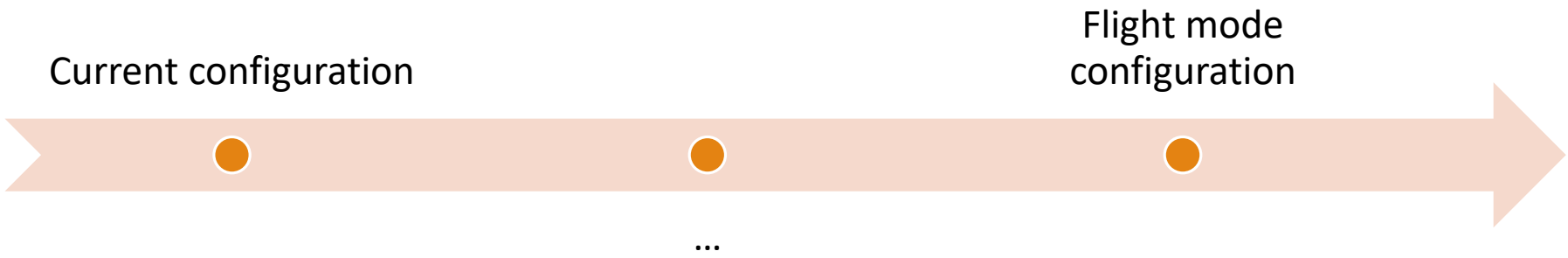
HERD Calorimeter

FLORENCE DESIGN PROPOSAL FOR SPS BEAM TEST

General conception

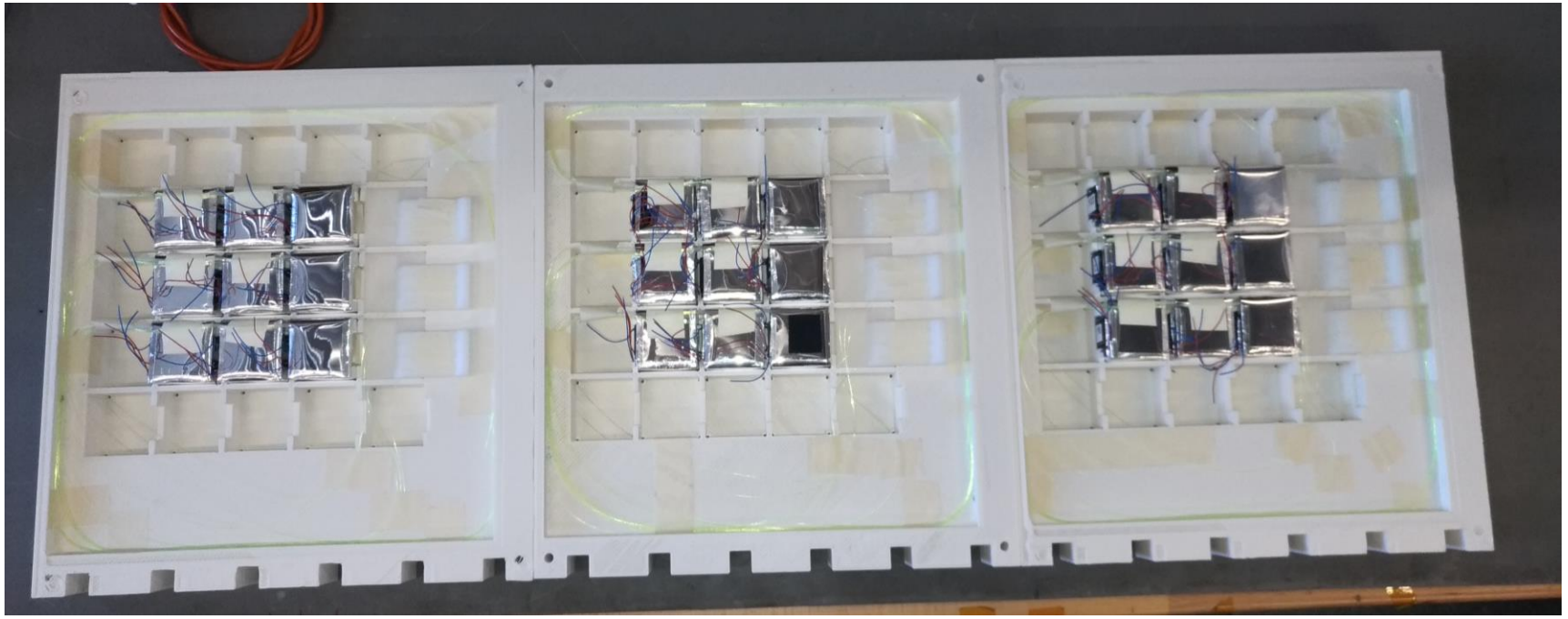


We have two extremes:

- The main goal is to build configuration which is scaled flight model.
- Current configuration with minimal modifications can be used as a emergency solution.

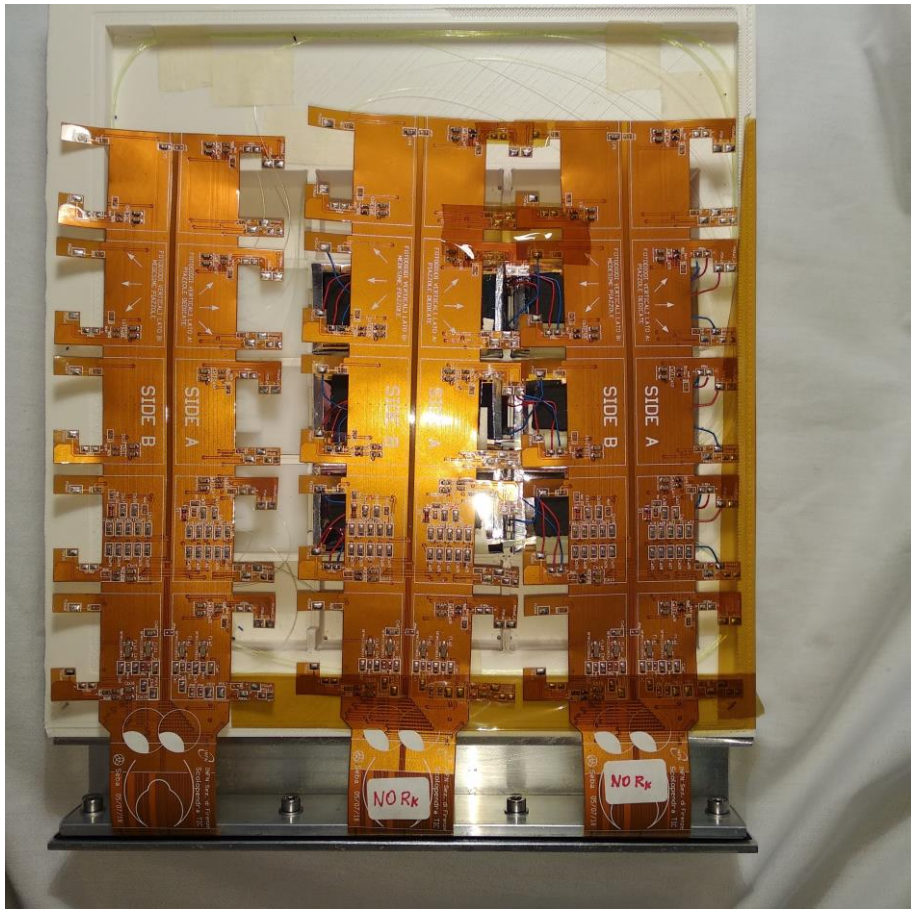
Current configuration

- 3 plains of 9 crystals (3x3 matrix)



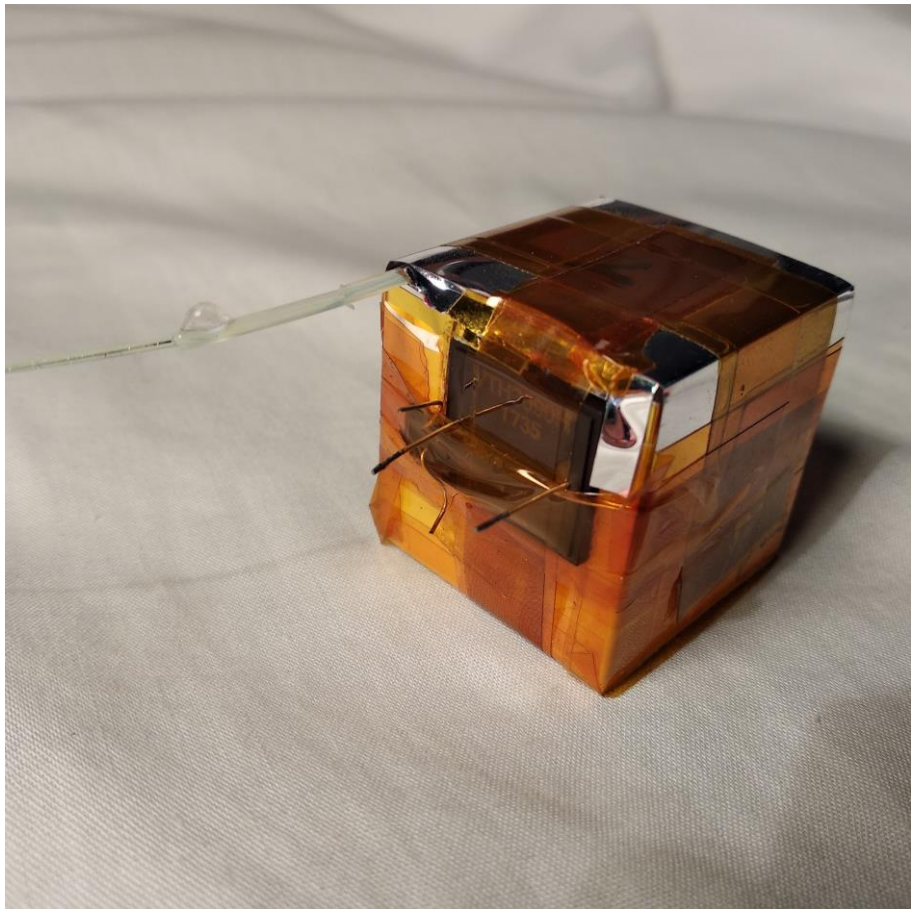
Current configuration

- 3 plains of 9 crystals (3x3 matrix)
- 3 FE boards and DAQ system
- Two flat cables x plane (5 crystals capacity)



