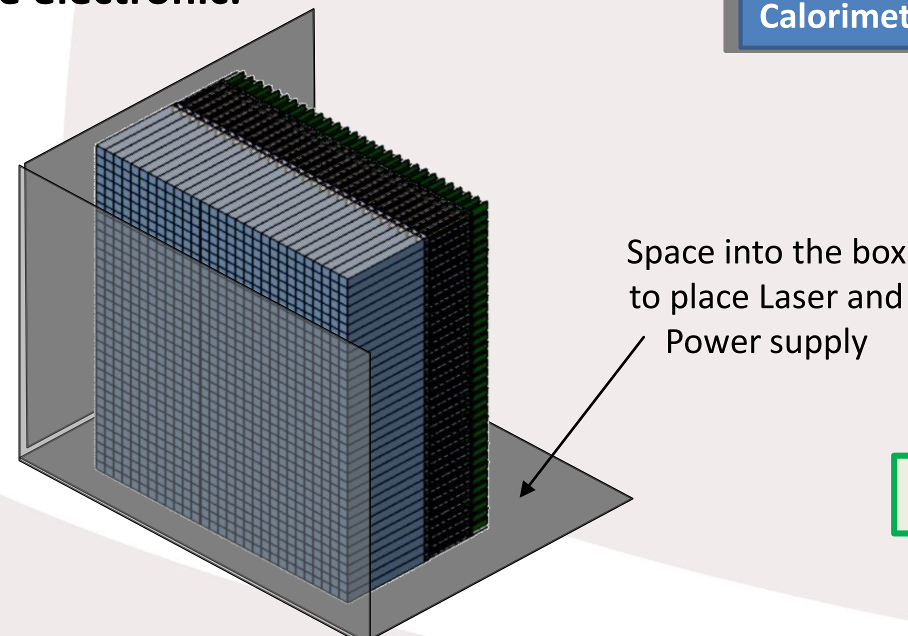
Copper plate machined

Machining of the circulation for the water
-> Thermic simulation to optimize the good shape

The cabling:
All the cables must go out by the top of the box



The electronic:



Study in progress

PLANNING

- Study context
- General design
- Components / Details
- Monitoring system
- Radiation curing
- Maintenance
- Mechanic
- Shielding
- Cooling
- Cabling / E
- **Planning**

	Planning NPS project		2017									2018												2019											
			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Technical	First discussions	*IPNO*	■	■																															
	Start of the study	*JB*			◆																														
	Pre study and first design	*JB*			■	■	■	■	■	■	■	■																							
	COLLABORATION MEETING	*IPNO + Jlab*										◆																							
	General design	*ER(80%) + JB(20%)*											■	■	■	■	■	■	■	■															
	Drawings	*ER*																		■	■	■	■												
	Construction																							■	■	■									
	Assembly at IPNO and tests																										■	■							
	Shipping to Jlab																												◆						
	Assembly at Jlab and tests																													■	■	■			
	Cosmic test																															■	■	■	
	Commissioning at Jlab																																		◆
Instrumental	R&D monitoring system				■	■	■	■	■	■	■	■	■																						
	R&D radiation curing				■	■	■	■	■	■	■	■	■	■	■	■	■																		
	Prototype for test									■	■	■	◆																						
	Mechanic for irradiation tests									■	■	■	■																						
	Irradiation tests													■	■	■	■	■	■	■	■														

CONCLUSION

Interface with other parts:

-> Check the space available into the hall C

-> Check the way to measure the positioning of the calorimeter

-> Connection to the water for the cooling (kind of

Main objective is to choose the location of the monitoring system and the radiation curing

-> IMPACT THE DESIGN:

MECHANICIAN: Place a structure to make easier the assembly and maintenance.

VS

PHYSICIST: Reduce the space between crystals.

Work in progress:

-> Wrapping

-> Shielding

-> Instrumental tests (monitoring and curing)

-> Radiation test on crystals at the LPC

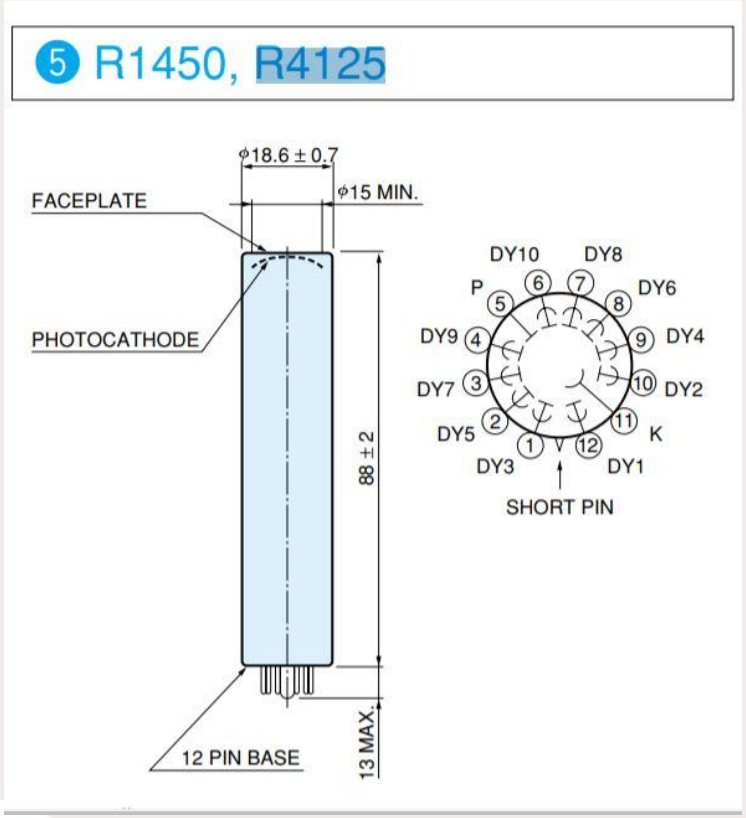
-> Electronic and cabling

-> Mechanic (Design and cooling)

DISCUSSIONS / QUESTIONS

BACK UP SLIDES 1 / PMT

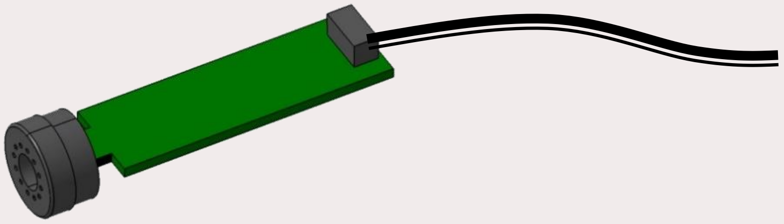
Référence PMt :	Hamamatsu R4125
Taille :	3/4 de pouce (*18,6 mm*)



BACK UP SLIDES 2 / HV DIVIDER + SOCKET

Design : Yerevan Institute

Dimensions extérieures : 70mm x 17,5 mm x D=18mm



BACK UP SLIDES 3 / TESTS AT LPC

Rayon minimal source/cristal : 50 cm

Rayon maximal source/cristal : 100 cml

Matière des boites (+couvercle étanche) :

Nombre de cristaux à tester : 300

Nombre maxi de cristaux par irradiation : 12

Nombre mini de cristaux par irradiation : 3

Durée d'irradiation :