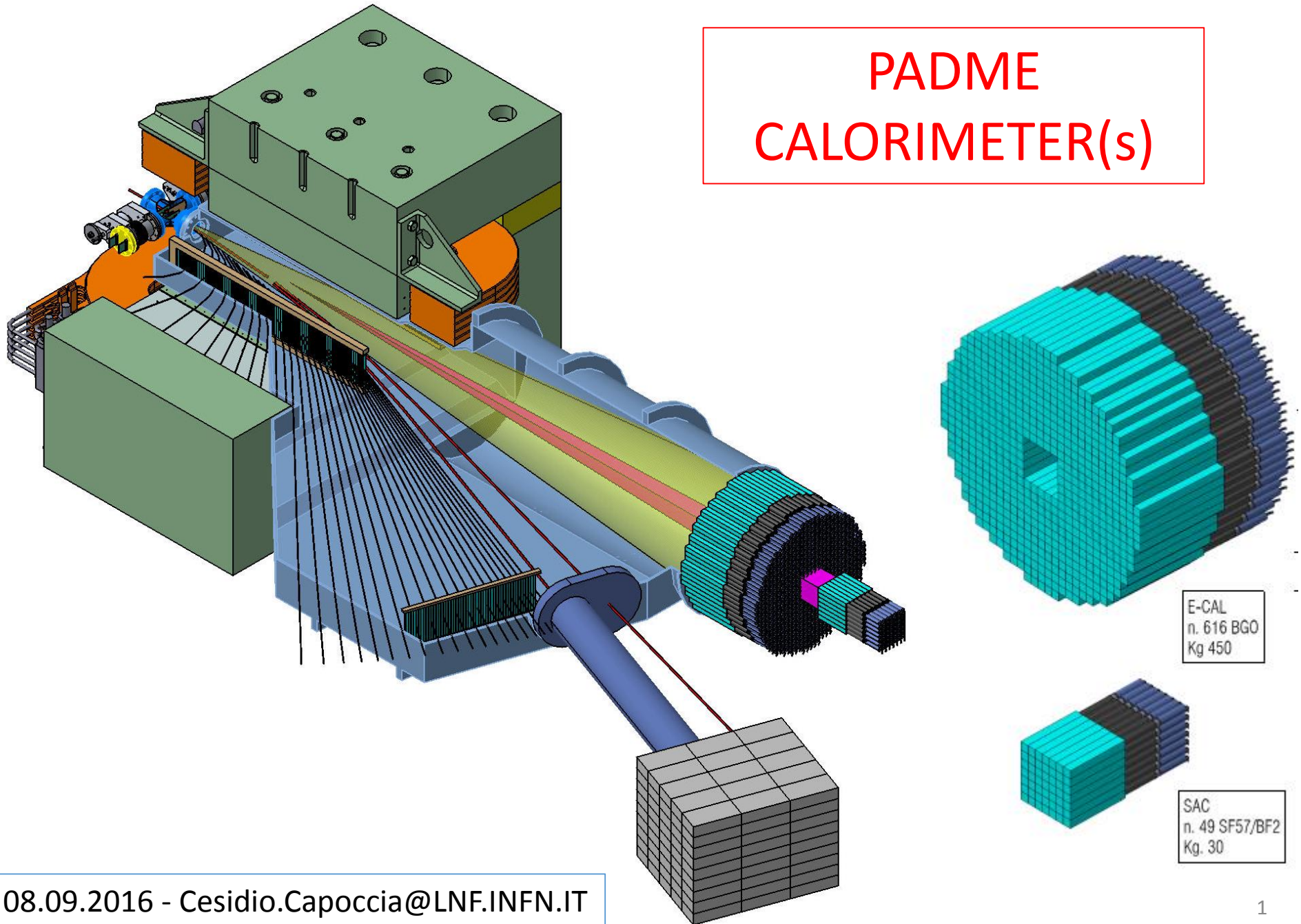


PADME CALORIMETER(s)



PHOTOMULTIPLIER TUBE



R1166P - Photomultiplier tube

- 19mm dia.,
- Head-on type,
- Bialkali photocathode
- Effective area : 15 mm dia.
- Spectral response : 300 to 650 nm
- Photon counting type of R1166

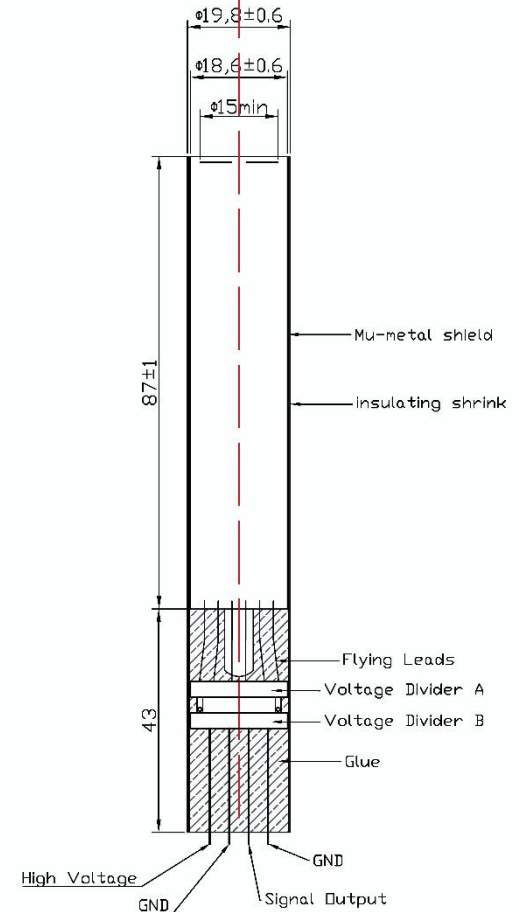
E974-17D-type socket assembly For 19mm dia. Head-on PMT



HAMAMATSU PHOTONICS

08.09.2016 - Cesidio.Capoccia@LNF.INFN.IT

HZE PHOTONICS



							材料规格		海南辰创光电技术有限公司	
							厚度		HZE PHOTONICS	
标记	处数	分区	更改文件号	签名	年月日	数量	数量	XP1911		
设计人员			标准化			检验标记	重量	比例		

... LOOKING AROUND FOR A CHEAPER
"HAMAMATSU – R1166P EQUIVALENT"...

OPTICAL GLUE

CEMENT EJ-500

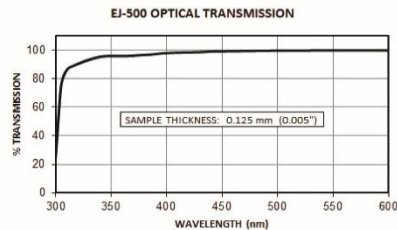
EJ-500 is a clear and colorless epoxy cement with refractive index at 1.57. It is ideal for optically bonding plastic scintillators and acrylic (PMMA) light guides. It is equally effective with PVT (polyvinyltoluene) or polystyrene based scintillators and may also be confidently used for making butt joints of optical fibers with polystyrene cores. This cement has a degree of flexibility making it useful for optically bonding glasses or the above plastics to glass windows. The optical transmission plot applies to a 0.125 mm (0.005") thick layer in comparison to air. It may also be used to cement metal or ceramic parts to plastic scintillators or PMMA light guides.

EJ-500 is fully cured at room temperature (20°C) with a working life of 60 minutes. The mixed cement takes 3-4 hours to set and 24 hours to harden, although it takes several days to achieve complete cure.



PACKAGE SIZES	
	300 g
	600 g

PROPERTIES	EJ-500
Mixed Viscosity (cps)	800
Bond Strength (psi)	1800
Dielectric Strength (volts/mil)	420
Specific Gravity, Cured	1.17
Service Temperature (°C)	-65 to 105
Volume Resistivity, 25°C (ohm-cm)	10 ¹⁴
Coefficient of Thermal Expansion (per °C)	7.2 × 10 ⁻⁵
NASA Outgassing Properties	
Mass Loss (%)	1.69
Condensed Volatiles (%)	0.04



125 Kg/Cmq

Note: Sup.Inc. Diam 19 mm -> 2,8 Cmq

Revision Date: 01/27/2016

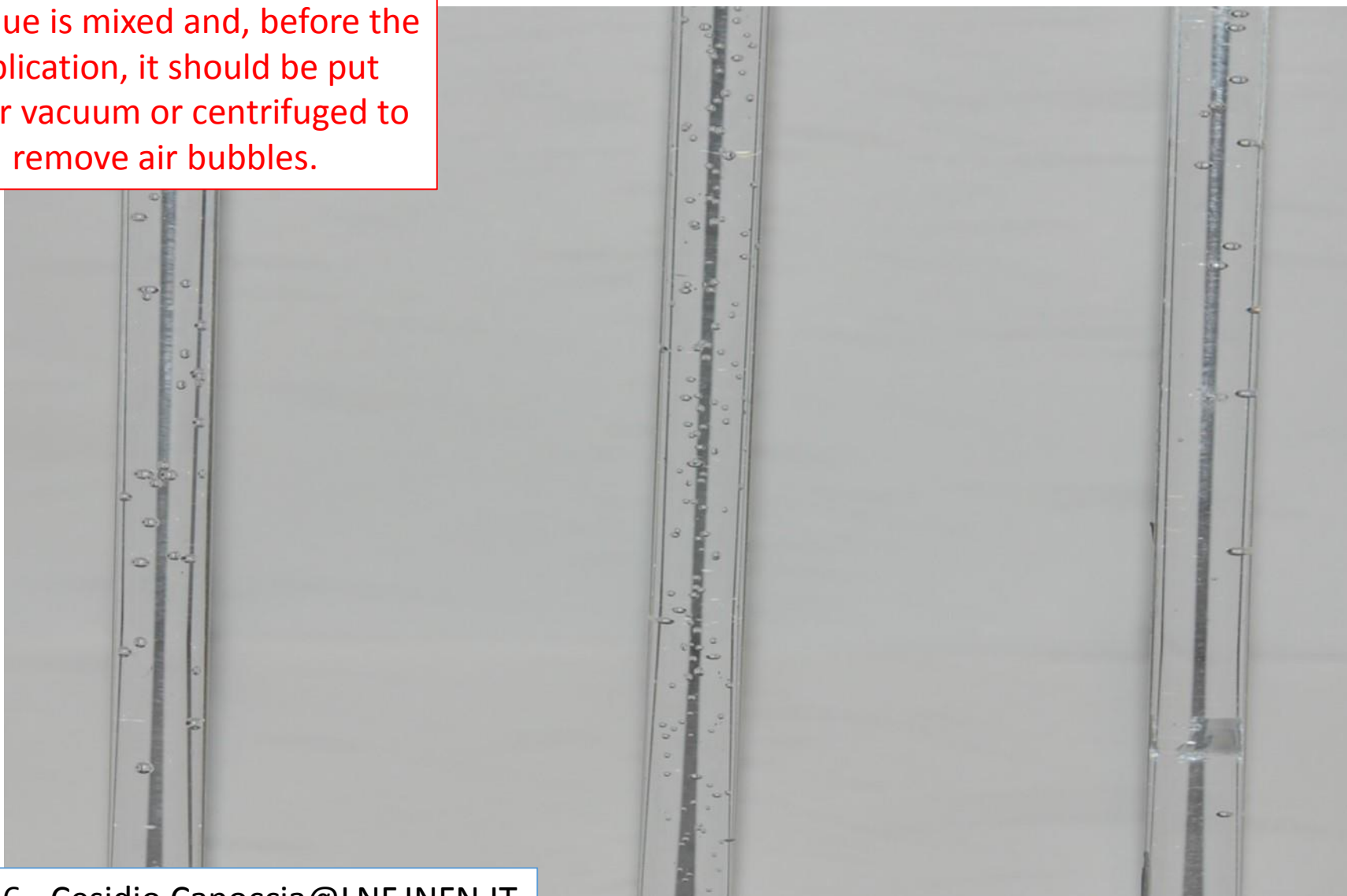
ELJEN TECHNOLOGY

08.09.2016 - Cesidio.Capoccia@LNF.INFN.IT

UNCURED PROPERTIES WITH CURING AGENT ADDED	RTV615
Color	Clear, Colorless
Consistency	Easily Pourable
Viscosity, cps	4000
Work Time @ 25°C (77°F), hrs	4
CURED PROPERTIES (Cured 1 hr. @ 100°C/212°F)	RTV615
Mechanical	65 Kg/Cmq
Hardness, Shore A Durometer	44
Tensile Strength, kg/cm ² (psi)	65 (920)
Elongation, %	120
Shrinkage, %	0.2
Refractive Index	1.406
Electrical	
Dielectric Strength, kv/mm (v/mil) (1.9 mm thick)	19.7 (500)
Dielectric Constant @ 1000 Hz	2.7
Dissipation Factor @ 1000 Hz	0.0006
Volume Resistivity, ohm-cm	1.8 x 10 ¹⁵
Thermal	
Useful Temperature Range, °C (°F)	-60 to 204 (-75 to 400)
Thermal Conductivity, gm-cal/sec, cm ² , °C/cm (Btu/hr, ft ² , °F/ft)	0.00045 (0.11)
Specific Heat, cal/gm, °C (Btu/lb, °F)	27 x 10 ⁻⁵ (15.3 x 10 ⁻⁵)
	0.3 (0.3)

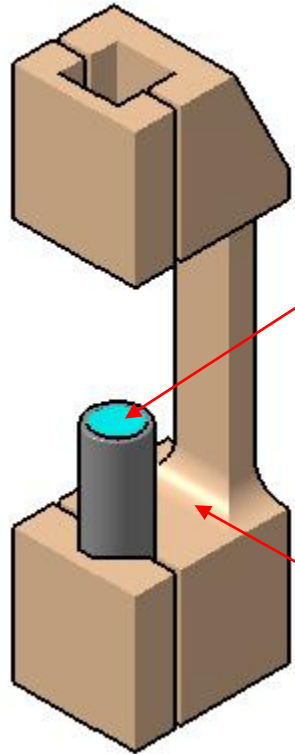
WARNING

The glue is mixed and, before the application, it should be put under vacuum or centrifuged to remove air bubbles.



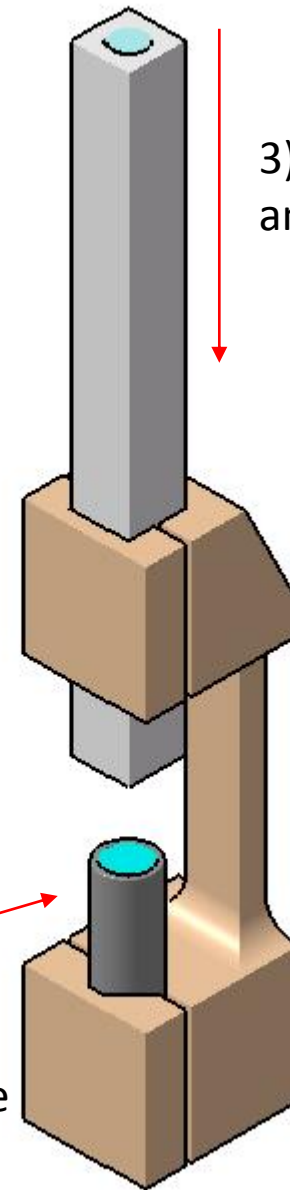
JOINT (GLUE)

1) PMT fixed into the gluing-stand (Made in plastic material)



2) Put a 'spot' of glue on the PMT

3) Insert Scintillator and push it against PMT



Note: Consider something like a collar or paper tape to protect the PMT during Gluing

4) Verify if the glue-joint is well done
(Without air-bubbles)

WARNING

If the Joint/Contact surface is not "Clean"
Remove the scintillator, clean all and then
repeat the operation from begin..

5) Fix Scintillator

6) Clean glue

7) Black Silicon (or 3M-DP490)
(When glue is dried)

PAINT

REFLECTIVE PAINT EJ-510, EJ-520

EJ-510 Reflective Paint for Plastic Scintillators

This is a bright white paint consisting of titanium dioxide pigment and a water soluble paint base selected for excellent resistance to yellowing and good adhesion. While primarily intended for coating of blue-emitting plastic scintillators, EJ-510 employs a blend of pigments selected also for enhanced reflectivity for longer wavelength scintillators with green emissions. This is a diffuse reflector for use on scintillators where the length is not greater than twice the width. It should not be used on long, narrow, optical elements. In addition to plastic scintillators, EJ-510 has been successfully applied to acrylic light guides and a variety of metals.