Current configuration

- 3 plains of 9 crystals (3x3 matrix)
- 3 FE boards and DAQ system
- Two flat cables x plane (5 crystals capacity)
- Two PDs x crystal, mounted with silicon glue
- Optic fiber



Current configuration

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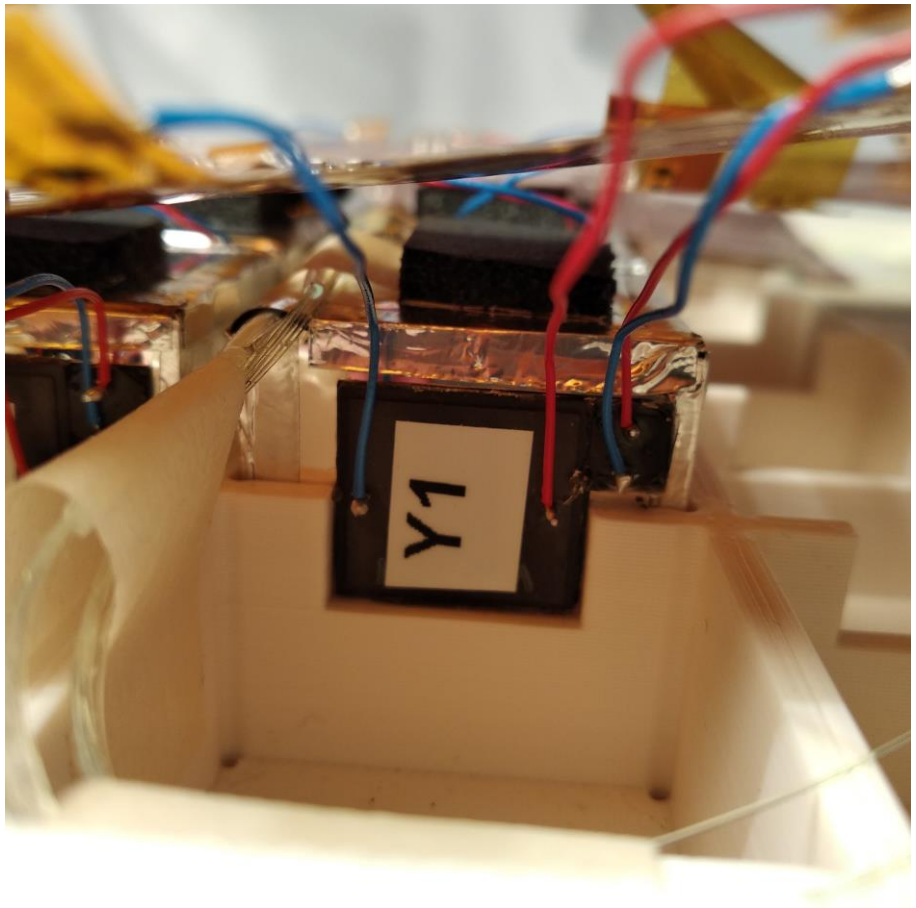
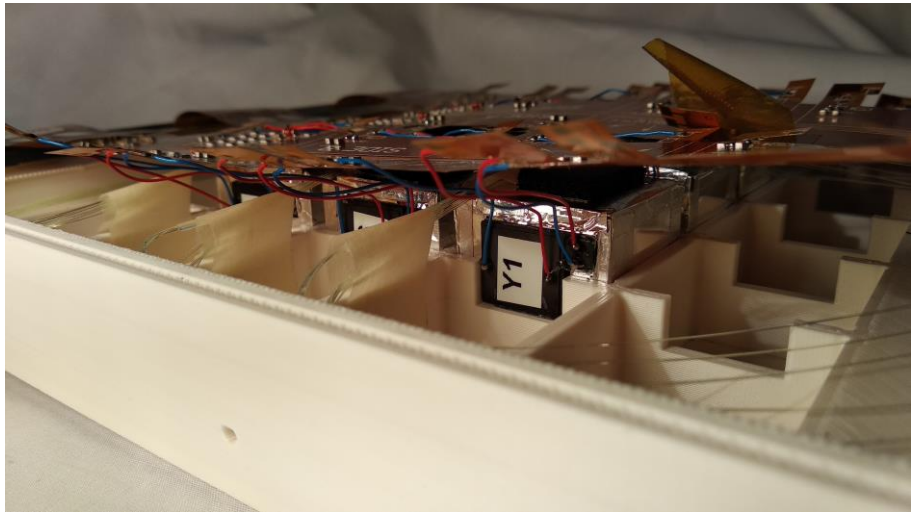
- Fiber exit and PDs on the same side of the support



Current configuration

- 3 plains of 9 crystals (3x3 matrix)
- 3 FE and DAQ system
- Two flat cables x plane (5 crystals capacity)
- Two PDs x crystal, mounted with silicon glue
- Optic fiber
- Fiber exit and PDs on the same side of the support
- Flat cable is on the top of the fibers (separators are used)
- Can be applied with minimal modifications



We consider this configuration as a backup point, some only emergency solution that can be applied in any case.

Main configuration

Photodiodes

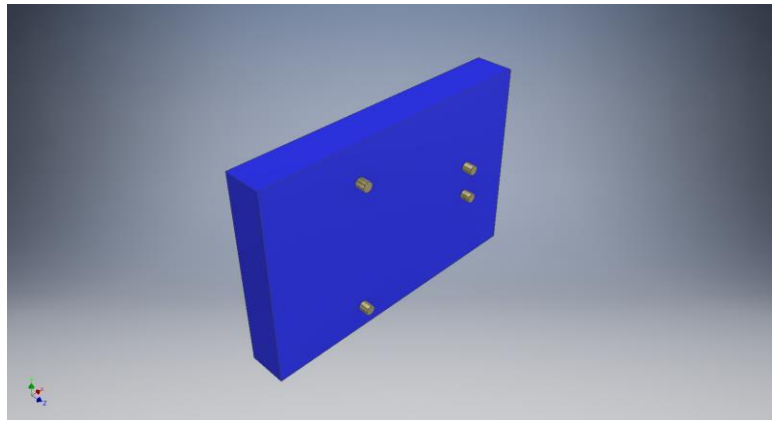
Multiple package:

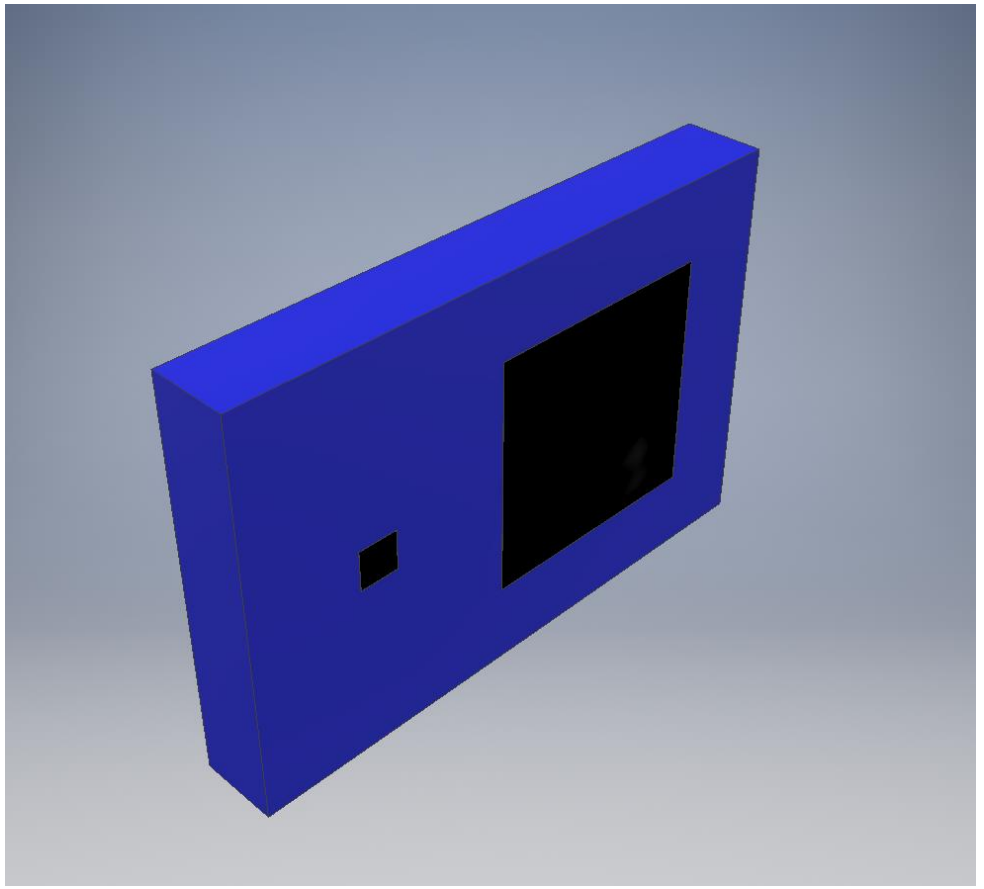
- 15x10x2 mm size
- Includes two PDs: 25 and 0,684 mm^2
- optical filter for small PD to optimize dynamic range