Maximum reflectivity is achieved by the application of three or four thin coats of EJ-510. After it has thoroughly dried, EJ-510 is not water soluble. However, it may be removed from a painted article by gentle rubbing with the aid of a mixture of water and isopropanol. EJ-510 should not be used on hygroscopic materials such as some inorganic scintillators. One liter of EJ-510 can easily cover 10 square meters with three layers of the coating.

EJ-520 Reflective Paint for Liquid Scintillators

This is a bright white paint consisting of titanium dioxide pigment and a paint base selected for its inertness to the solvent action of nearly all liquid scintillators. Unlike other paints based on epoxies, EJ-520 does not develop a yellow cast as it ages. The paint base is a two-part polyurethane selected for these optimal properties. It is intended for coating the inside walls of metal cells designed for holding liquid scintillators, including liquid scintillators based on xylene and toluene which exhibit strong chemical solvent activity. Liquid EJ-520 contains strong solvents which can attack many plastics and hence should not be used on plastic scintillators or on liquid scintillator cells fabricated out of plastic materials such as acrylics. One liter of EJ-520 covers about 1.5 square meters with four coats.



EJ-510

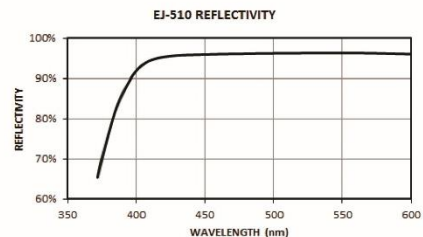


EJ-520

PACKAGE SIZES

EJ-510	EJ-520
500 ml	500 g
1000 ml	1000 g

COMPOSITION	EJ-510
Typical 3-Layer Coating Thickness (mm)	0.11
Typical Density of Dried Coat (mg/cm ²)	13
Ti Atoms per cm ² (×10 ¹⁹)	6.71
C Atoms per cm ² (×10 ²⁰)	1.12
H Atoms per cm ² (×10 ²⁰)	2.25
O Atoms per cm ² (×10 ²⁰)	1.90



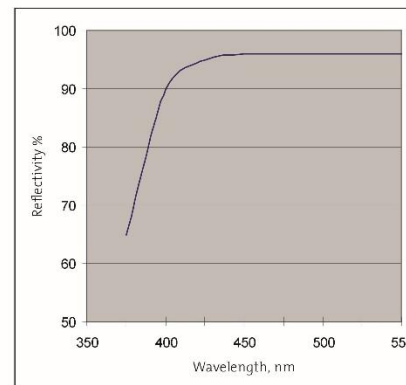
BC-620

Reflector Paint for Plastic Scintillators

BC-620 is a highly efficient reflector employing a special grade of titanium dioxide in a water soluble binder. It is applied directly onto plastic scintillators, acrylic light guides, glass and metals. It is not intended for direct contact with liquid scintillators (use BC-622A for that application). It is a diffuse reflector, and, therefore, should not be applied to sheets of scintillator or light guide material where the length is much longer than the thickness.

BC-620 provides an excellent combination of high reflectivity, excellent resistance to yellowing with age, good adhesion, and ease of application. It is recommended for all scintillators having emission spectra above 400nm.

Reflectivity –



Application

BC-620 should be stirred or shaken well before using. It may be applied by brushing or spraying, and may be diluted with water as required. Equipment may be cleaned with cold or warm water and detergent. When the reflector is dried, it is not affected by moisture.

Two to three coats are recommended. Allow each coat to dry at room temperature before applying another layer. 300ml covers approximately a square meter with one sprayed coat



Revision Date: 01/27/2016

ELJEN TECHNOLOGY

08.09.2016 - Cesidio.Capoccia@LNF.INFN.IT

SAINT-GOBAIN

PAINTING....

Subject: Painting

From: Venelin KOZHUHAROV <Venelin.Kozhuharov@cern.ch>

Date: 25/07/2016 22:52

To: "cesidio.capoccia@lnf.infn.it" <cesidio.capoccia@lnf.infn.it>

Ciao Cesidio,

This is what I found as notes for the scintillator painting... I thought the paint should be diluted more, but it seems that 1:1.5 or 1:1 was enough ... I would start for sure with at least 1:1.5, (may be even more..?)

Painting procedure experience gained and the technology fixed:

Compressor pressure: ~4-5 bar static, 2.5-3 bar "dynamic"

Pistol opening to be experimentally determined

Spraying distance: 15-20 cm

Dilution of the paint - 1:1 with water, not critical

Number of passes

- 1 st : rough, could be with 1:1.5 diluted paint, 2-3 hours of drying
- 2 nd : major pass, requires ~4hours of drying
- 3 rd : correction pass - concentrate on the non-uniformities of the second one

The work has to be done with mask due to the amount of pulverized TiO₂ in the air

I also found a slide with "memories" of the painting 😊

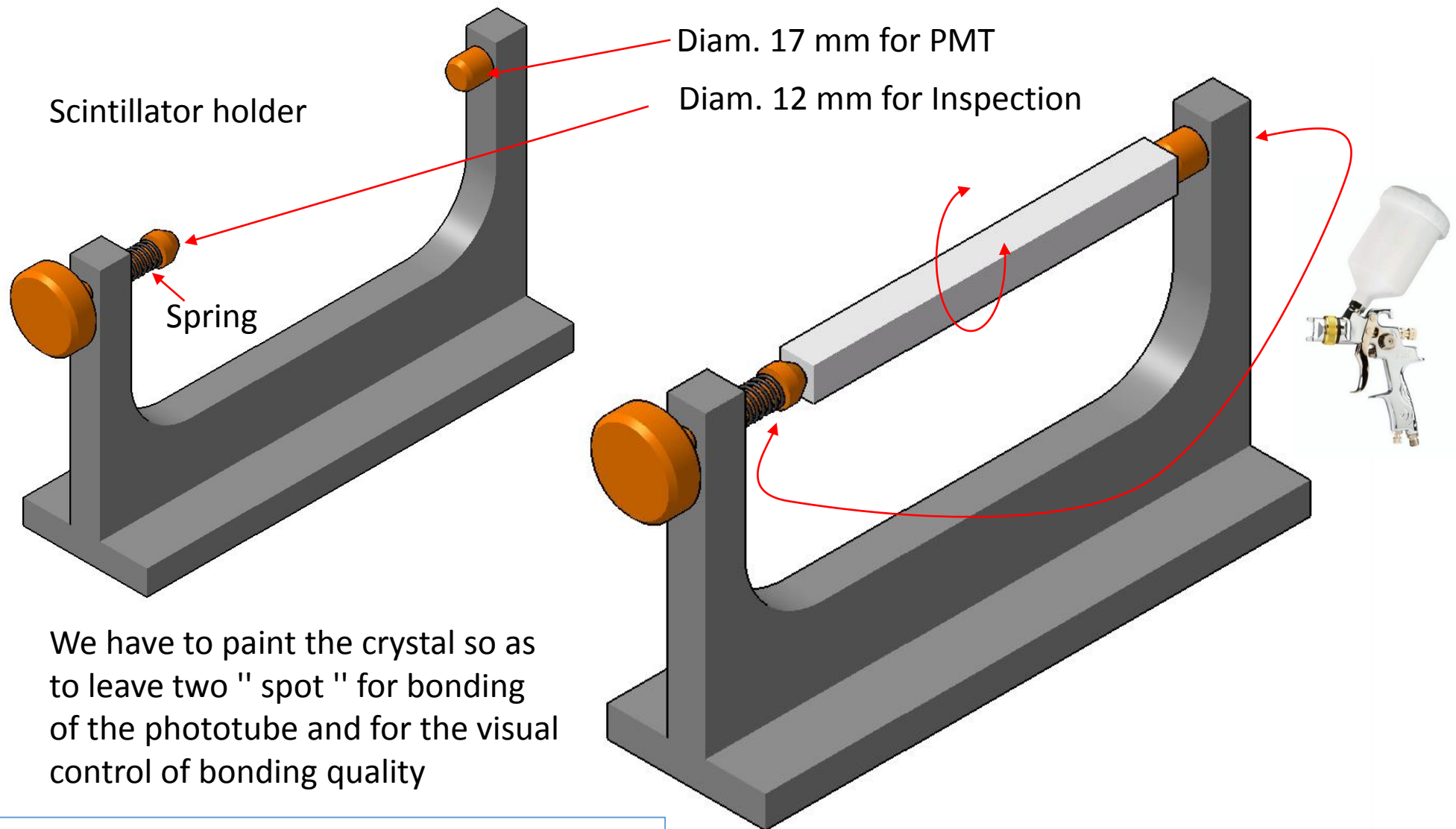
Best greetings

Venelin

08.09.2016 - Cesidio.Capoccia@LNF.INFN.IT



PAINTING BEFORE JOINT



PAINTING AFTER JOINT

Advantages:

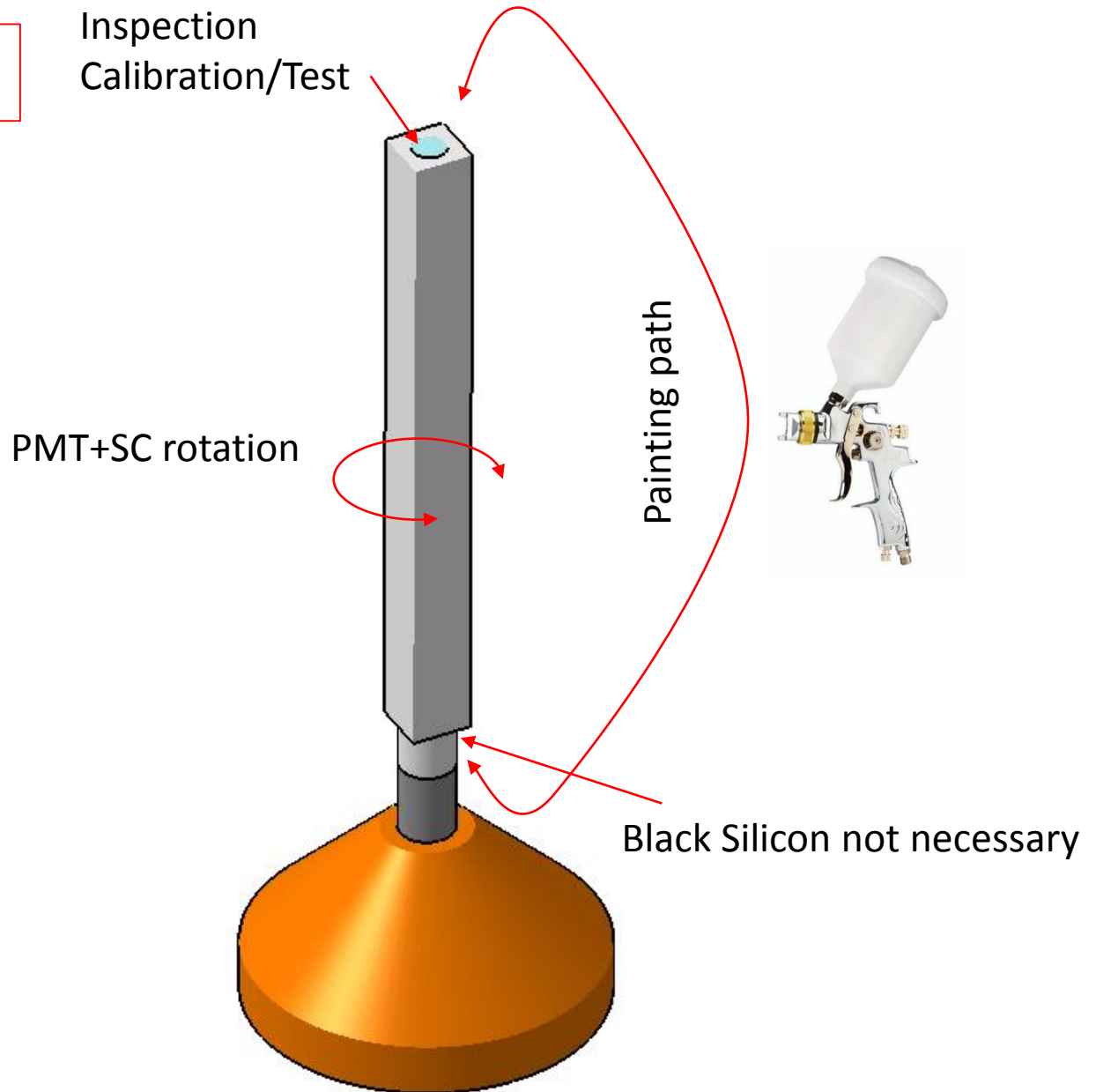
The operation is more simple by having the phototube as "handle"
The painting becomes the final operation, and then has a clean finished product.

During gluing you have maximum visibility of the operation and behavior of the glue.

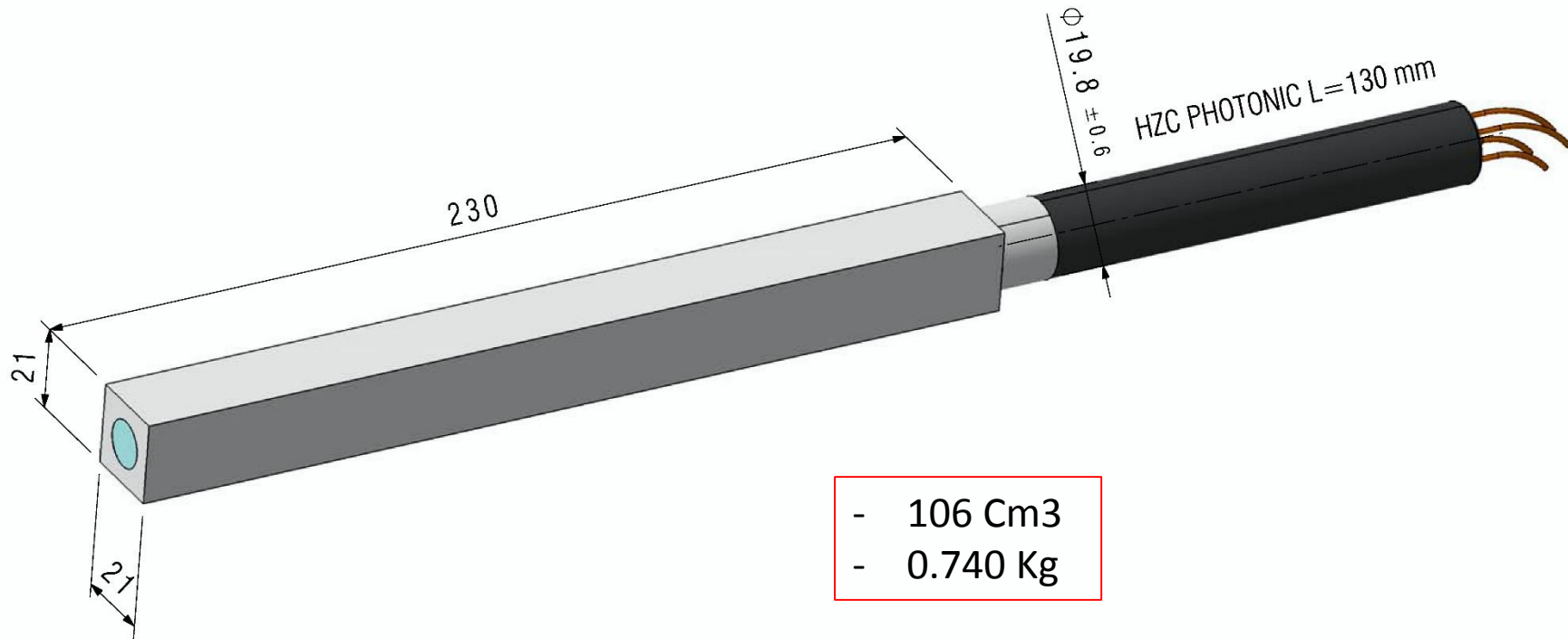
During bonding you can proceed to make all the necessary cleaning with acetone and alcohol without the risk of ruining the paint.

Disadvantages:

The operation probably will not be "associated" to the machining of the crystals



PADME E-CAL SCINTILLATOR



- 106 Cm³
- 0.740 Kg

CALORIMETER ASSEMBLING...