Multipakage will be produced by Excelitas

Work is in progress

This picture is only a model and does don represent a final design

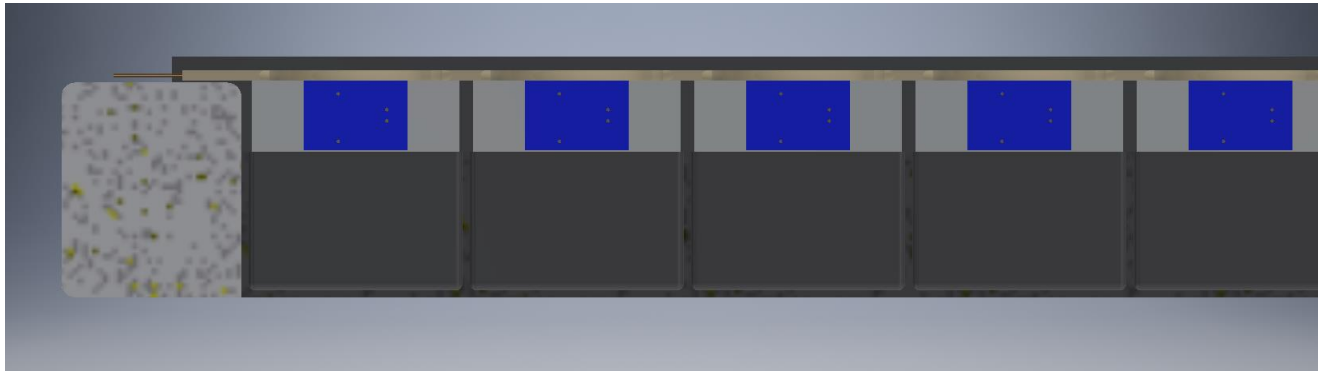


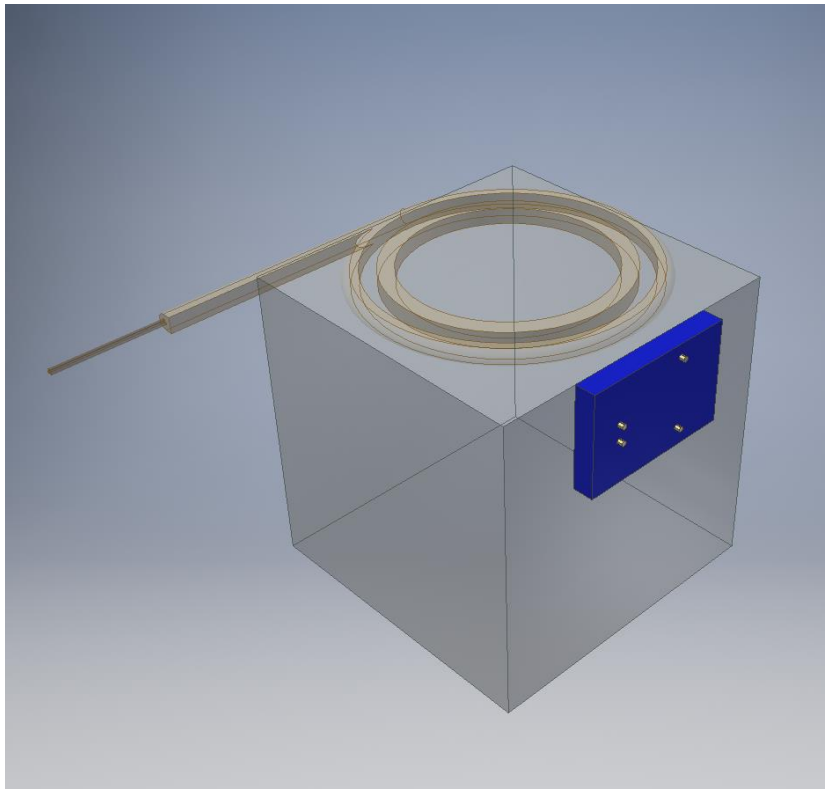


Main configuration

Flat cable on the side of the crystal

- PD is mounted on the lateral side of the LYSO

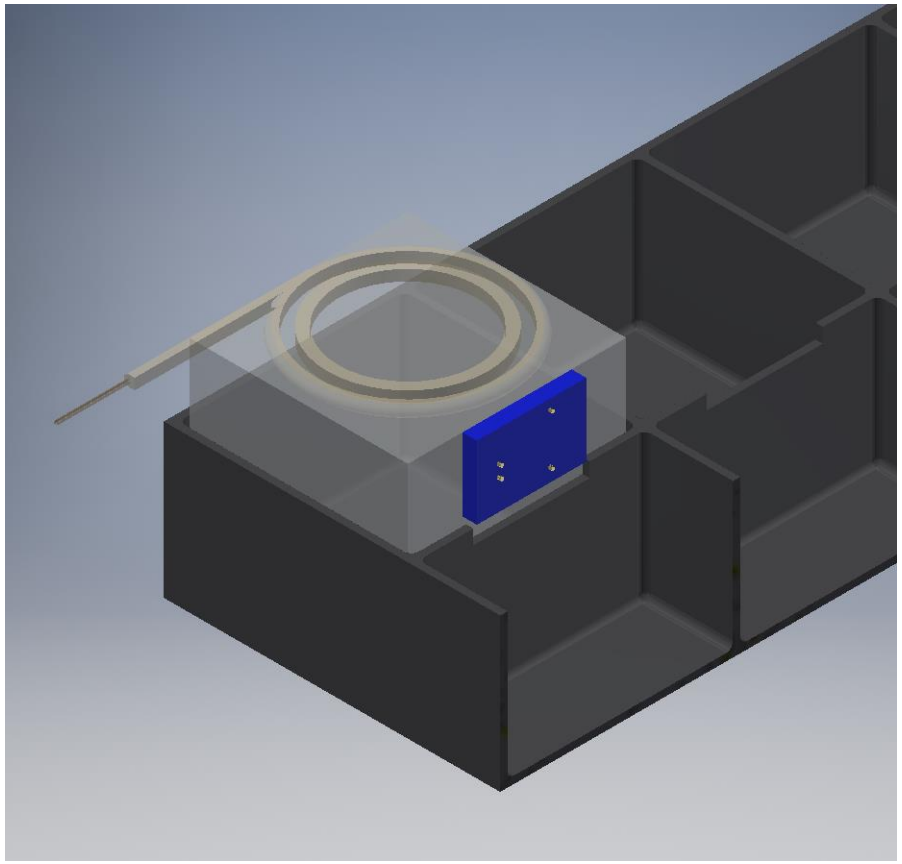




Main configuration

Flat cable on the side of the crystal

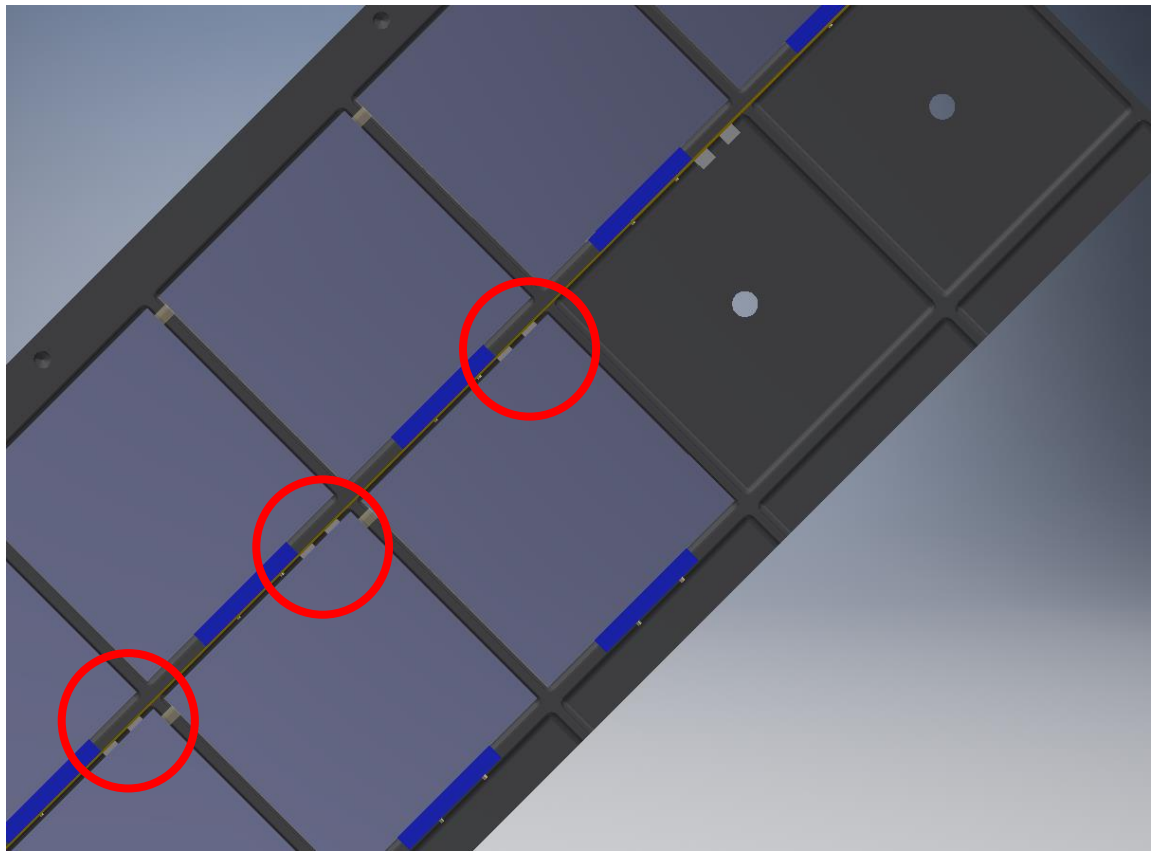
- PD is mounted on the lateral side of the LYSO
- Support structure modification is needed:
  - Additional aperture to hold PDs



Alternative configuration

Flat cable on the side of the crystal

- PD is mounted on the lateral side of the LYSO
- Support structure modification is needed:
  - Additional aperture to hold PDs
  - Distance between cubes must be increased up to 4 mm. There is no room for PD and flat cable.



Main configuration

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- PD is mounted on the lateral side of the LYSO
- Support structure modification is needed:
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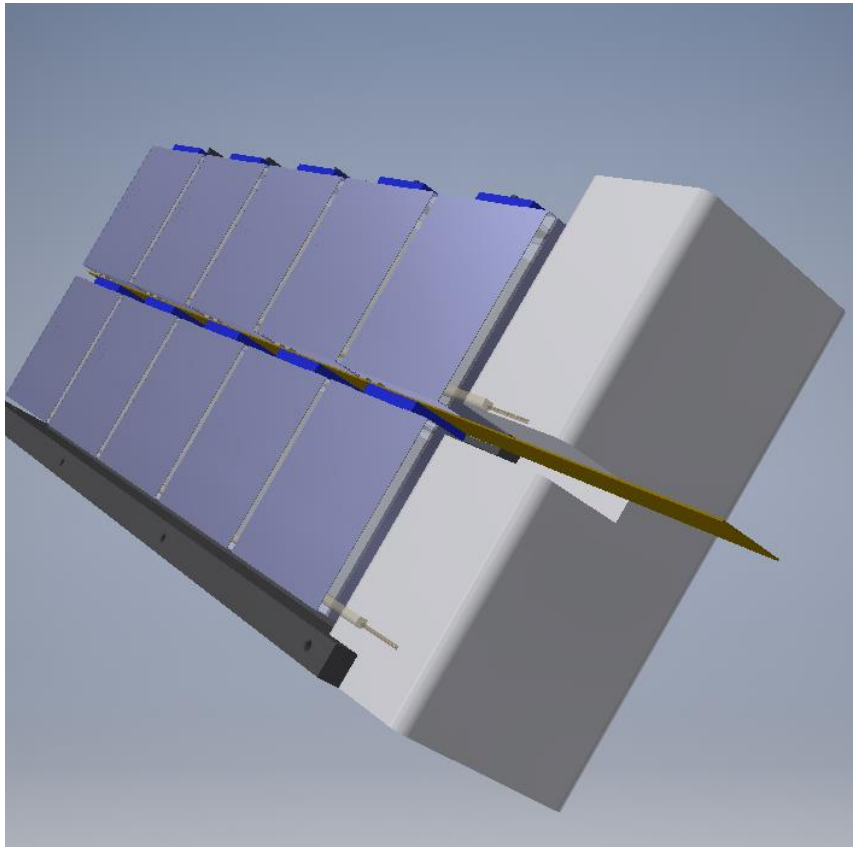
  - Distance between cubes must be increased. There is no room for PD and flat cable.
  - Additional aperture is needed for the flat cable output.