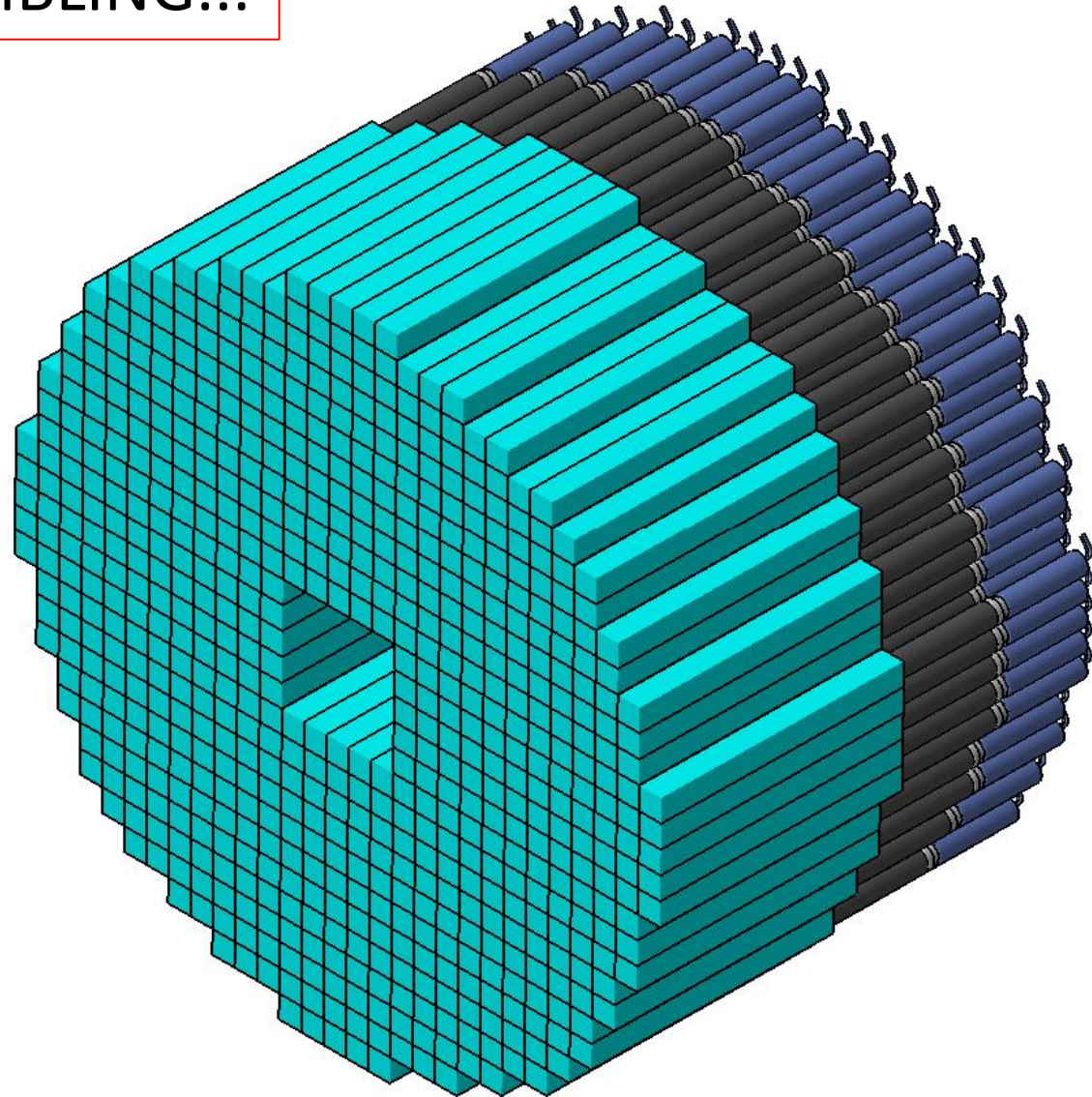
The ideal is to have all scintillators with the same dimensions.

In this conditions we could assemble them simply ordering them horizontally side by side and vertically on top of each other ...

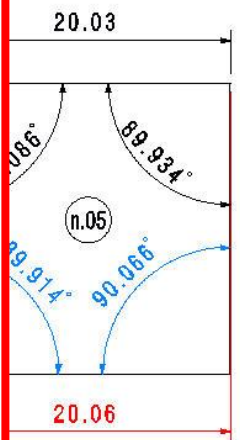
... but they don't have the same dimensions.

We have to consider:

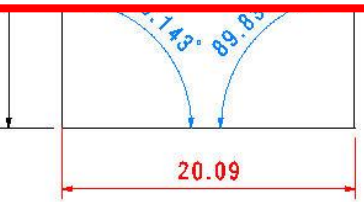
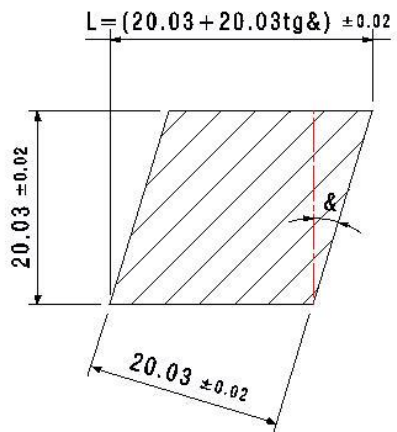
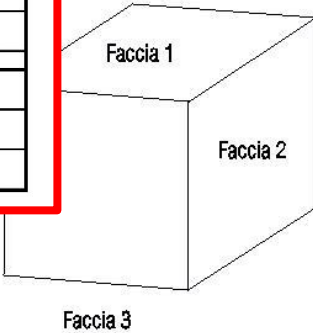
- dimension tolerances
- Geometrical toll.
- Shape deformation from painting and thermal gradient



N.	MISURA	MEDIA-MISURA	RMS
01	20,024	0,005	0,005
01	20,019	0,010	0,010
02	20,044	-0,015	0,015
02	20,019	0,010	0,010
03	20,049	-0,020	0,020
03	20,020	0,009	0,009
04	20,035	-0,006	0,006
04	20,021	0,008	0,008
05	20,030	-0,001	0,001
05	20,024	0,005	0,005
06	20,044	-0,015	0,015
06	20,027	0,002	0,002
07	20,030	-0,001	0,001
07	20,021	0,008	0,008
08	20,034	-0,005	0,005
08	20,028	0,001	0,001
MEDIA		20,029	0,008
MIN		20,019	0,001
MAX		20,049	0,020



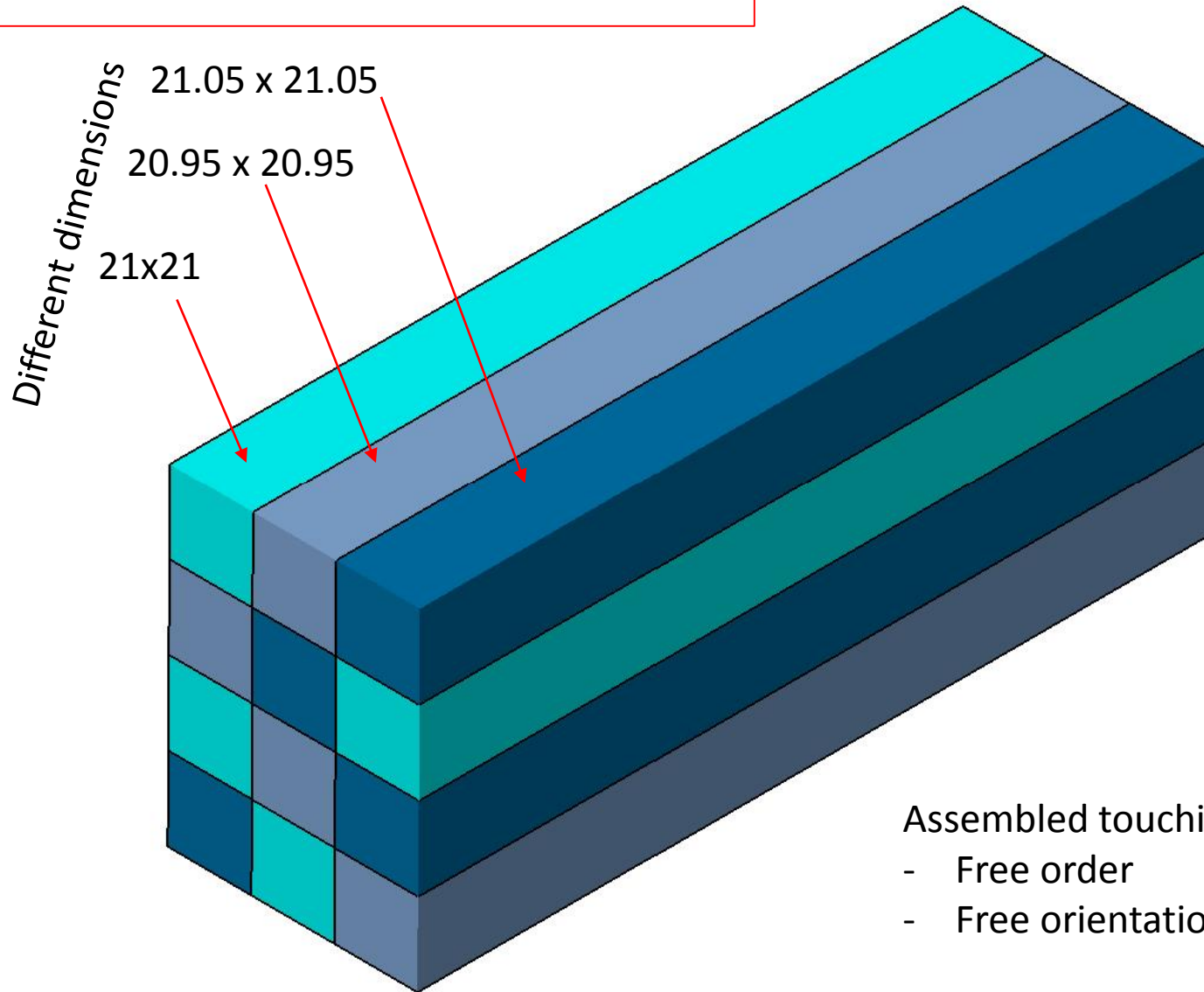
Cristallo N.	04	05	08
Angolo 1-2 (Rif)	89,872	89,934	90,165
Angolo 1-4 (Rif)	90,125	90,086	89,857
Angolo 3-2	90,136	90,029	89,862
Angolo 3-4	89,889	89,975	90,150
Angolo Tot	360,021	360,023	360,034
Diff. Da 360°	-0,021	-0,023	-0,034
Diff. Div. 4	-0,005	-0,006	-0,009
ERR. su Lato 20,03 mm			
Per Angolo 1-2	19,985	20,007	20,088
Per Angolo 1-4	20,074	20,060	19,980
Per Angolo 3-2	20,077	20,040	19,982
Per Angolo 3-4	19,991	20,021	20,083



08.09.2016 - Cesidio.Capoccia@LNF.INFN.IT


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 Cesidio CAPOCCIA
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 Fax +39.06.94032618
 Cesidio.CAPOCCIA@LNF.INFN.IT

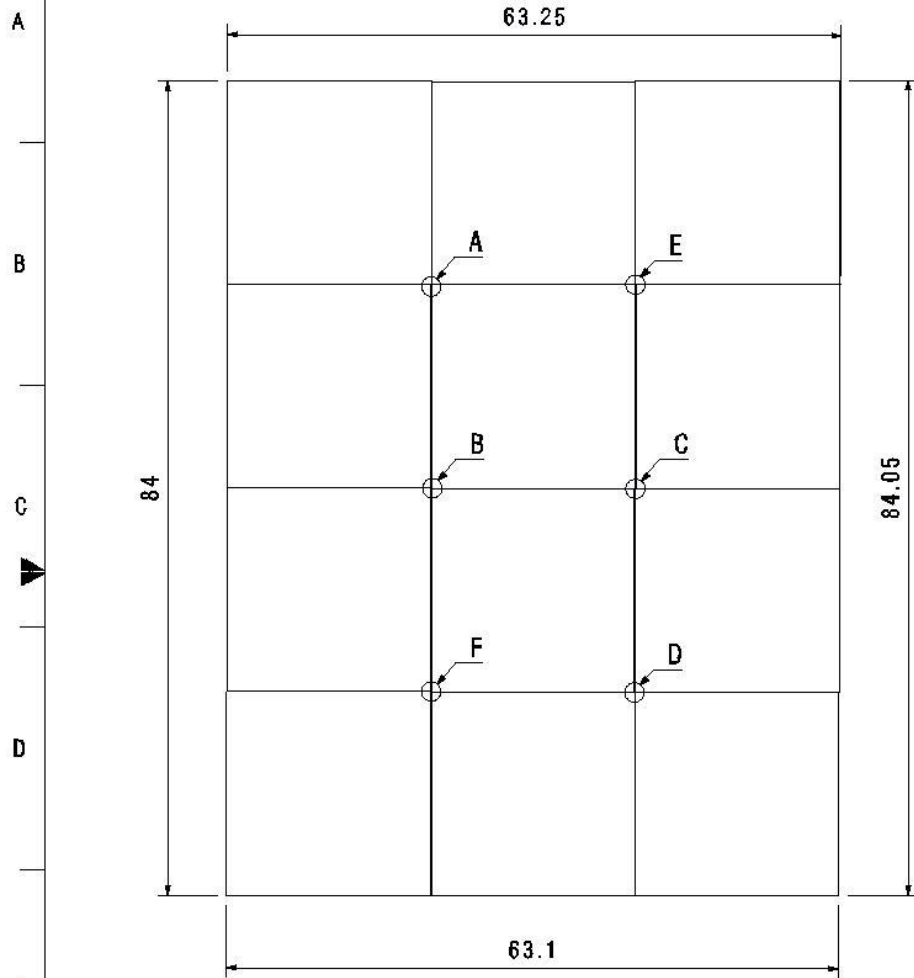
GROUP OF 4x3 SCINTILLATORS



Assembled touching each-other:

- Free order
- Free orientation

2d-GEOMETRY



Detail A
Scale: 20:1

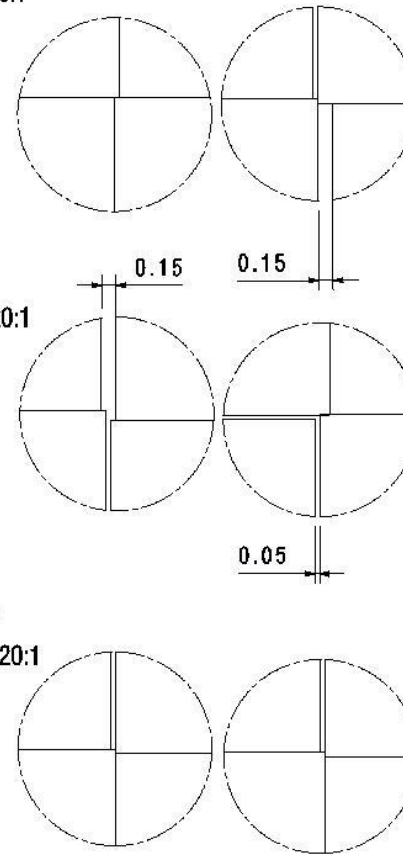
Detail E
Scale: 20:1

Detail B
Scale: 20:1

Detail C
Scale: 20:1

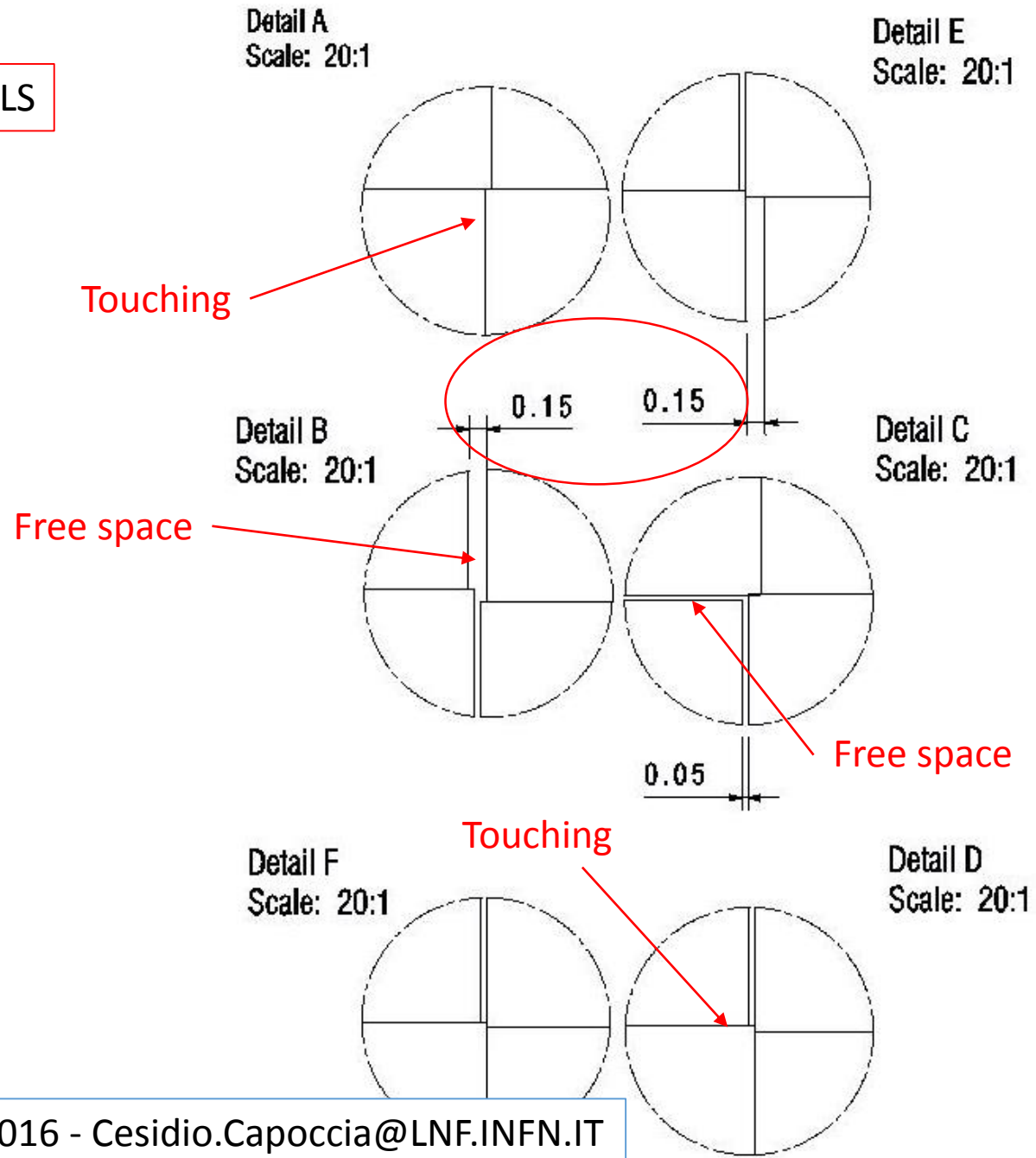
Detail F
Scale: 20:1

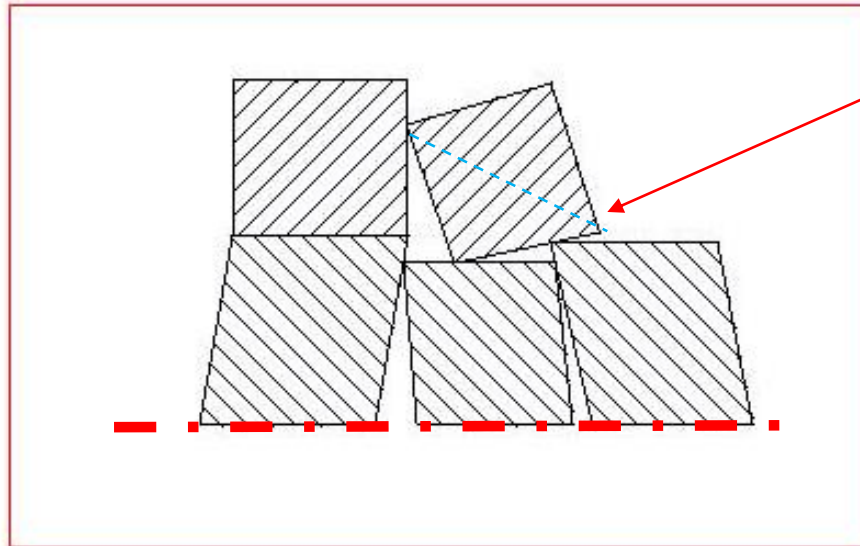
Detail D
Scale: 20:1



RESULTS IN THE CORNERS..

DETAILS



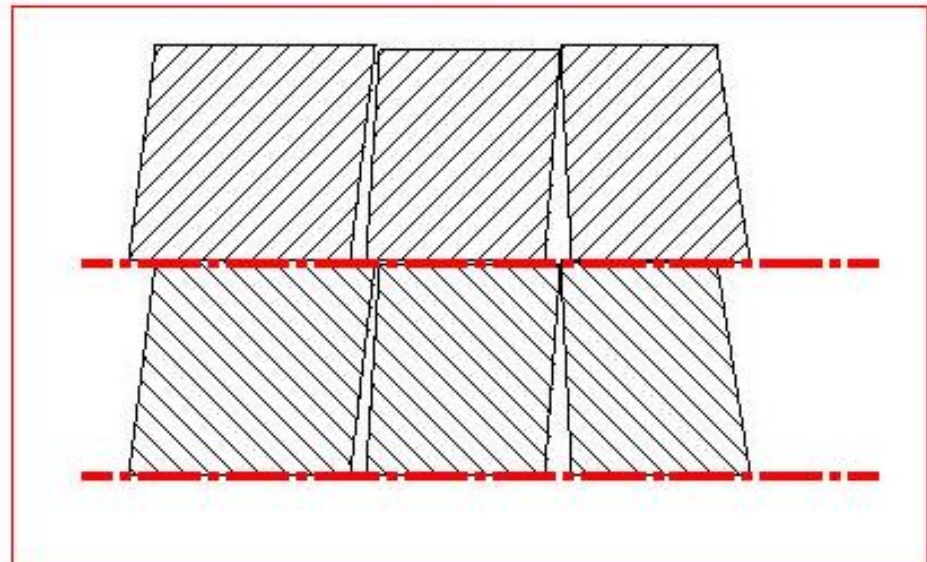


Error is amplified by the absence of the horizontal plane

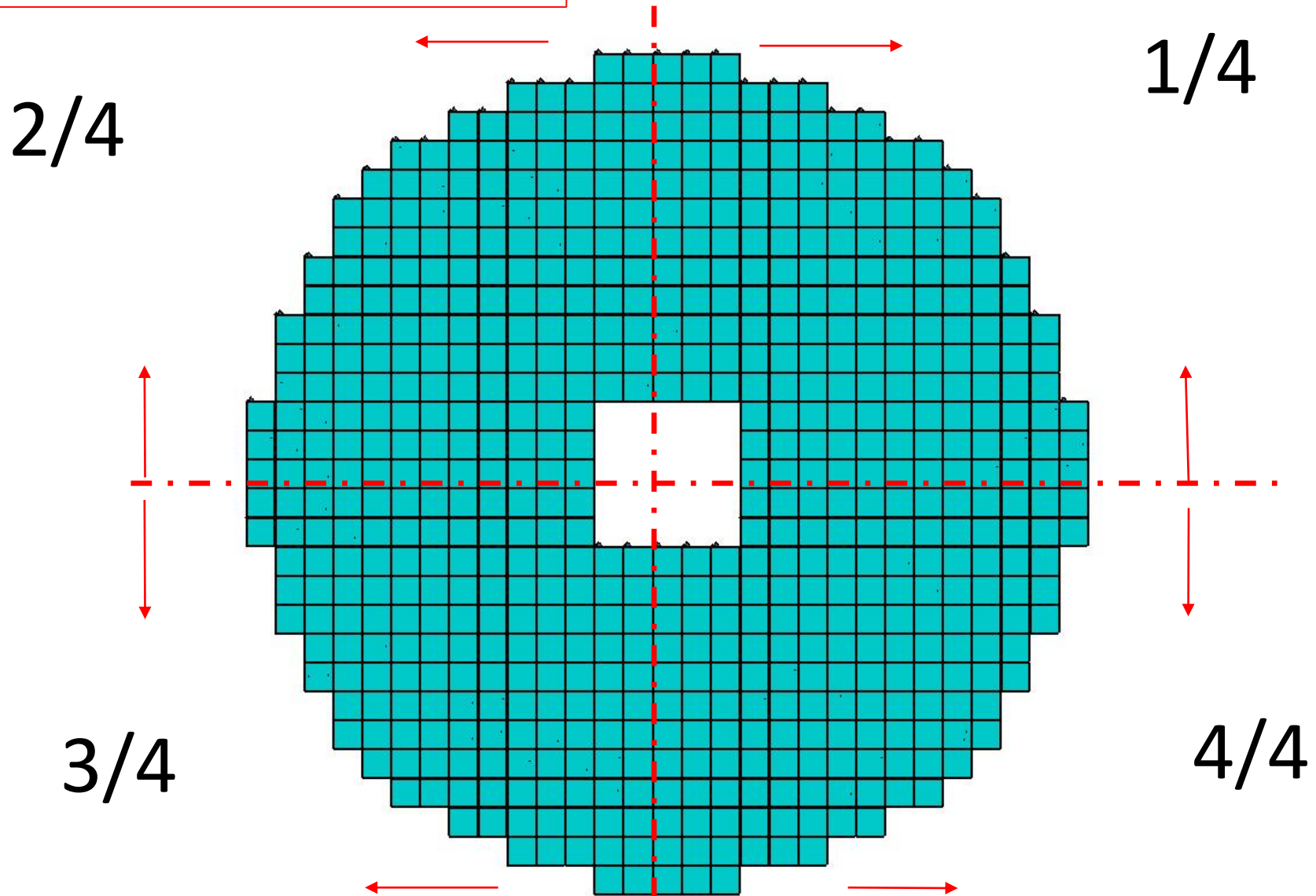
The dimensions of the diagonals create a leverage effect ...

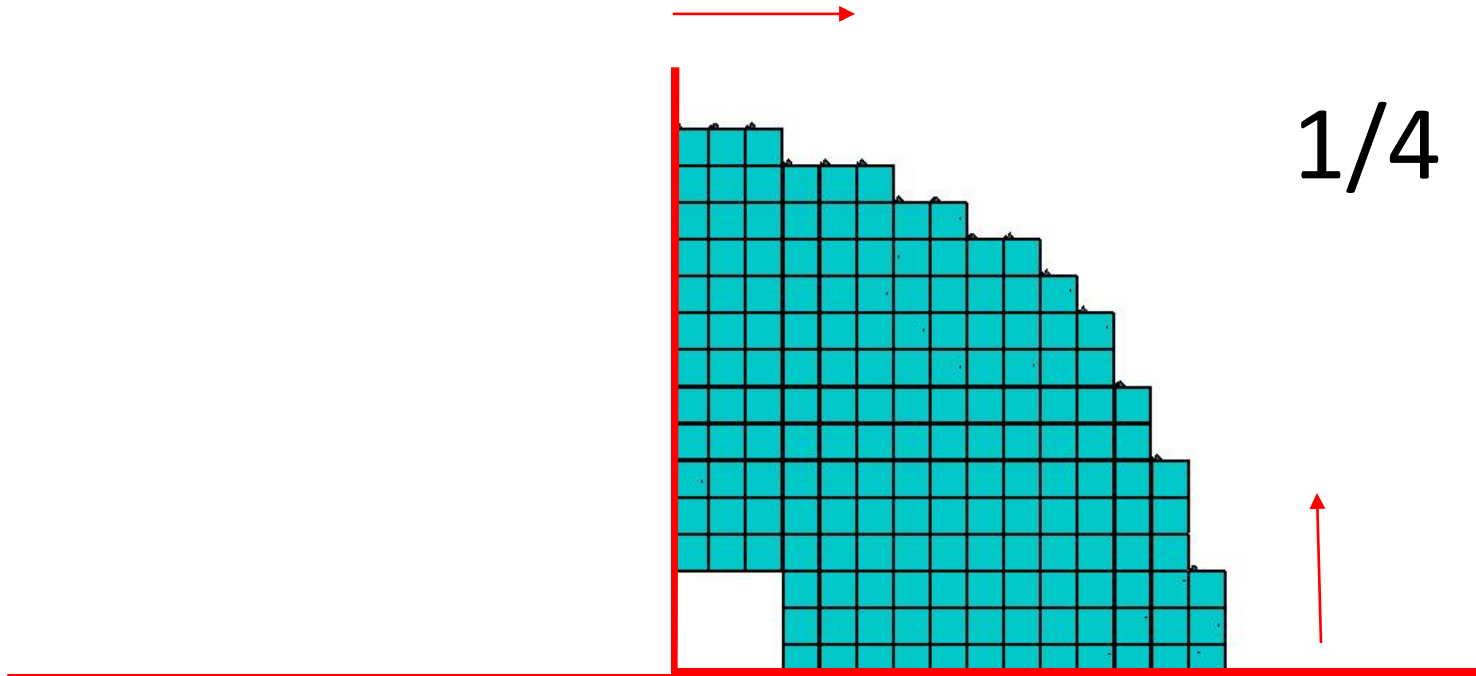
Considering to have horizontal plane for each layers...

Note: We have also the third dimension to consider in the geometric shape of the detector. So we will have a shape like banana, conical etc.