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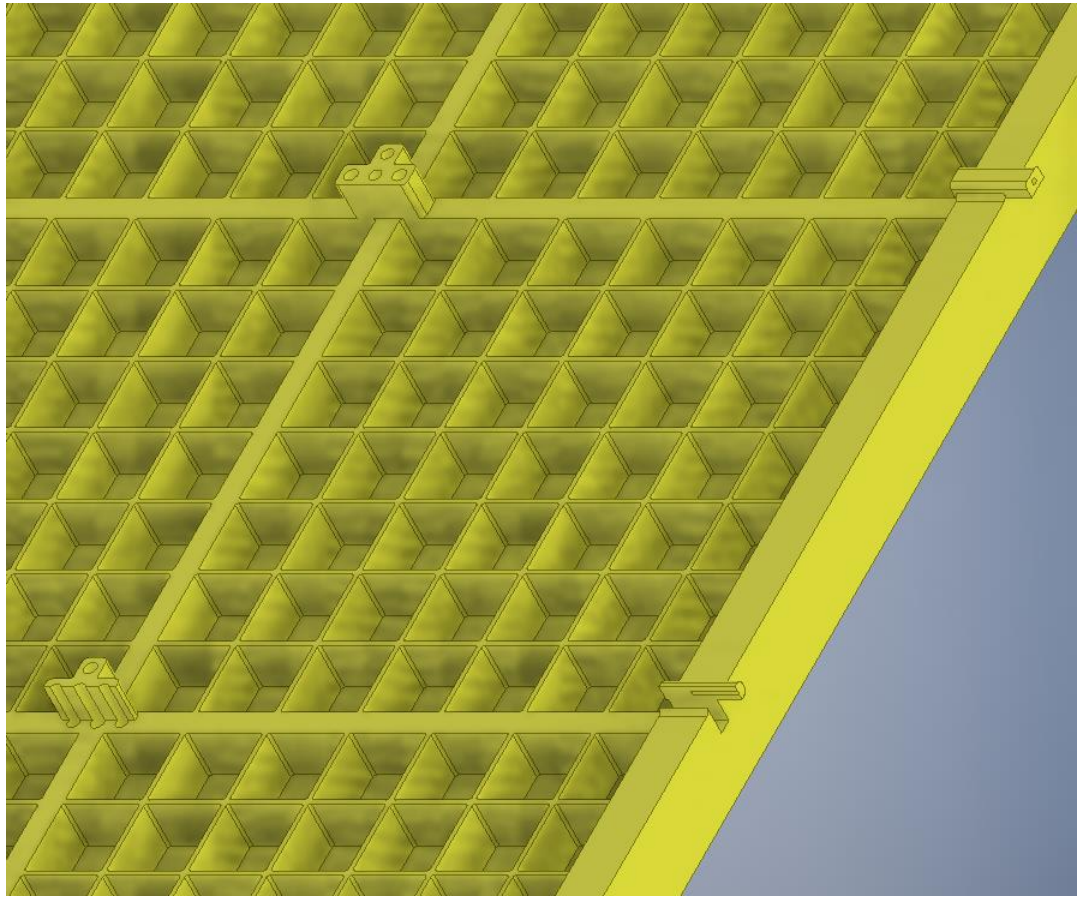
Flat cable on the side of the crystal

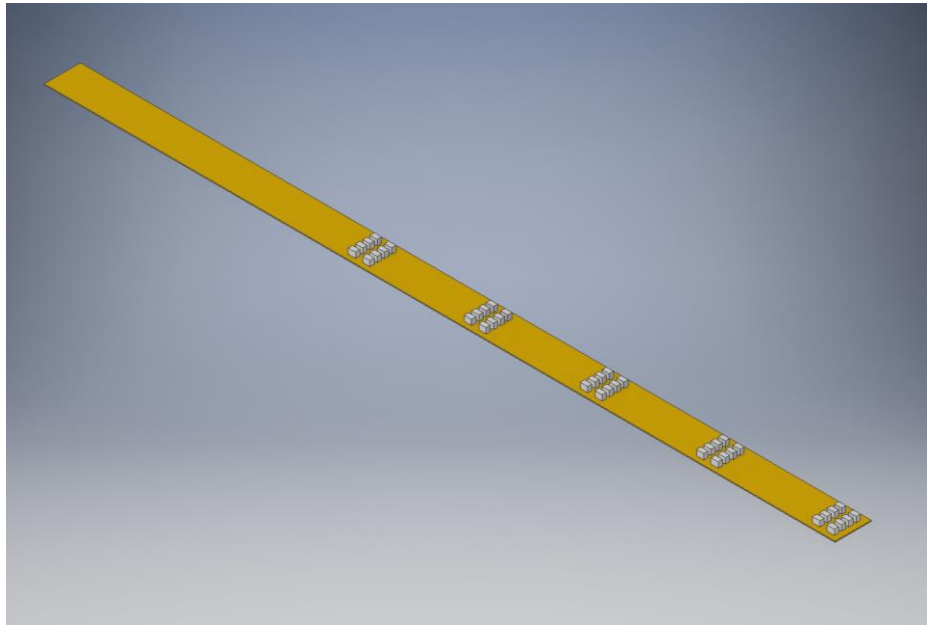
- PD is mounted on the lateral side of the LYSO
- Support structure modification is needed:
  - Additional aperture to hold PDs
  - Distance between cubes must be increased. There is no room for PD and flat cable.
  - Additional aperture is needed for the flat cable output. It can be problematic for the flight grid model at same points.



Main configuration

Flat cable on the side of the crystal

- Flat cable requirements
  - Should handle one row of 21 crystals or 50-60 channels (42 analog outputs + HV channels)
  - Total length is about 80 cm
- Cable width is 10 mm
- Almost one half of the cable is occupied by PDs
- Estimated number of layers is about 17
- Cable design and assemblage difficulties
- Estimated thickness is about 1 mm
- Cable is very thick and inflexible
- Elevated interchannel crosstalk and parasitic capacitive coupling
- Noise increasing



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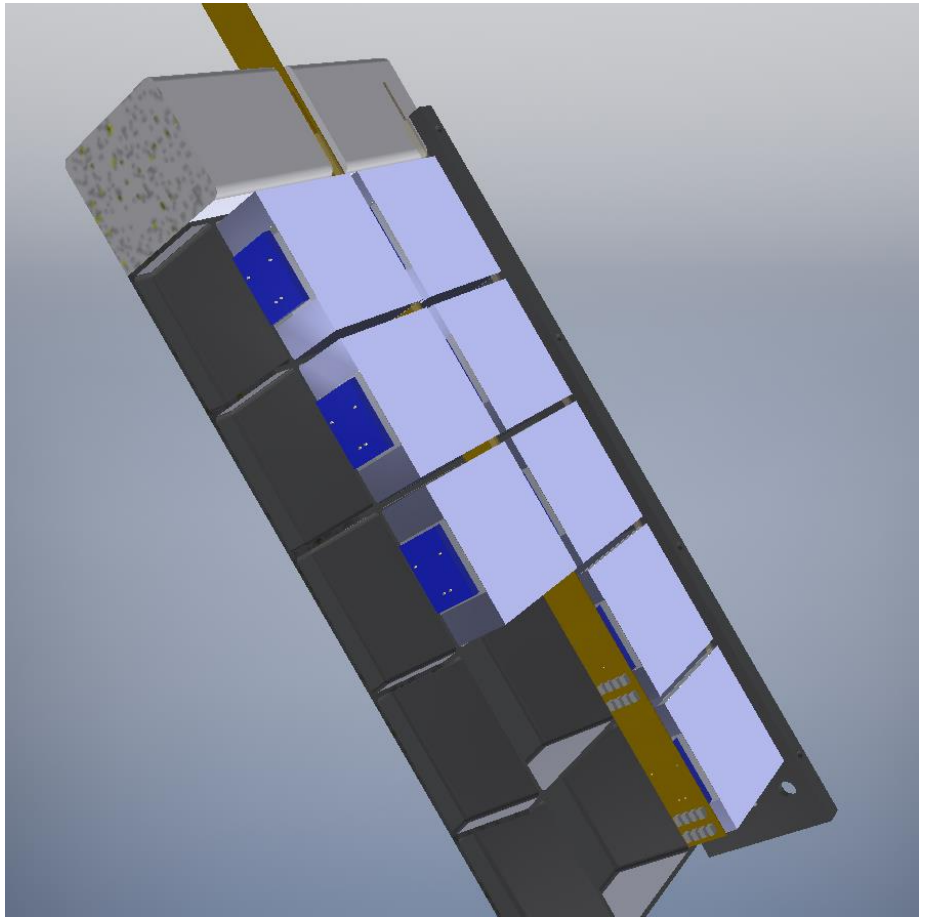
- PDs and cable installation depends on LYSO and optic fiber installation