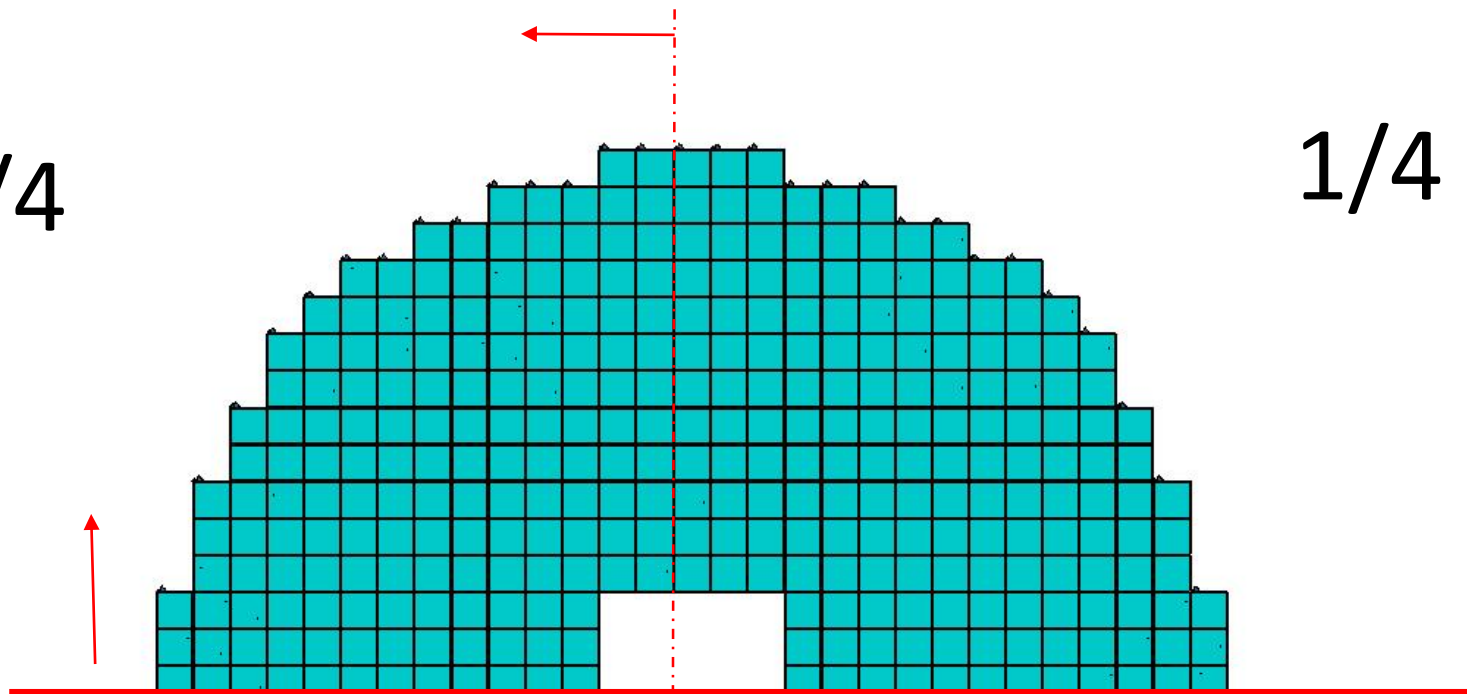
ASSEMBLING FACE TO FACE

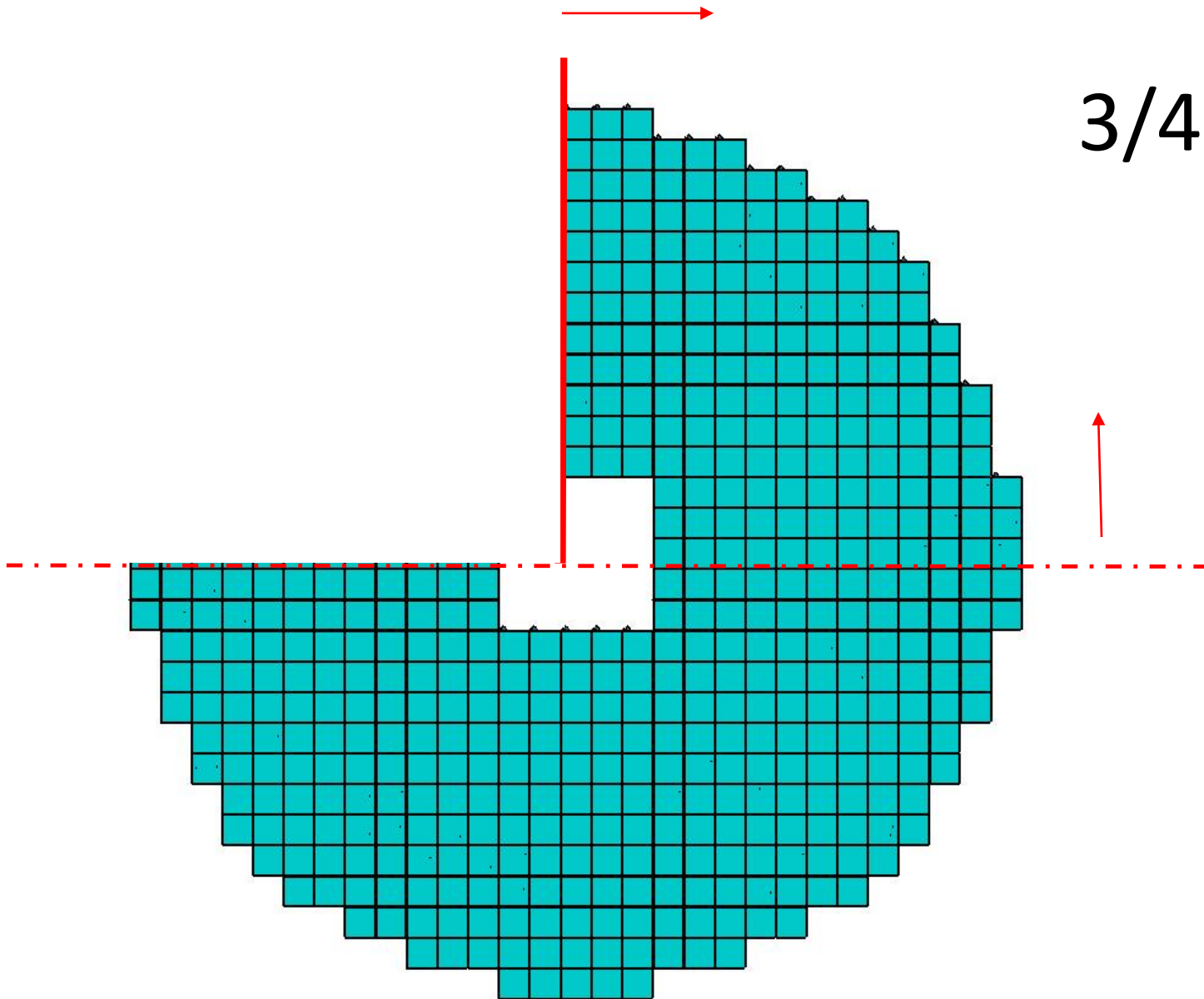




2/4

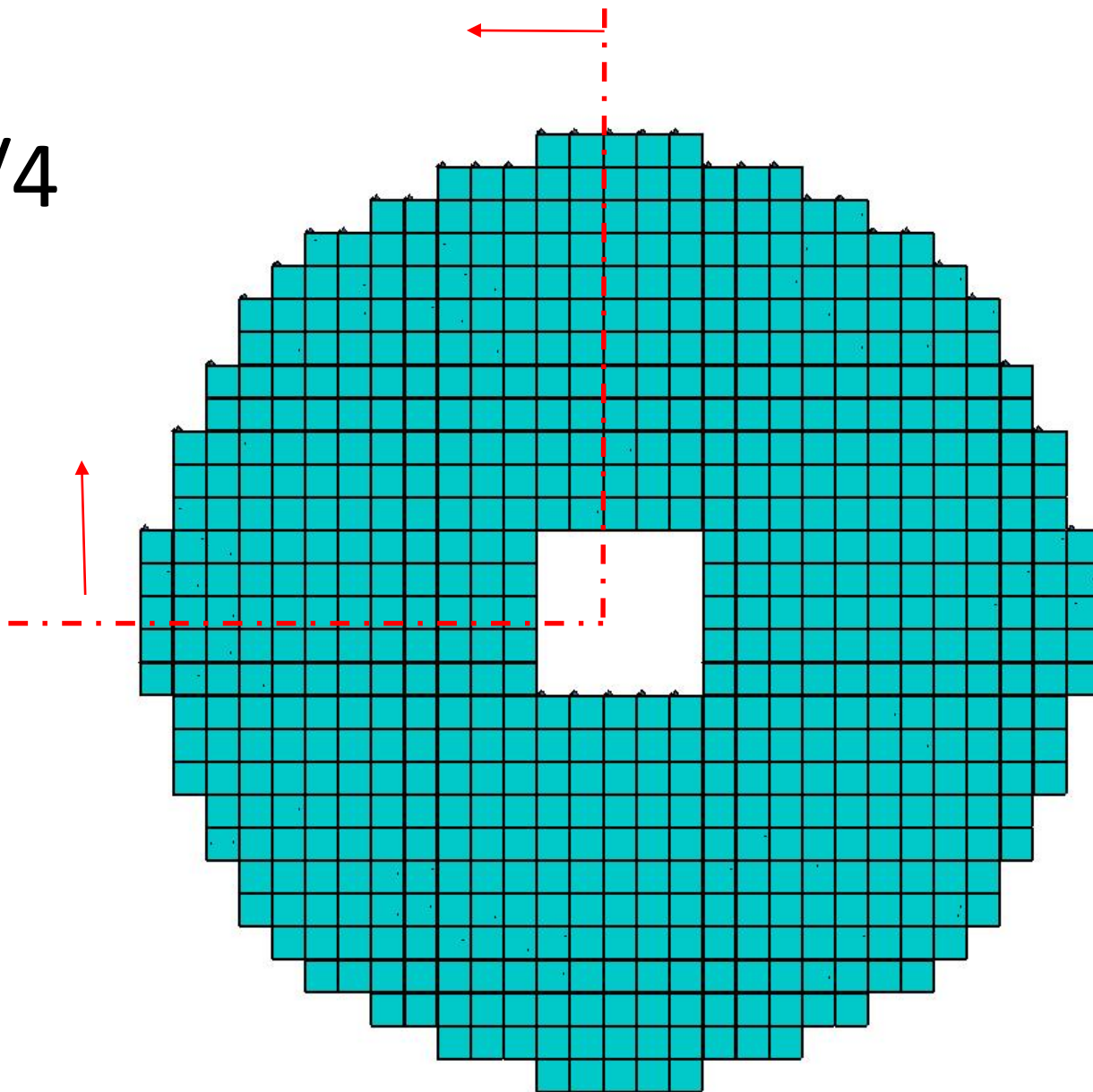
1/4





4/4

3/4

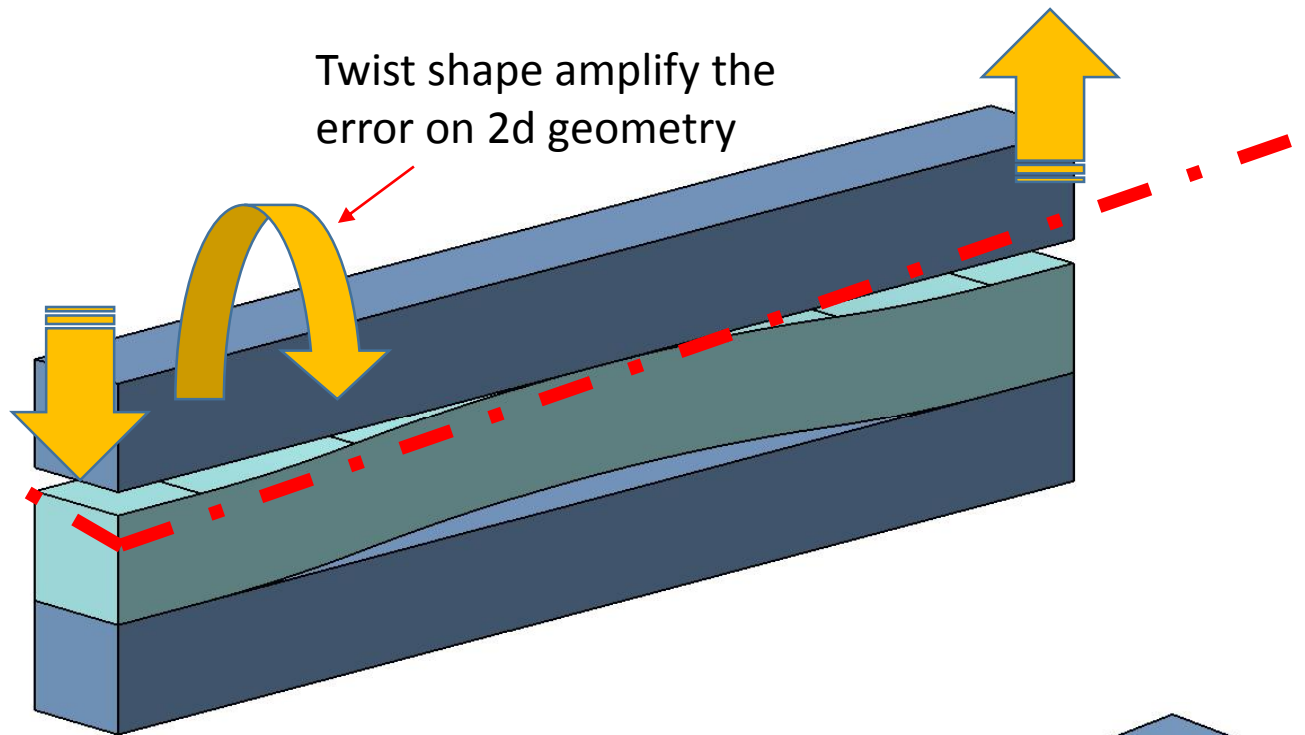


3d-GEOMETRY

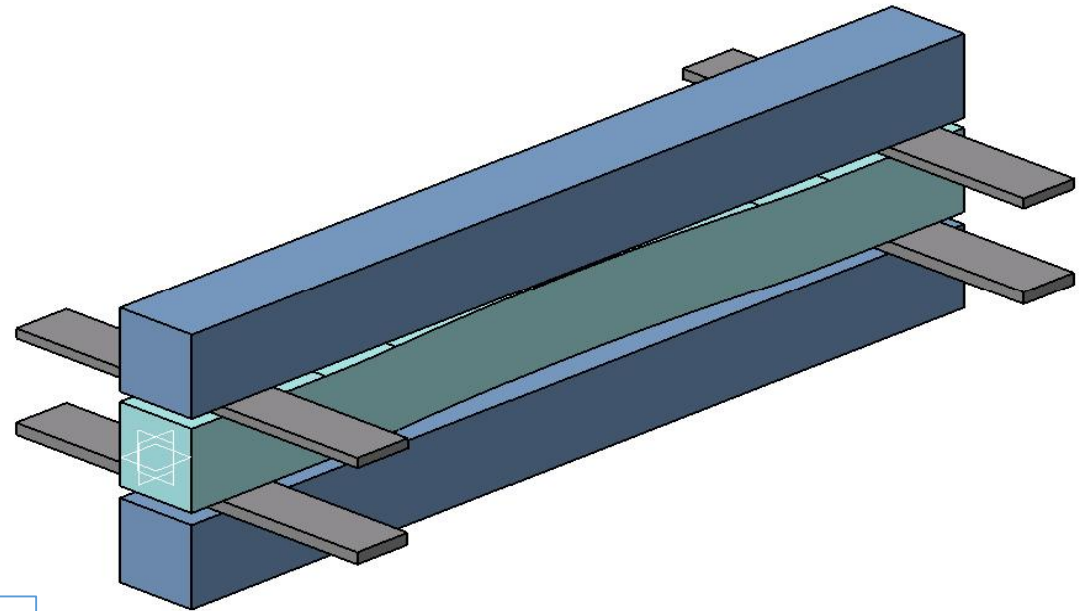
BANANA SHAPE

TWIST SHAPE

With scintillators in contact in the center of them (or along), we have conical effect amplified...

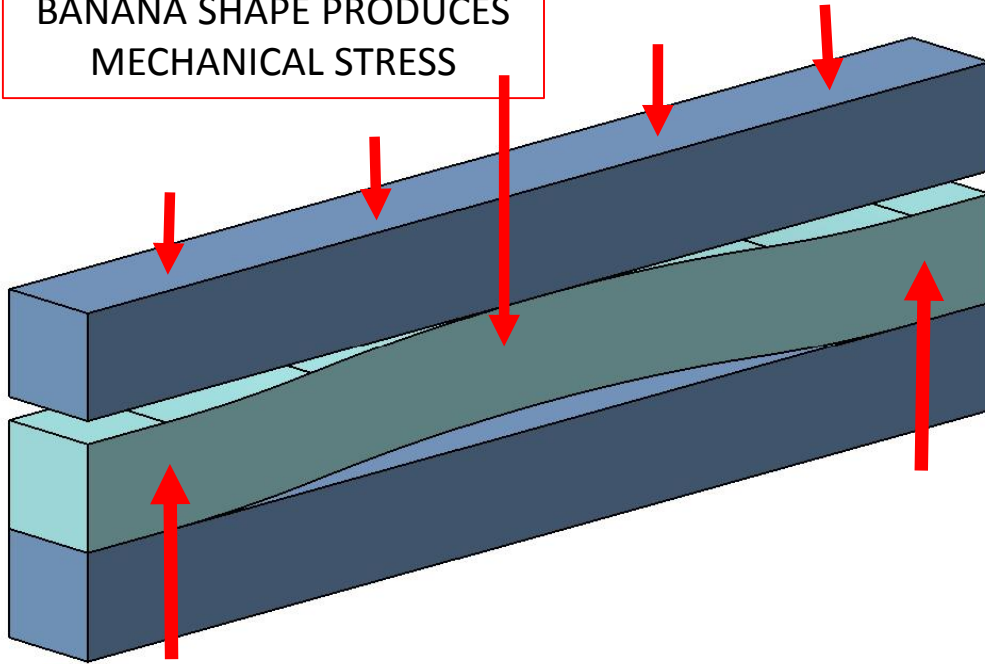


... Putting spacers at the ends, we eliminate the amplification.



3d-GEOMETRY

BANANA SHAPE PRODUCES
MECHANICAL STRESS

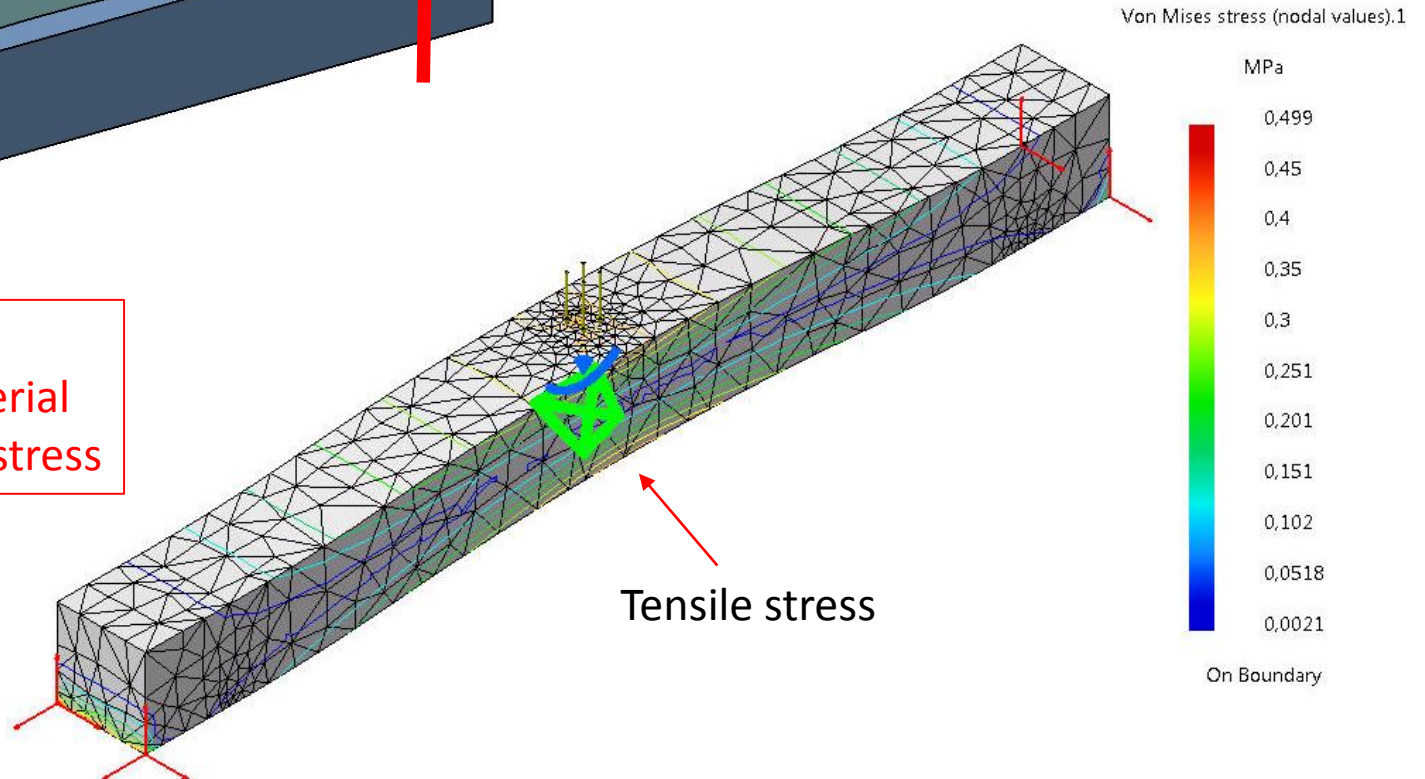


The banana shape of Scintillators is real dangerous for the mechanical stress that develop inside the calorimeter.

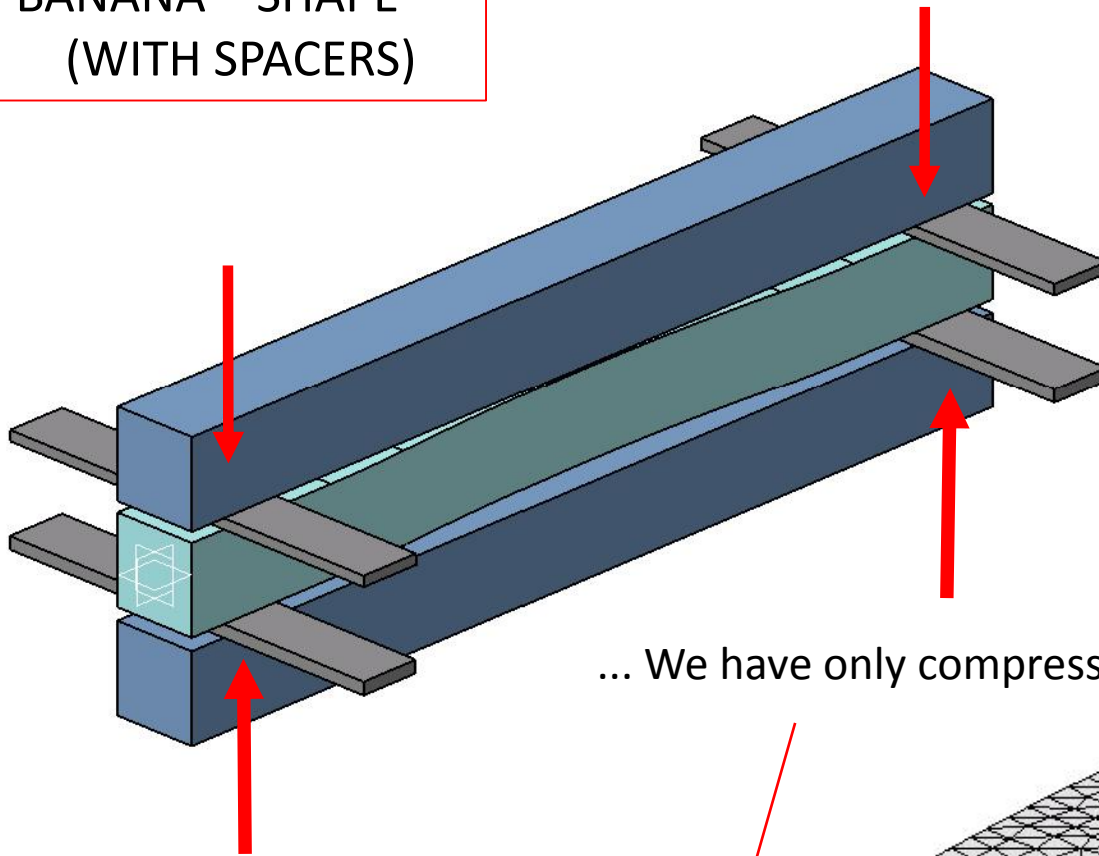
Banana shape could be from:

- Machining
- Painting
- Thermal deformation (gradient)

WARNING
BGO is a fragile material
Better to avoid tensile-stress



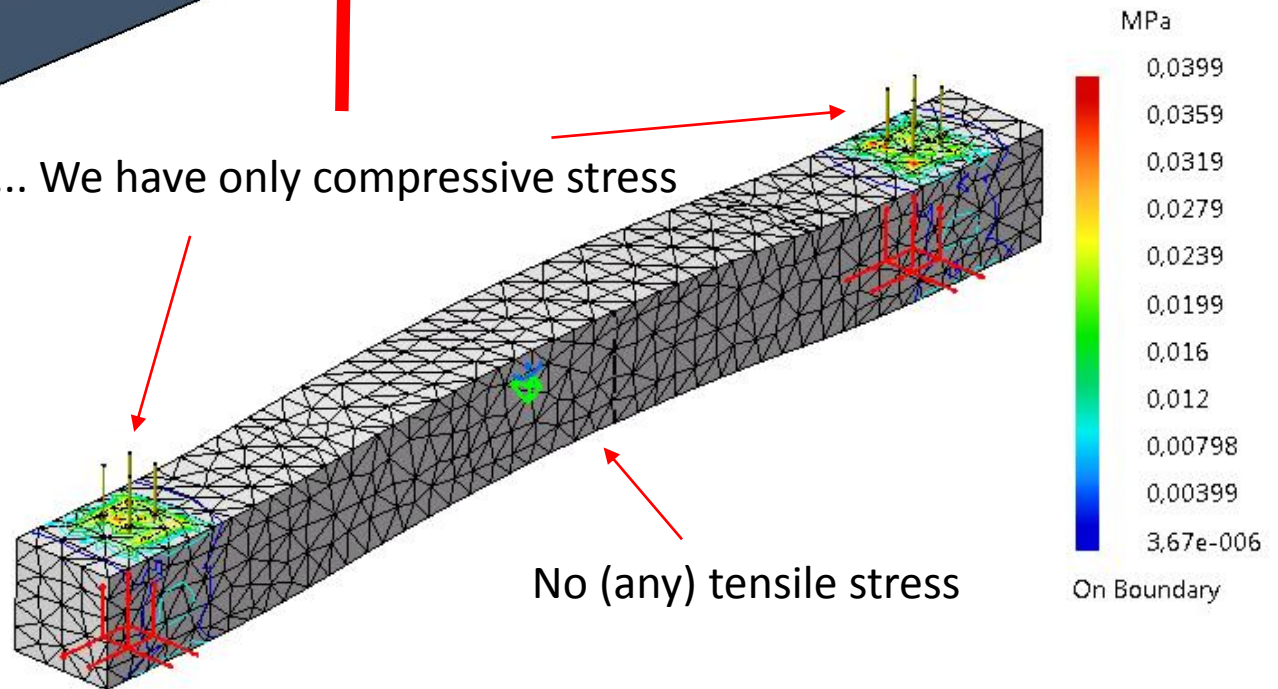
**BANANA – SHAPE
(WITH SPACERS)**

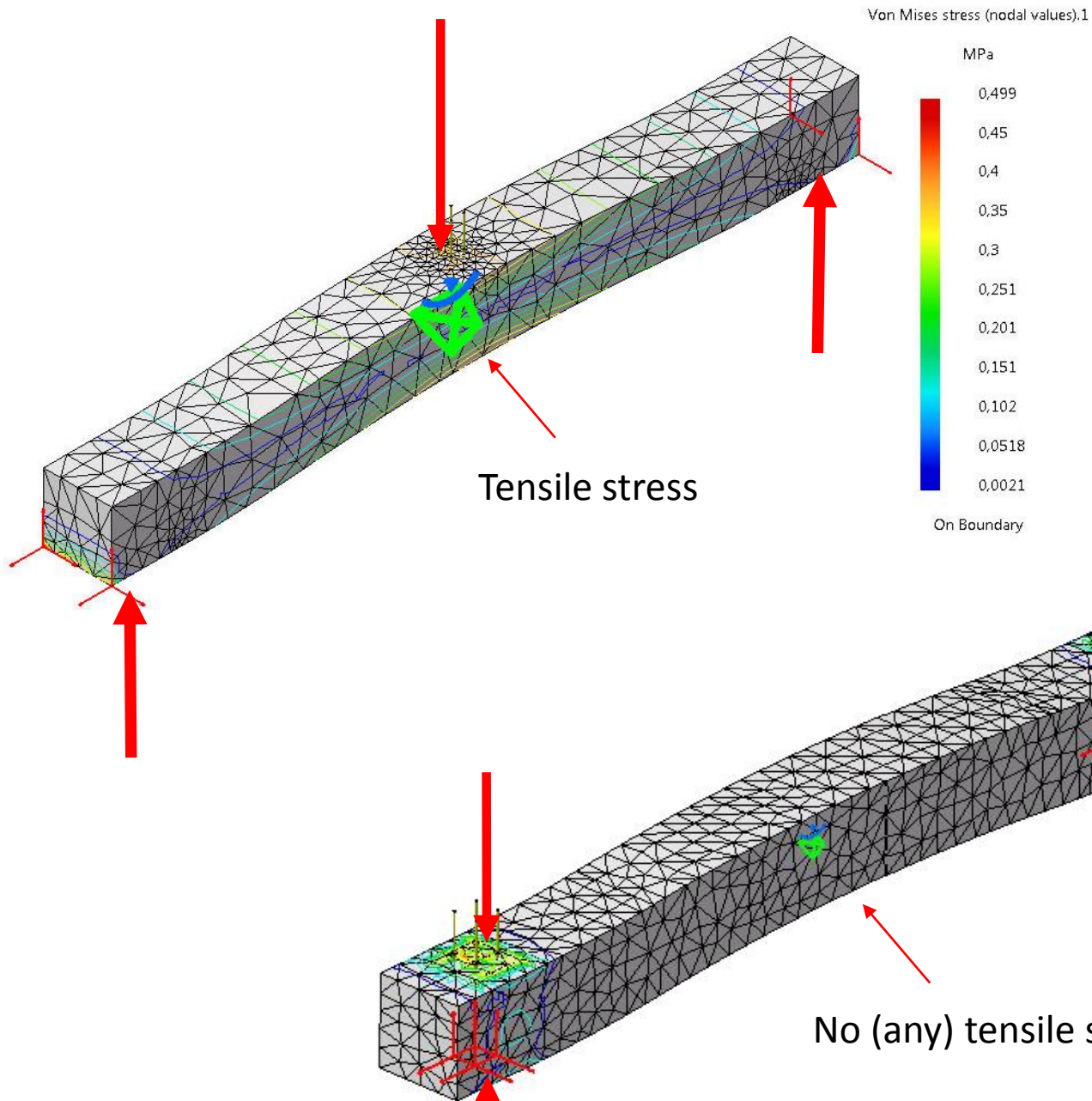


Consider to put some spacers in order to define exactly the contact area between scintillators...

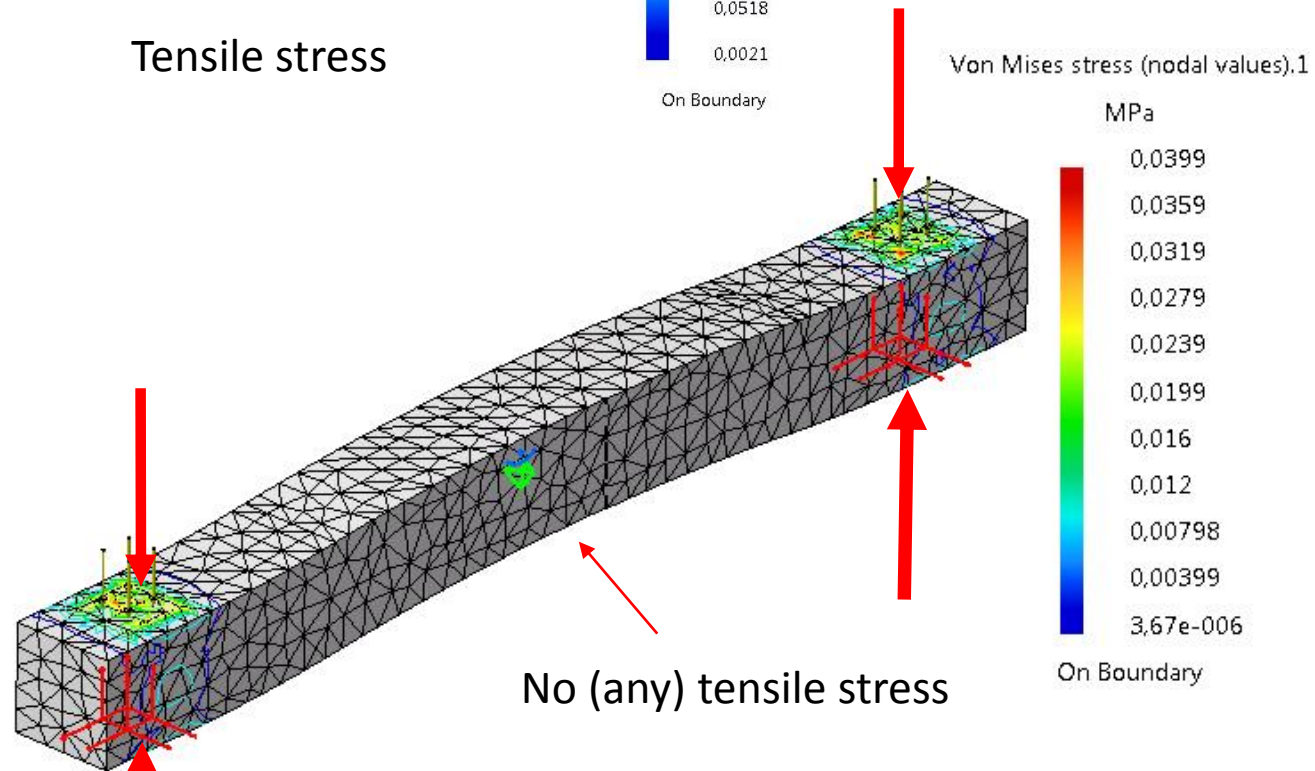
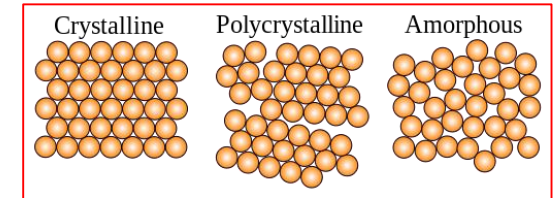
WARNING
BGO is a fragile material
Better to avoid tensile-stress