Main configuration

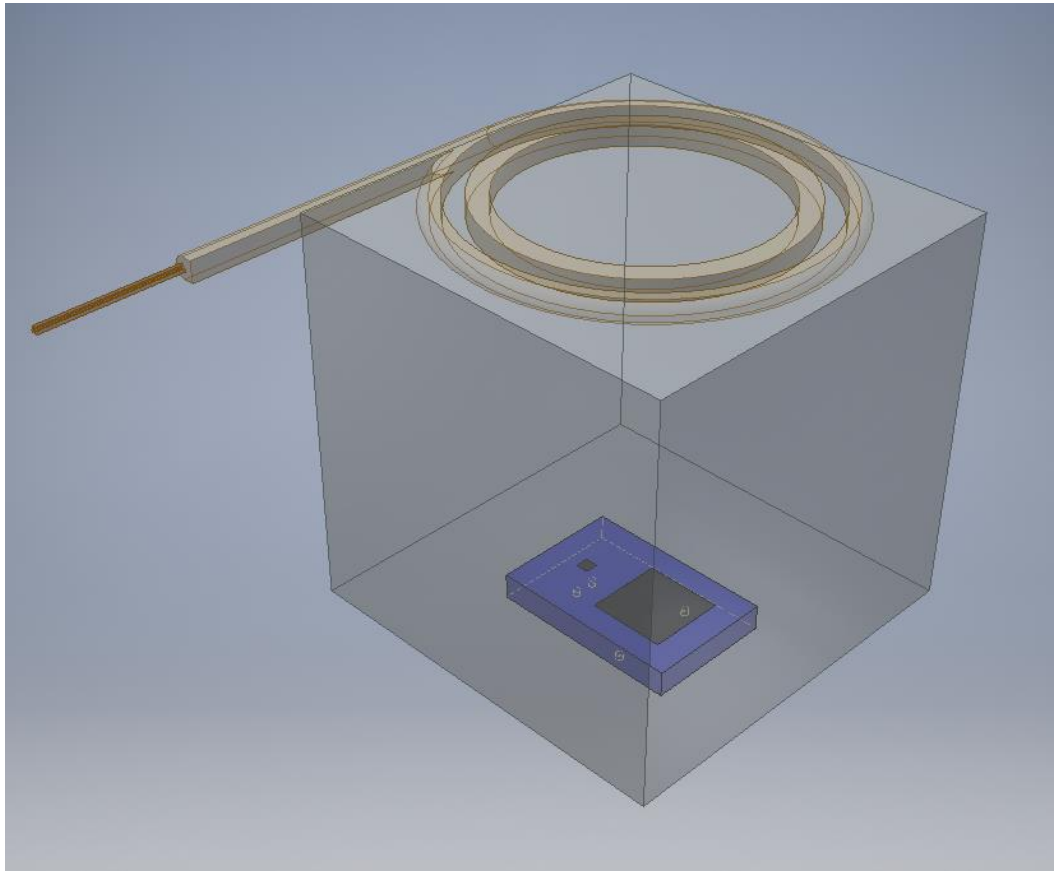
Flat cable on the side of the crystal

- Significant design modification: pitch, supports
- Narrow flat cable: elevated number of channels, high thickness and rigidity, high interchannel coupling and parisitic capacity
- PDs and cable installation depends on LYSO and optic fiber installation

Alternative configuration

Crystal assembling

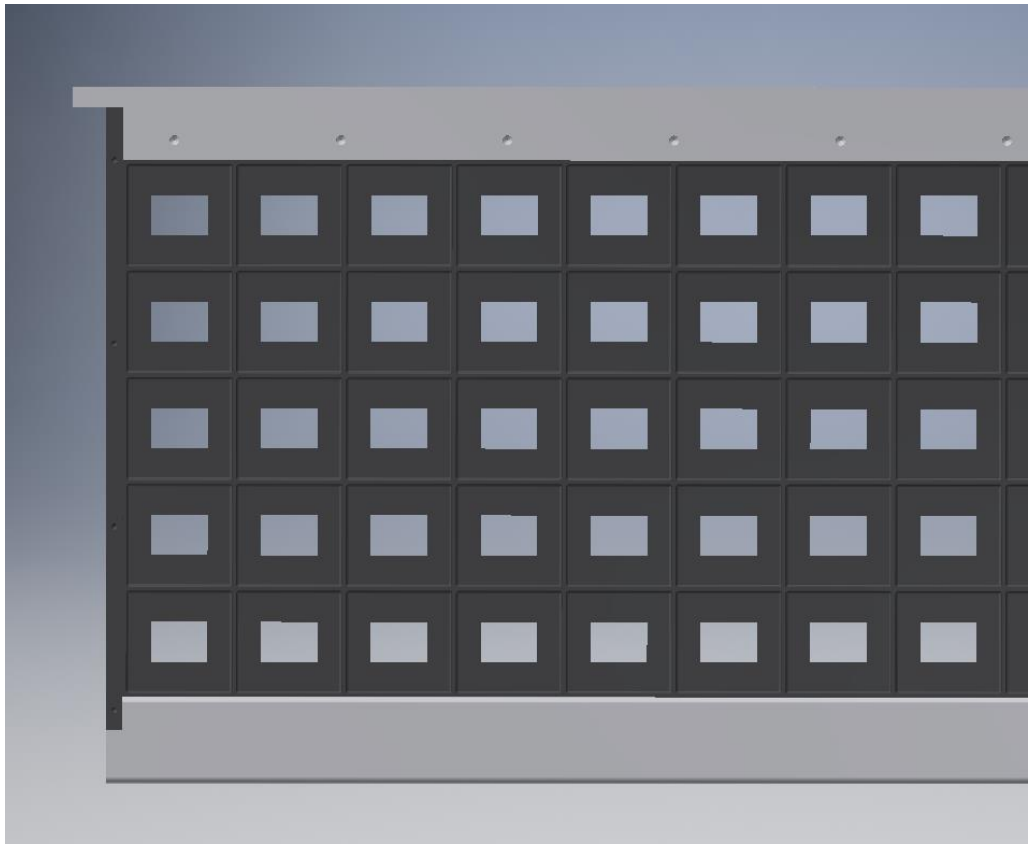
- Optical fibers and PDs are placed on opposite sides of the crystal
- PDs are mounted with an optical glue
- Usual wrapping



Alternative configuration

Plane configuration

- Support structure modification is needed:
  - 12x17 mm aperture on the bottom side to hold PDs



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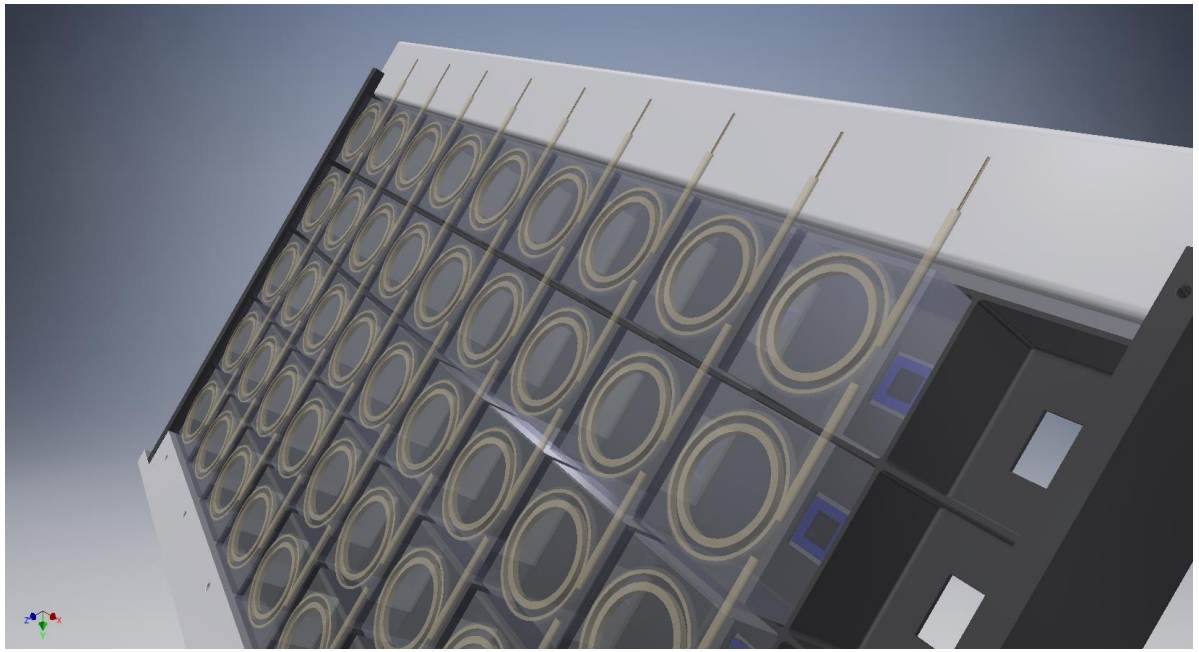
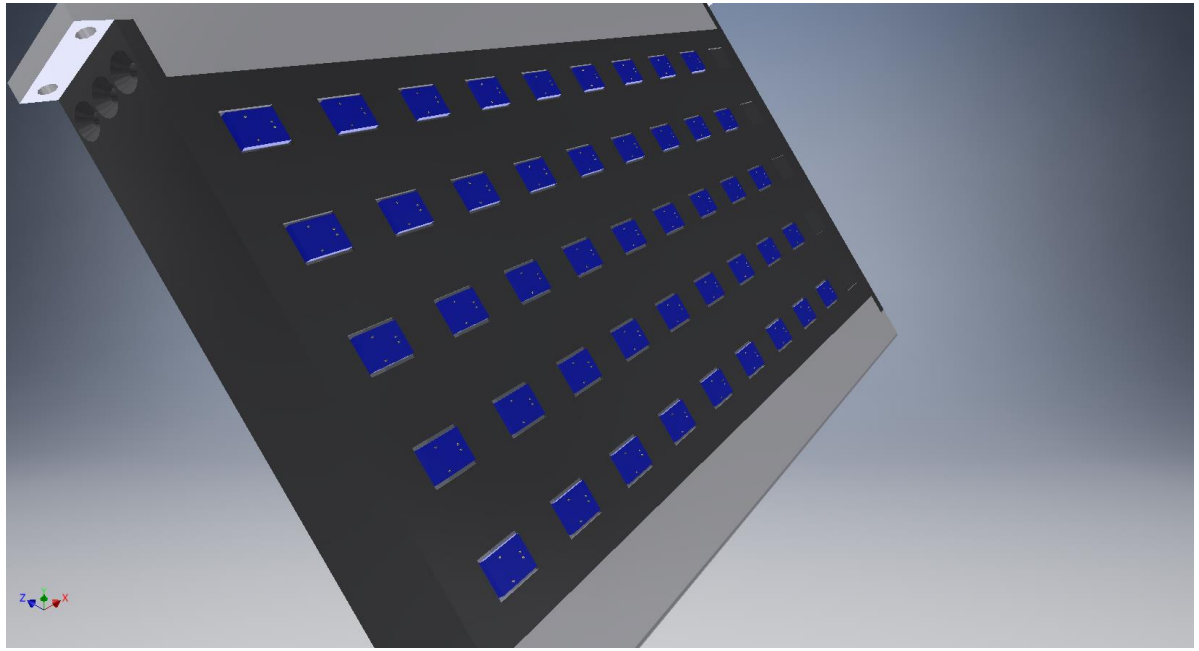
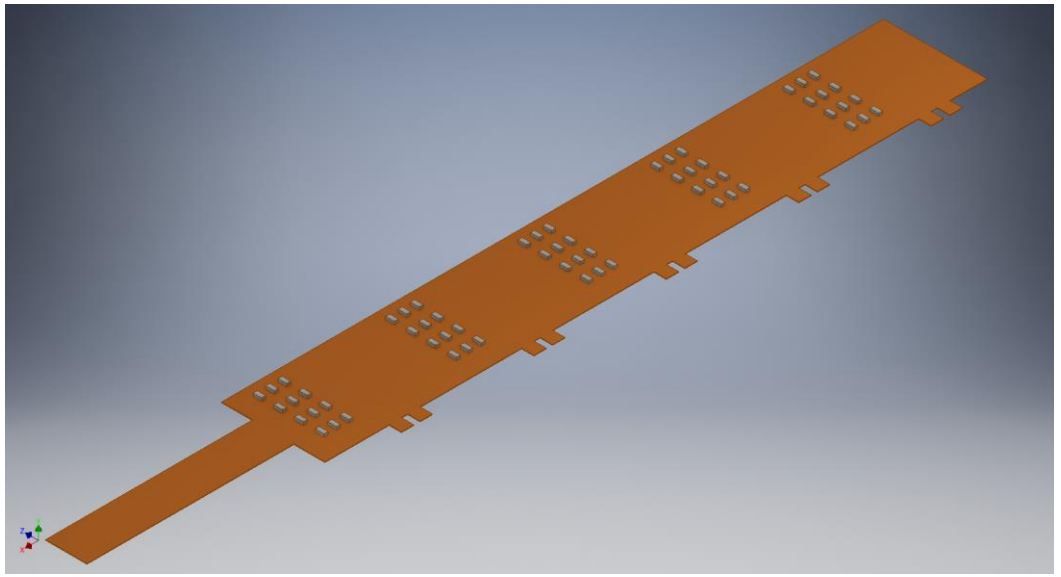




Alternative configuration

Flat cable

- Width is 30 mm
- Estimated number of layer is 7
- Estimated thickness is about 0,5 mm
- For prototype we consider an option to cut this cable for the first 5 crystals only



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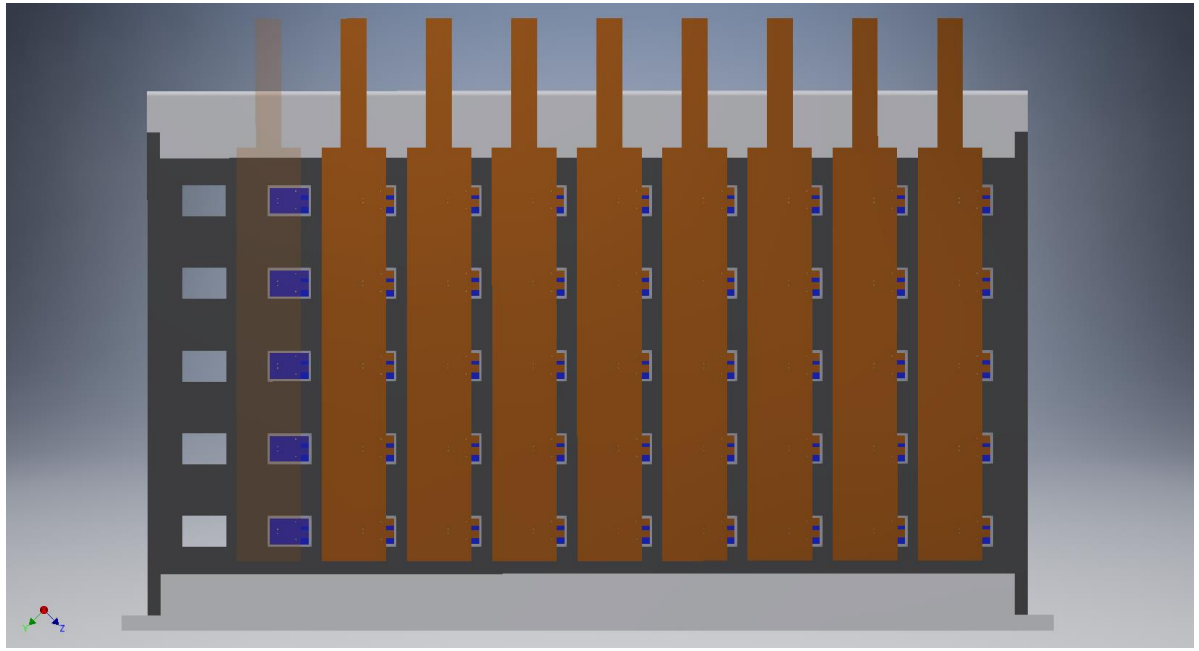
Alternative configuration

Plane configuration

- Support structure modification is needed:
  - 12x17 mm aperture on the bottom side to hold PDs
- Flat cable is placed on the bottom side



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Plane configuration

- Support structure modification is needed:
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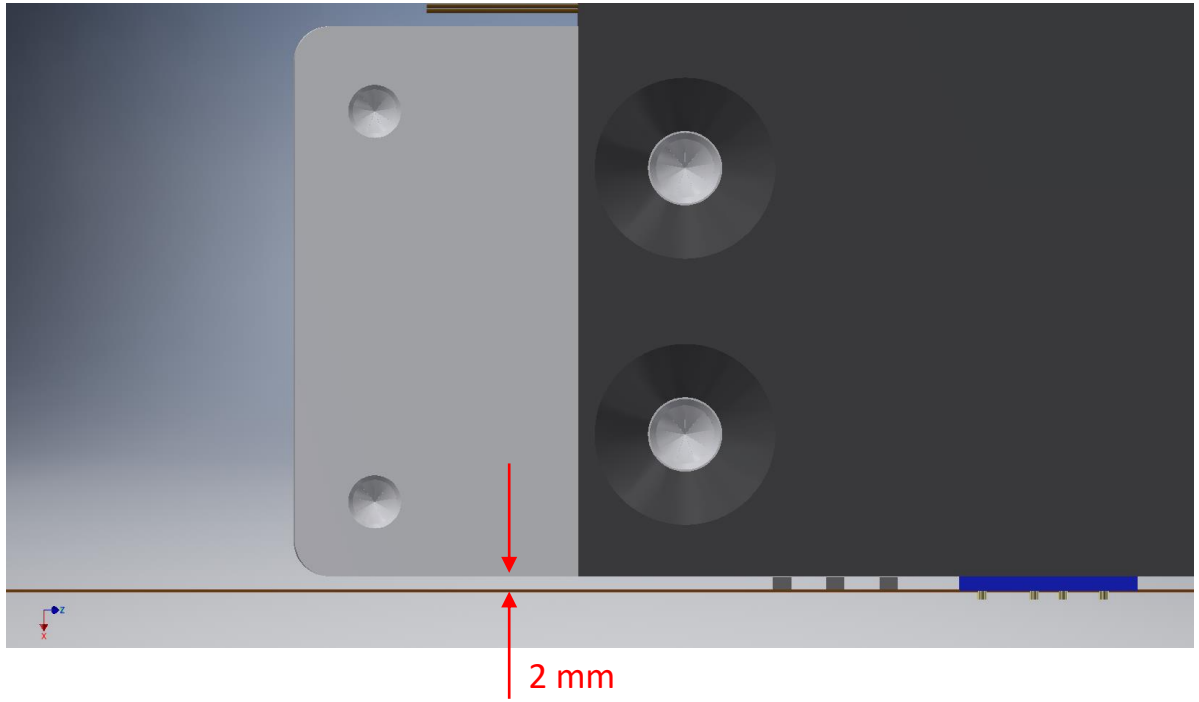
Total height is about 2 mm

Cable maximal width is 30 mm



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Total height is about 2 mm

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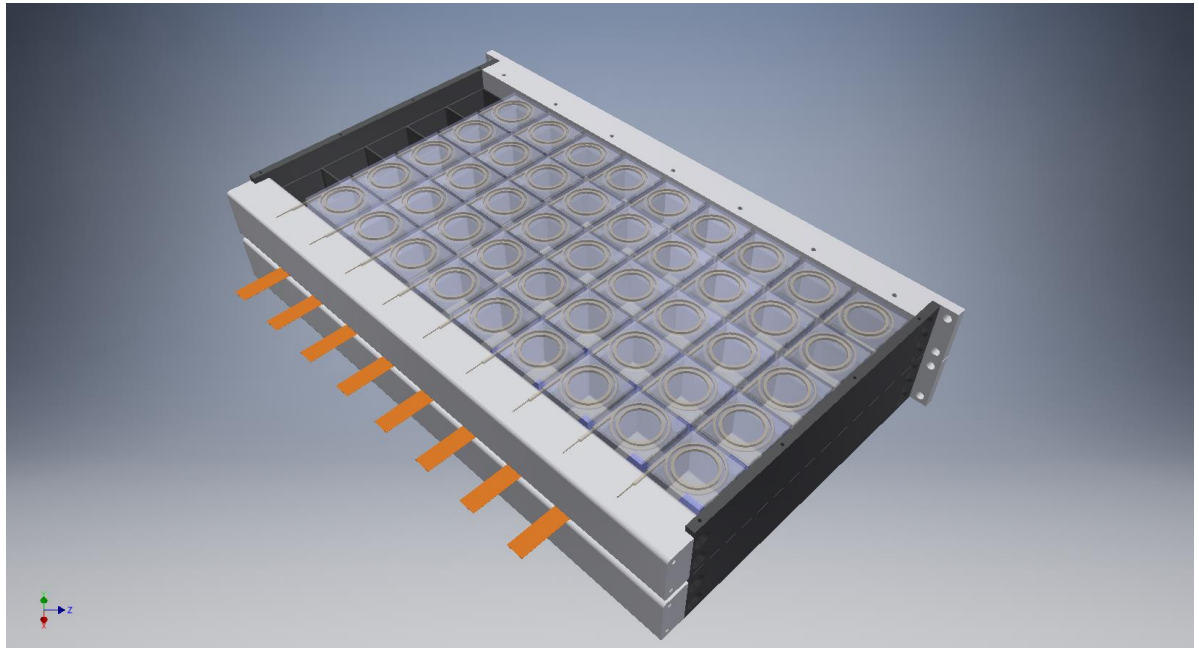
No changes needed for the interplane distance