... We have only compressive stress

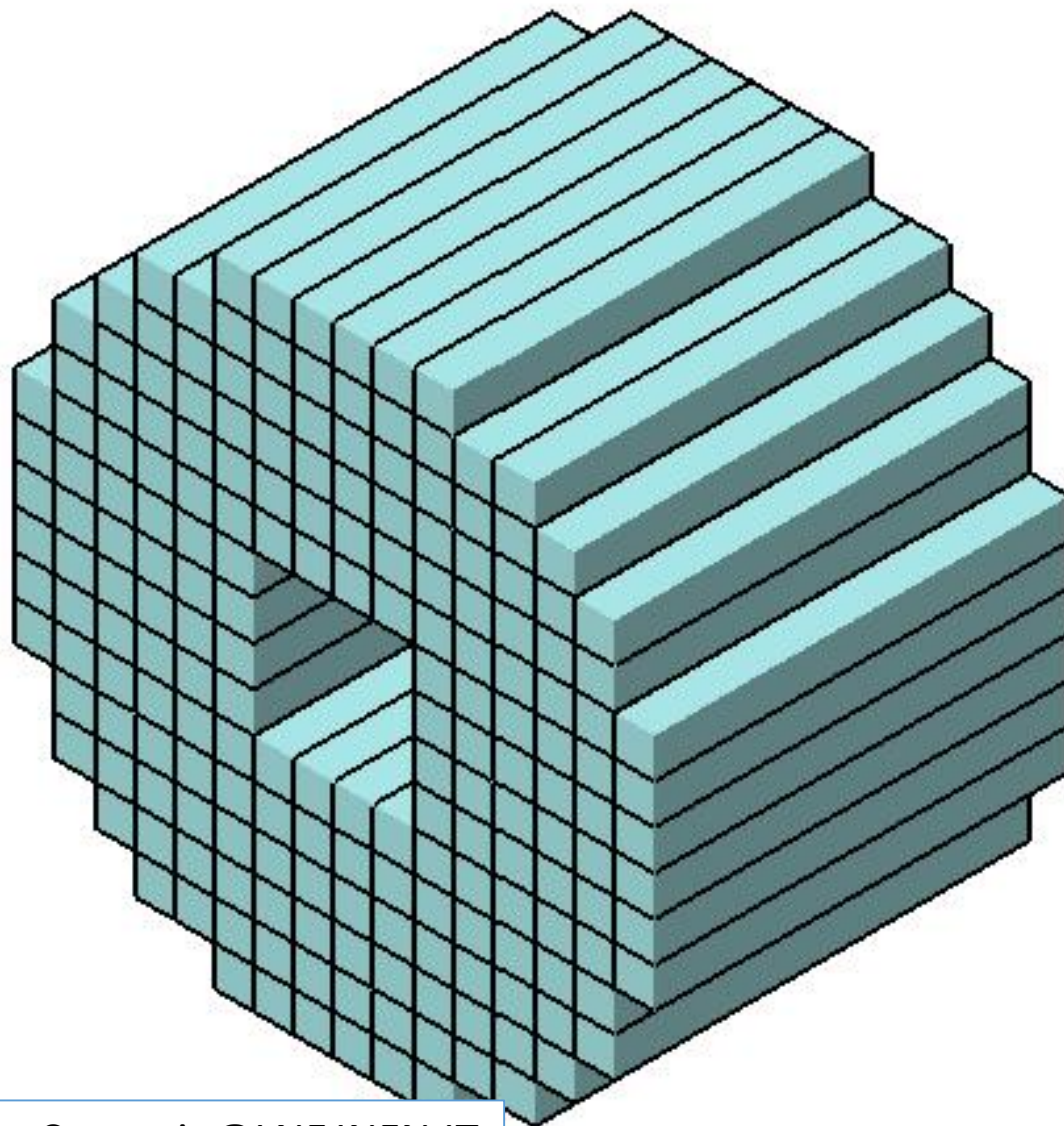


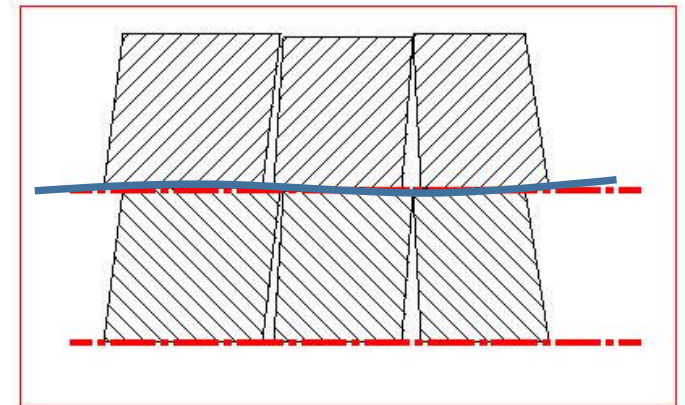
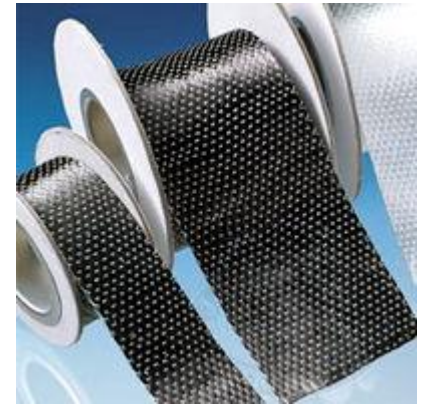
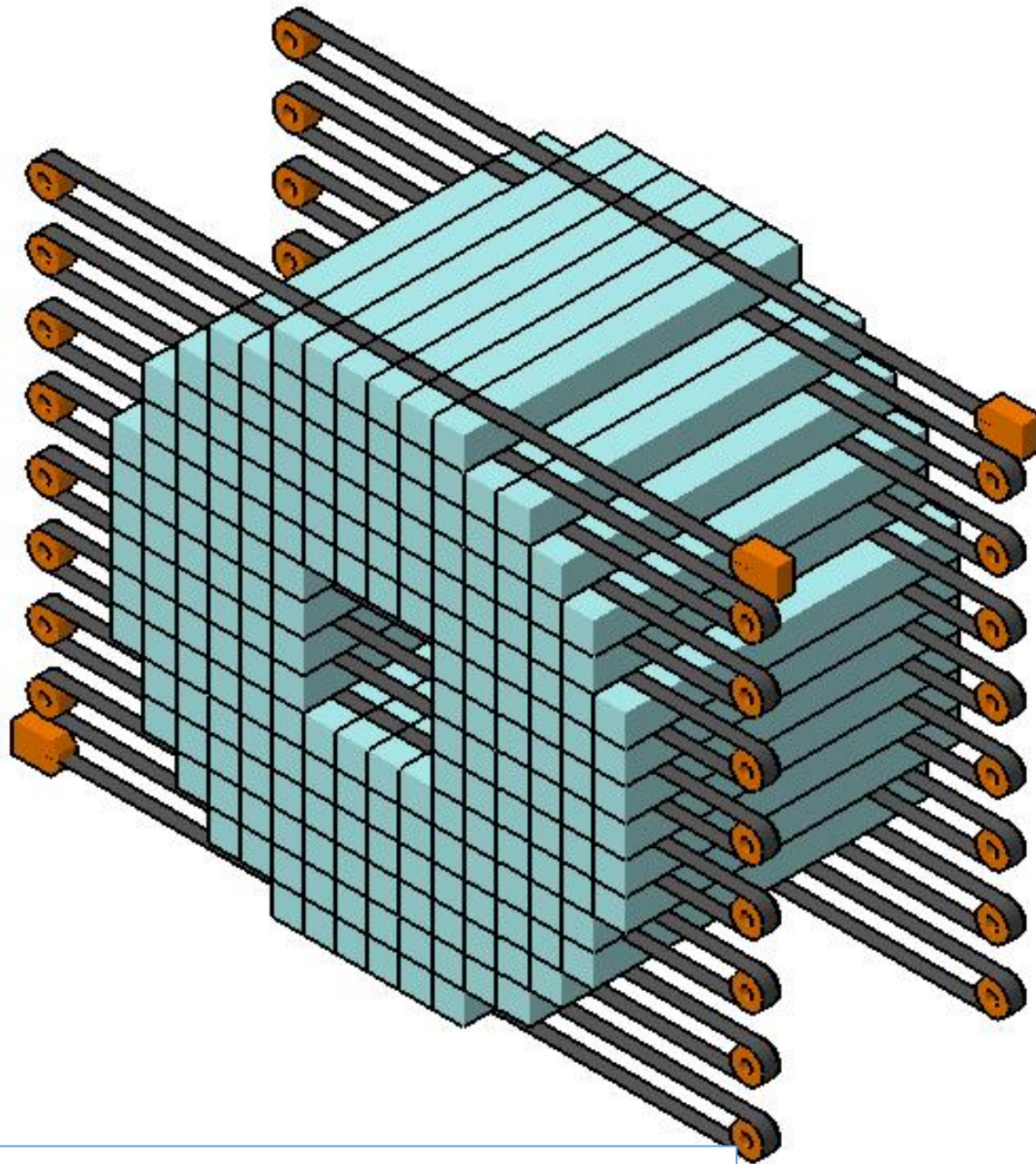


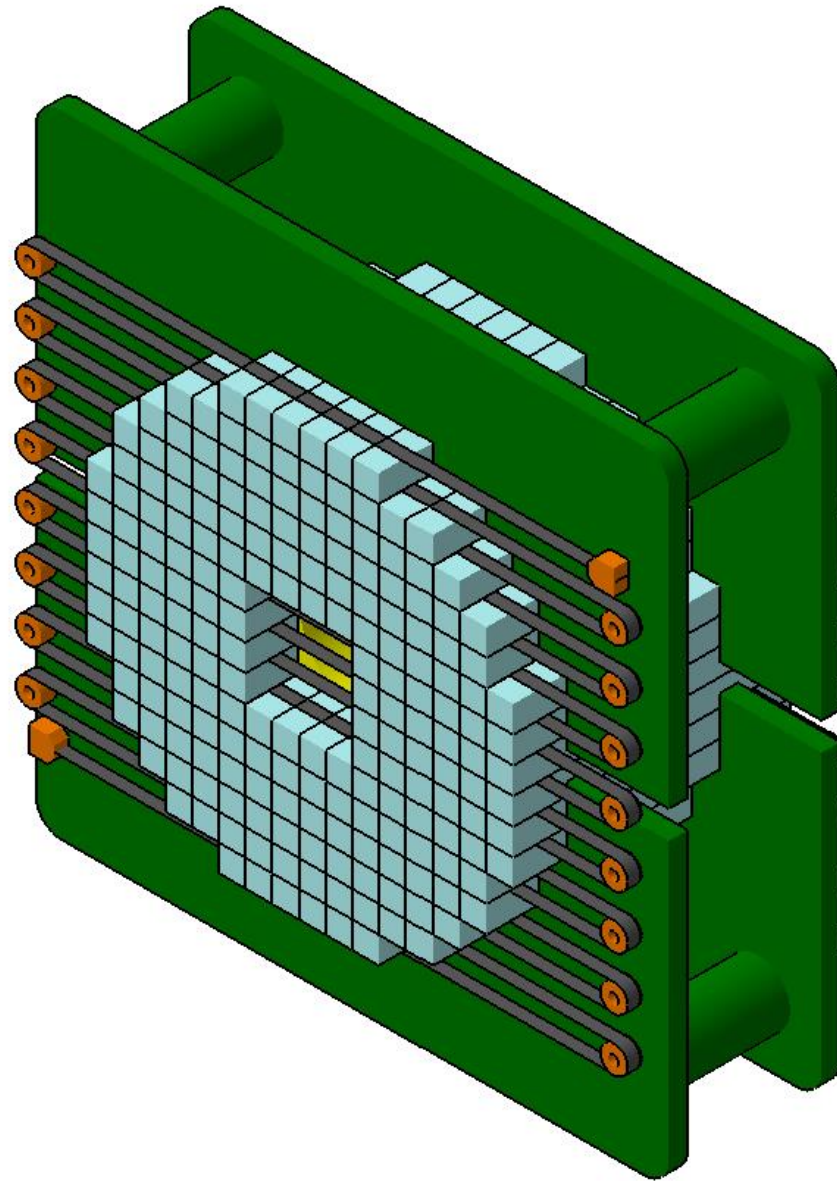
The BGO has an Amorphous structure.
Tensile strength is (about) ten times
lower than the compressive strength