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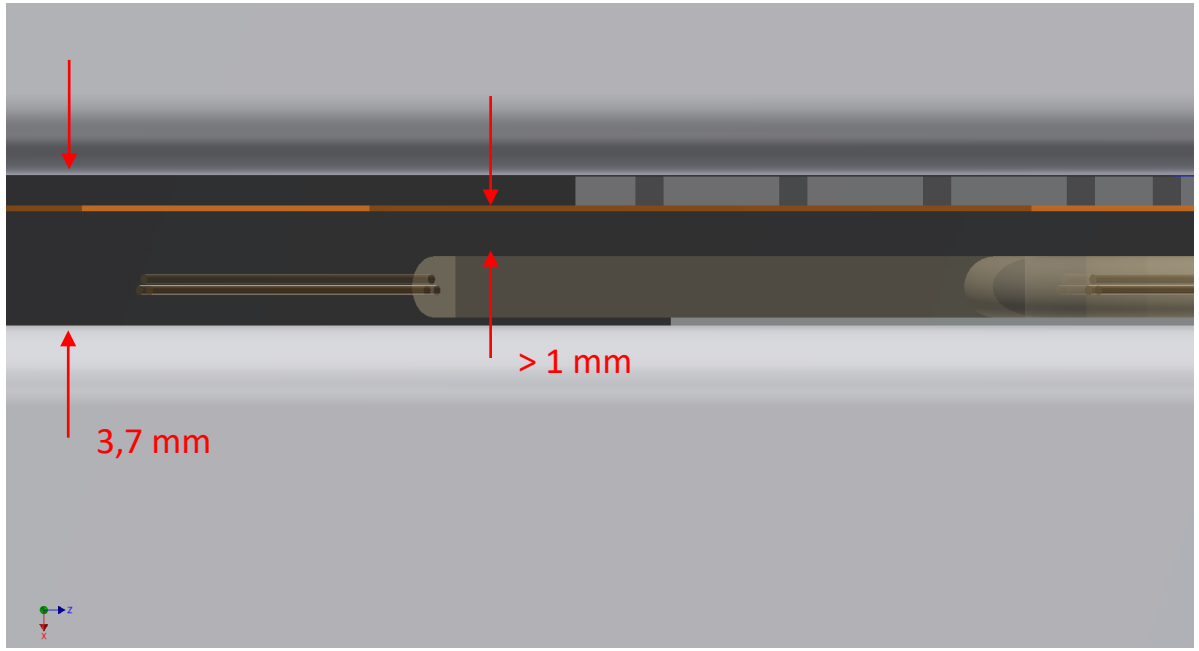
> 2 mm distance between flat cable and optic fiber

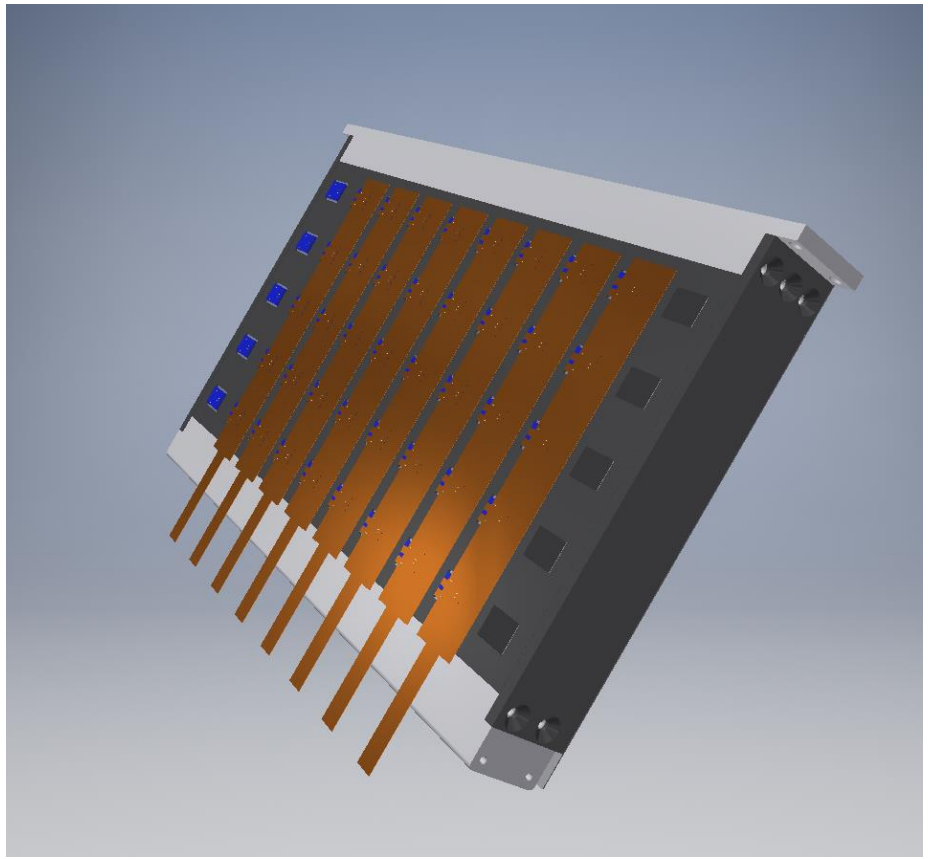
This distance is even more in the case of flight model (6 mm interplane distance)



Alternative configuration

Plane configuration

- Support structure modification is needed:
  - 12x17 mm aperture on the bottom side to hold PDs
- Flat cable is placed on the bottom side
  - Flat cable can be mechanically fixed or glued on the bottom side
  - Smooth and uniform surface of the cable



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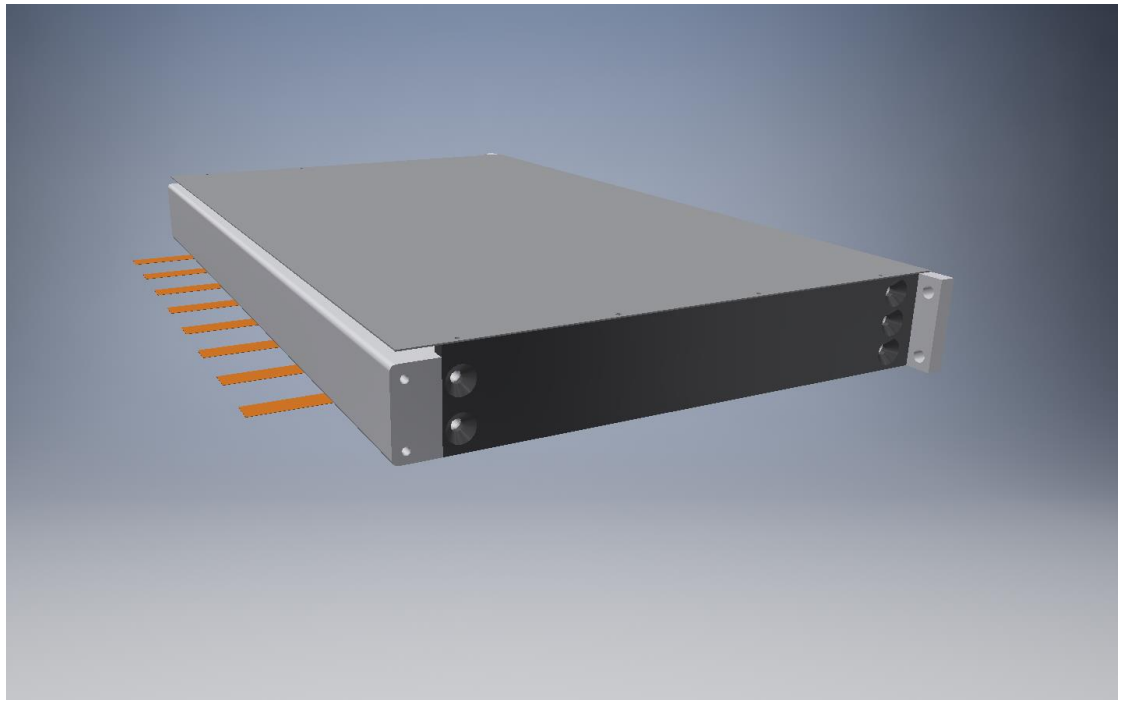
  - Smooth and uniform surface of the cable
  - Optic fiber and PDs installation processes are completely independent
  - Optic fibers can be protected with temporary cover up to final assembly

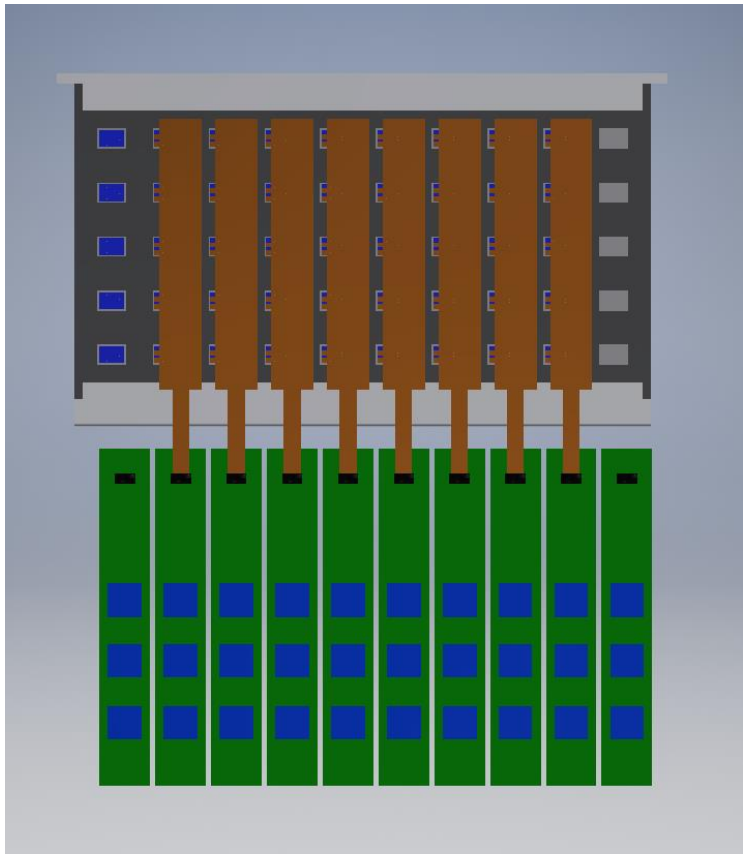


Alternative configuration

FE and DAQ electronics

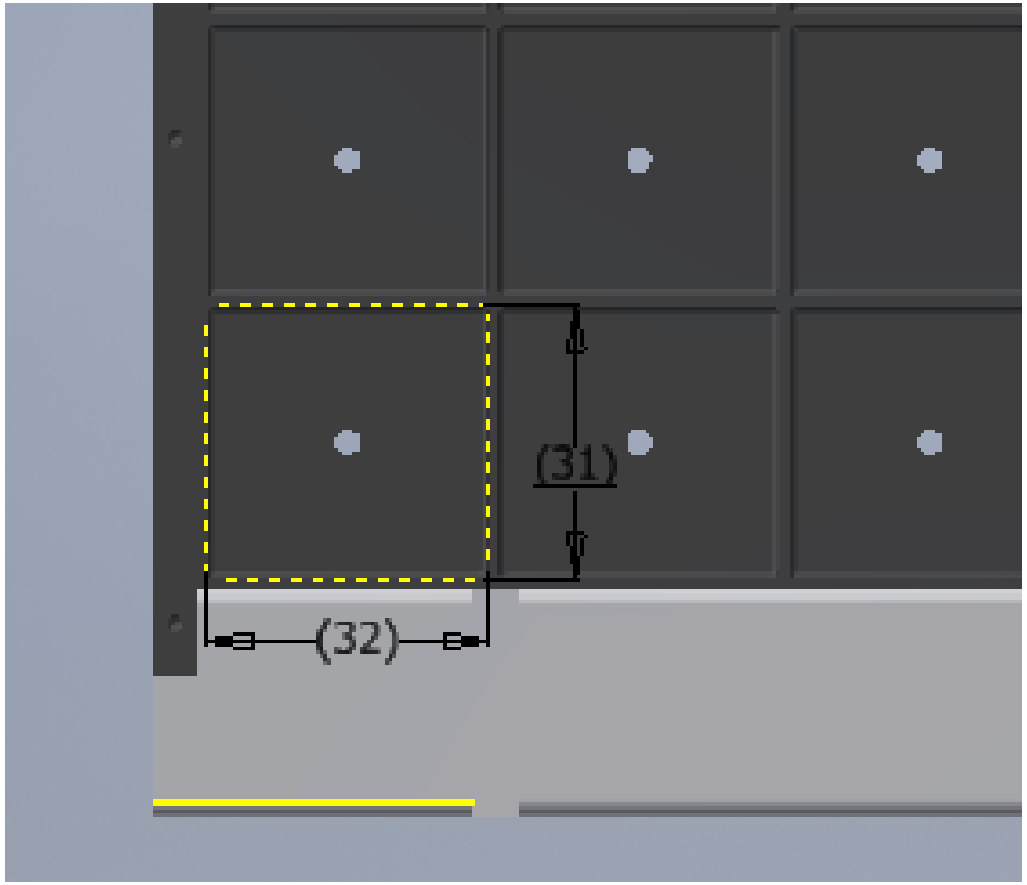
FE board should be optimized:

- One FE board for one flat cable
- Number of chips
- Number of channels per chip
- Separate chips for large and small PD



Concordance

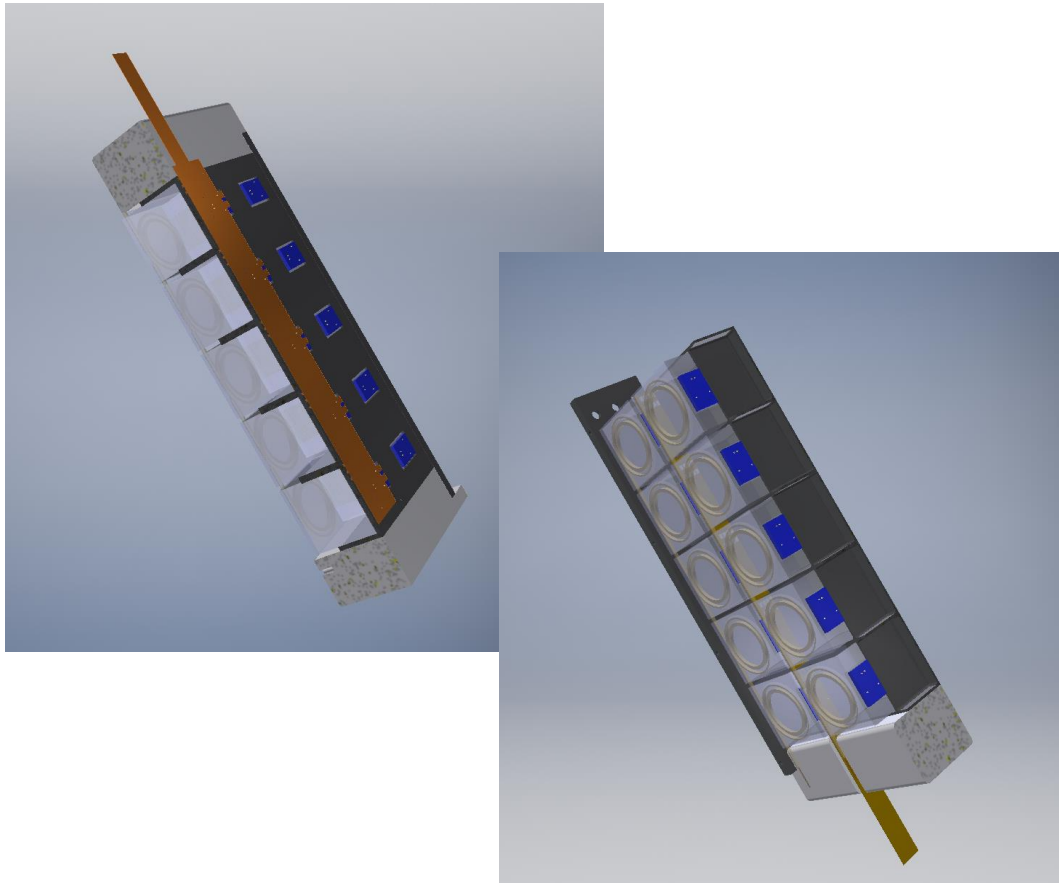
Cell size (and path) is not equal in x and y directions. Is it desired effect?



Concordance

Which flat cable configuration we will use?

This is main point which determines almost all our activities.



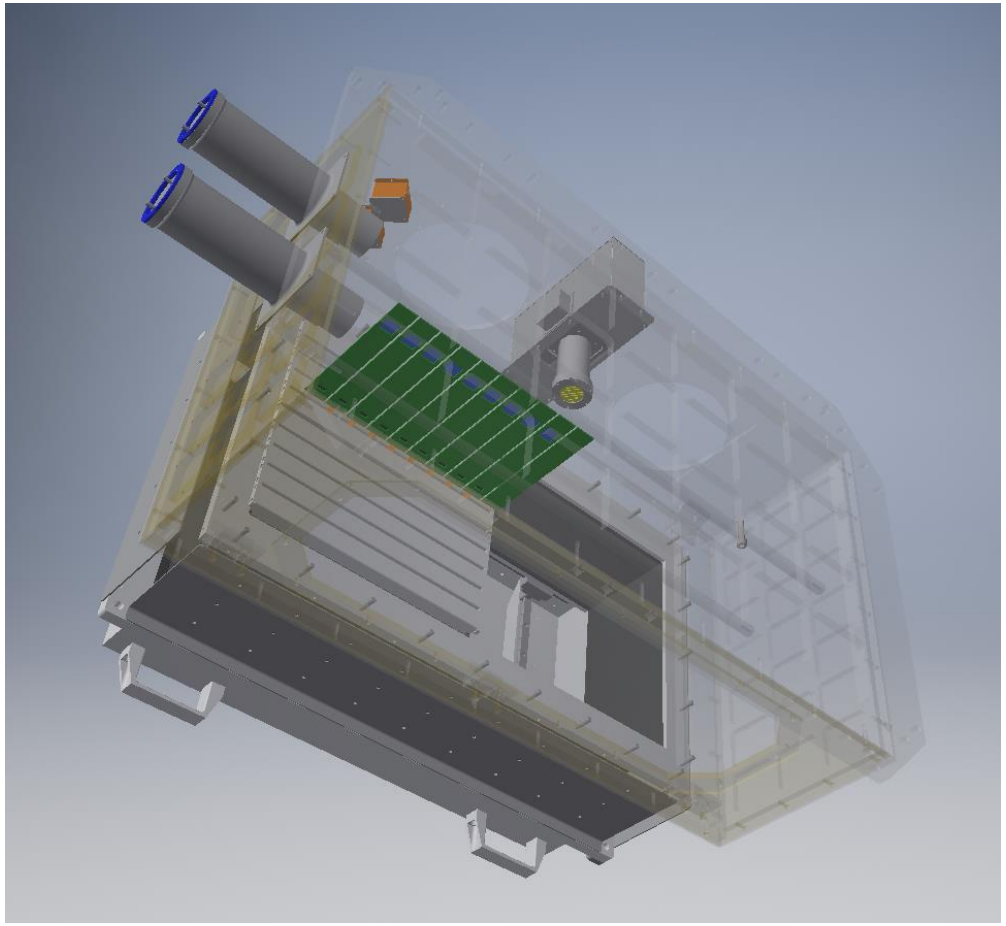
Concordance

	Bottom cable	Side cable
Mechanical Design	Bottom windows for PDs	Side windows for PD
	Thread for cable fixing?	Distance between cubes 4 mm
		Aperture for flat cable
Flat cable	30 mm width	10 mm width
	~ 7 layers	~ 17 layers
	~ 0.5 mm thick	~ 1 mm thick
		High noise and parasite coupling
Assemblage	PDs and optic fibers installation is completely independent	Installation sequence is needed
	Optic fibers can be protected up to final installation	Only one row can be assembled at a time

Concordance

FE boards position

What is FE boards dimensions limits allowed by optic fiber routing?



Concordance

FE boards position

What is FE boards dimensions limits allowed by optic fiber routing?

Which staff we can use to fix the FE boards? FE boards and PDs must be as close as possible for noise reasons.