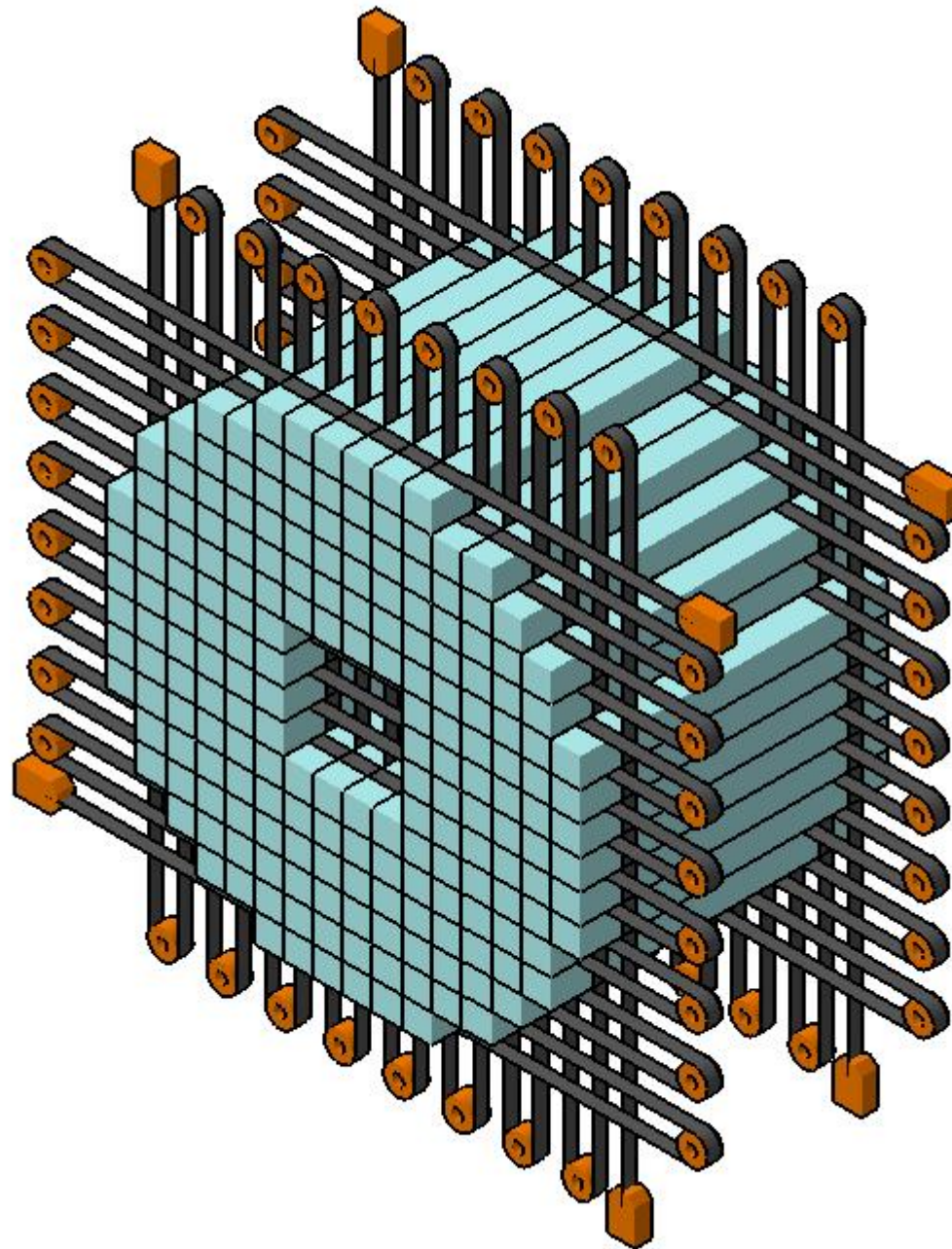


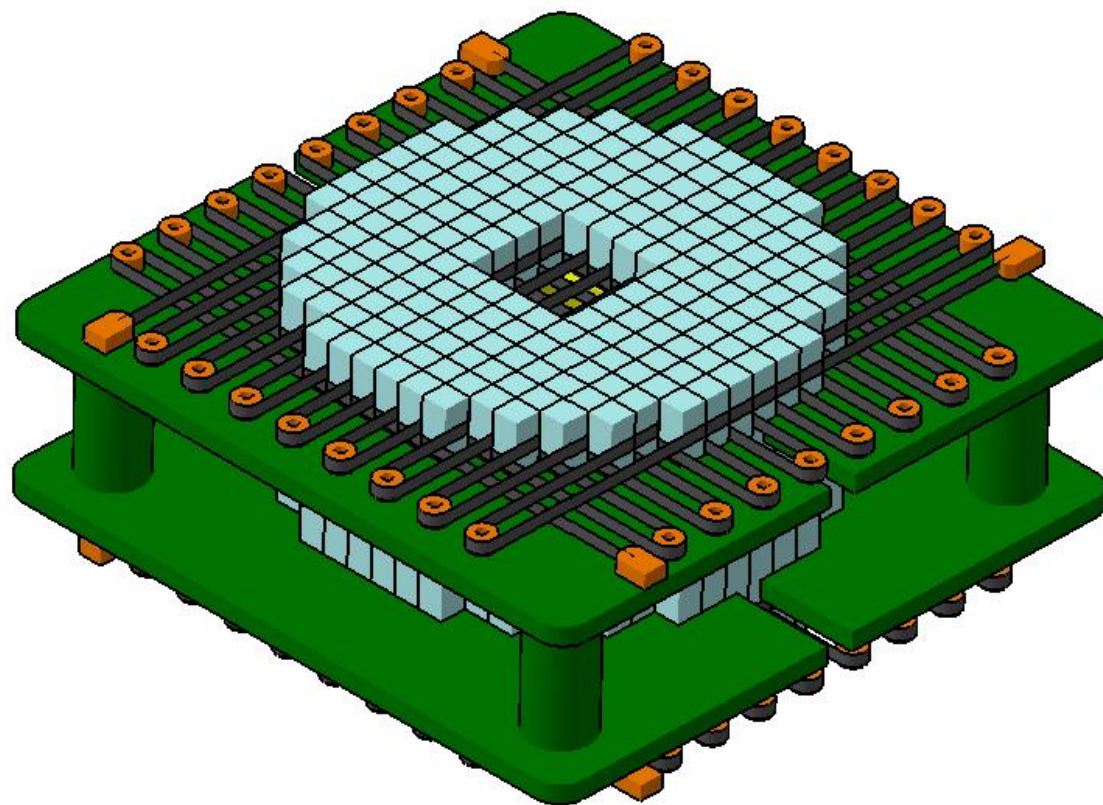
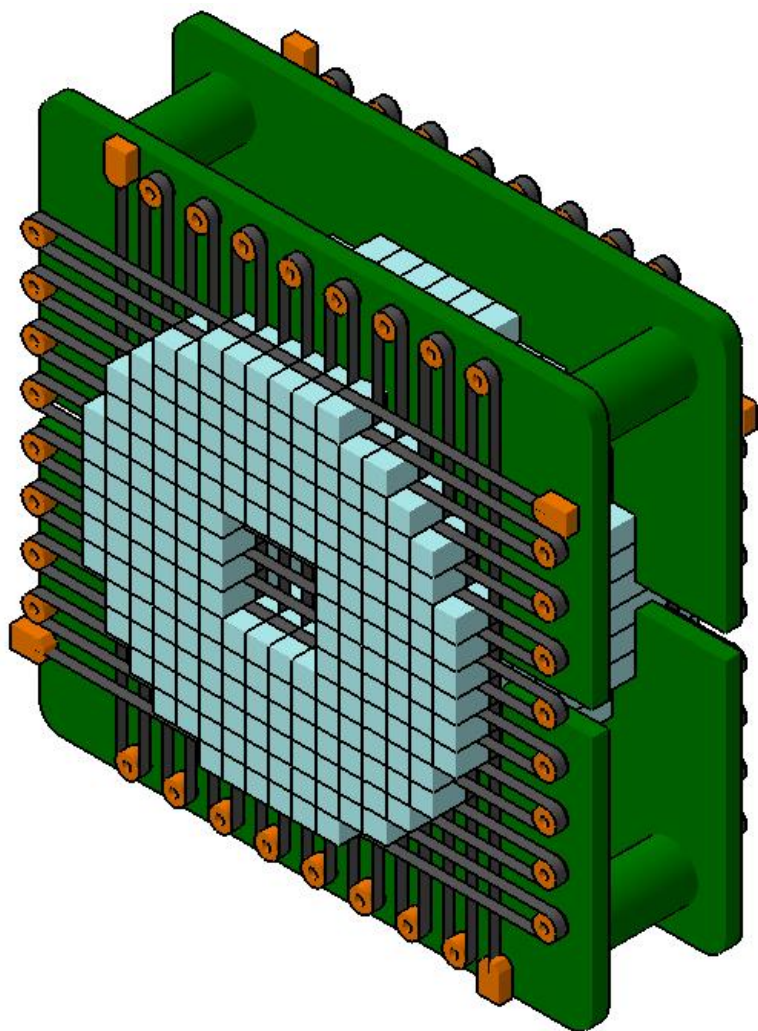
ASSEMBLING WITH TAPE-SPACERS

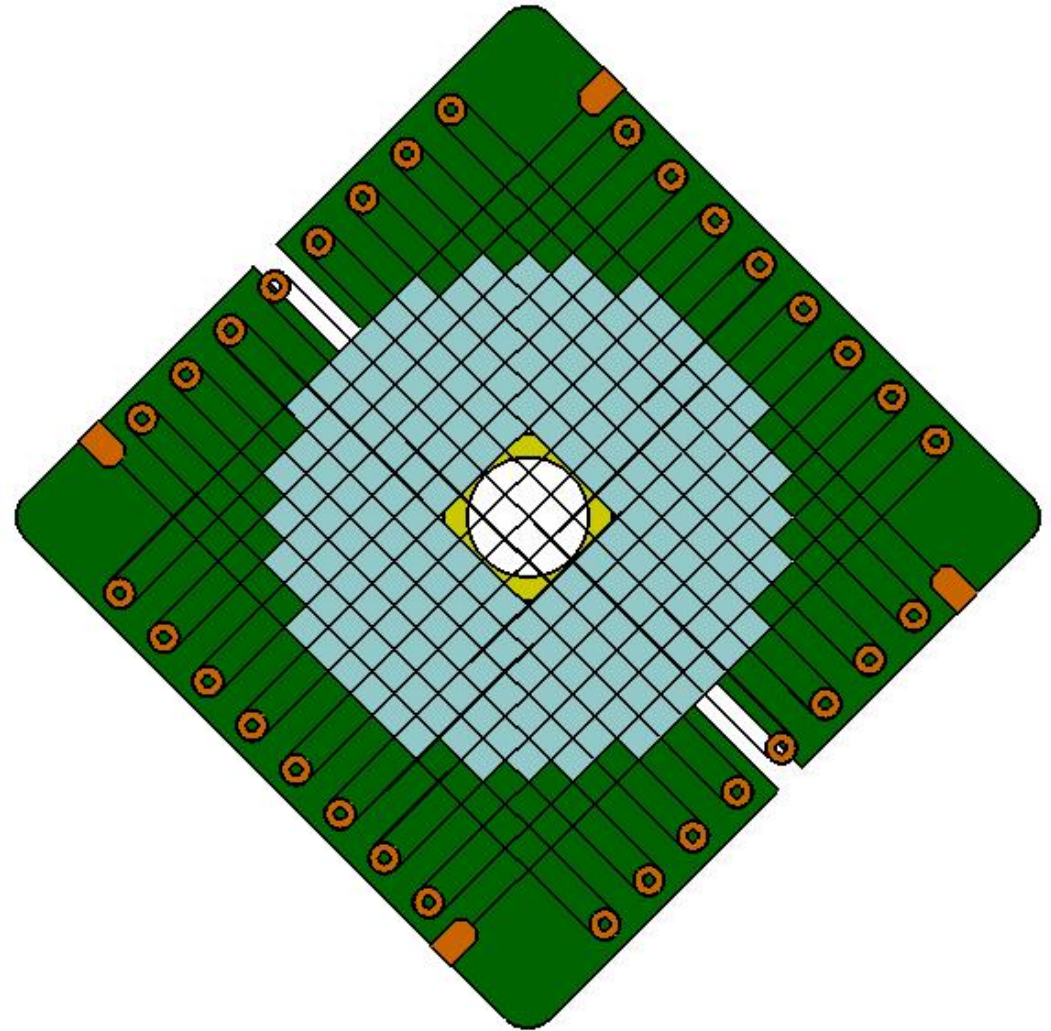
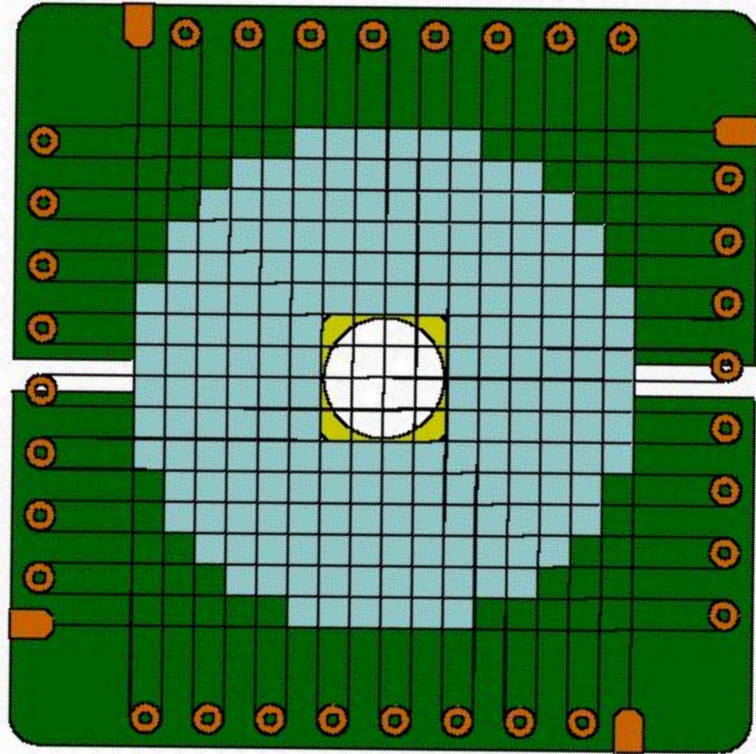




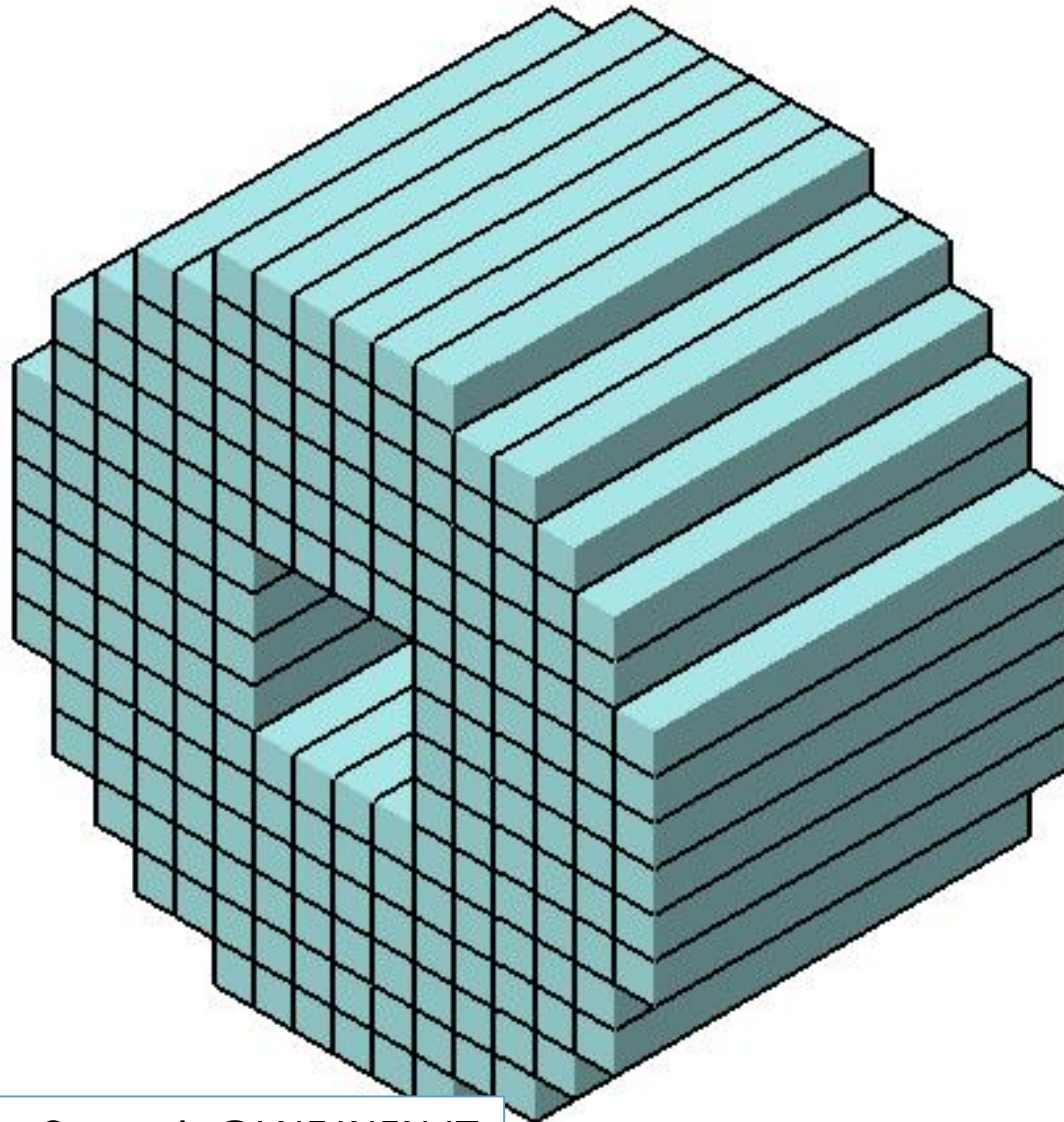




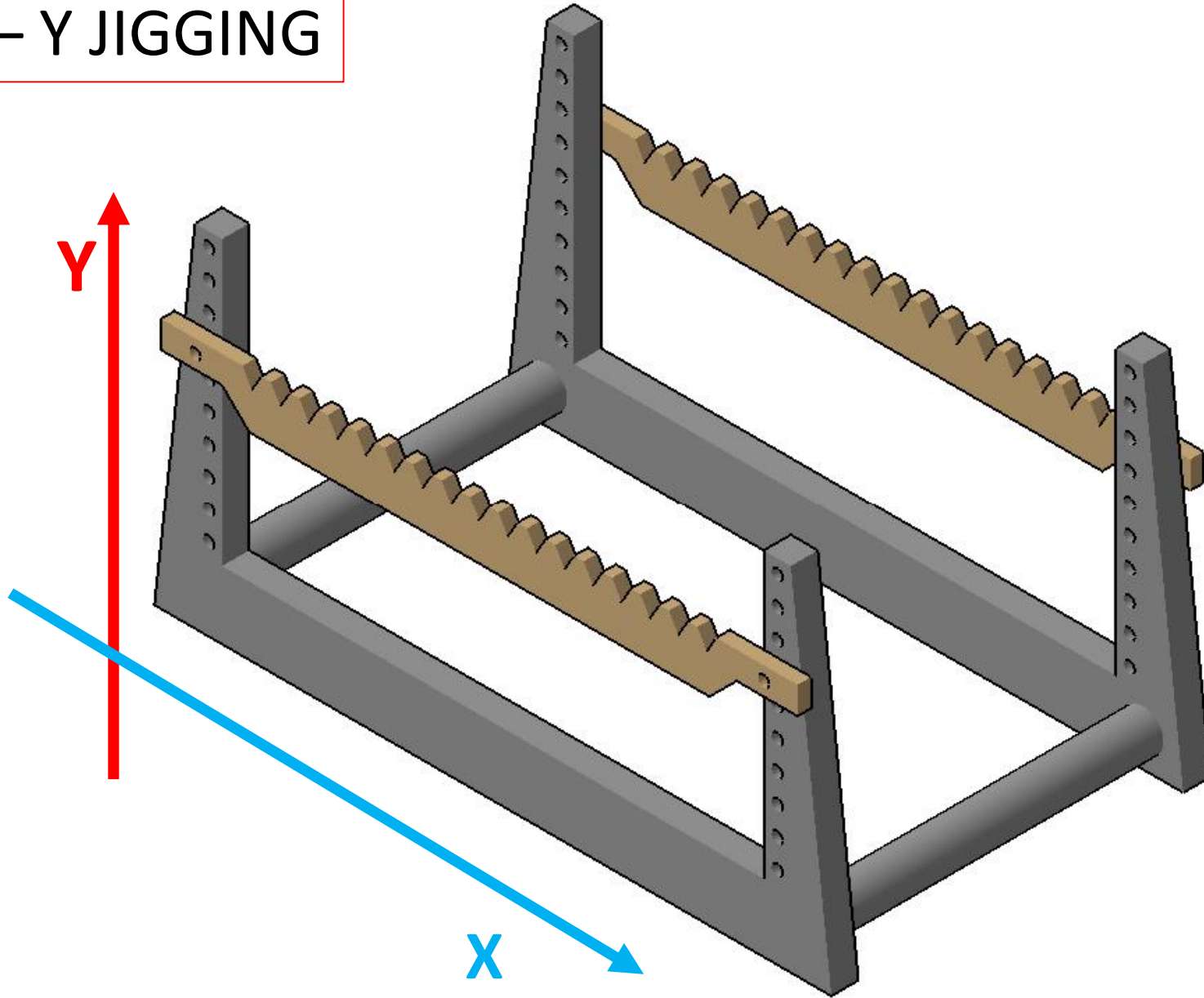




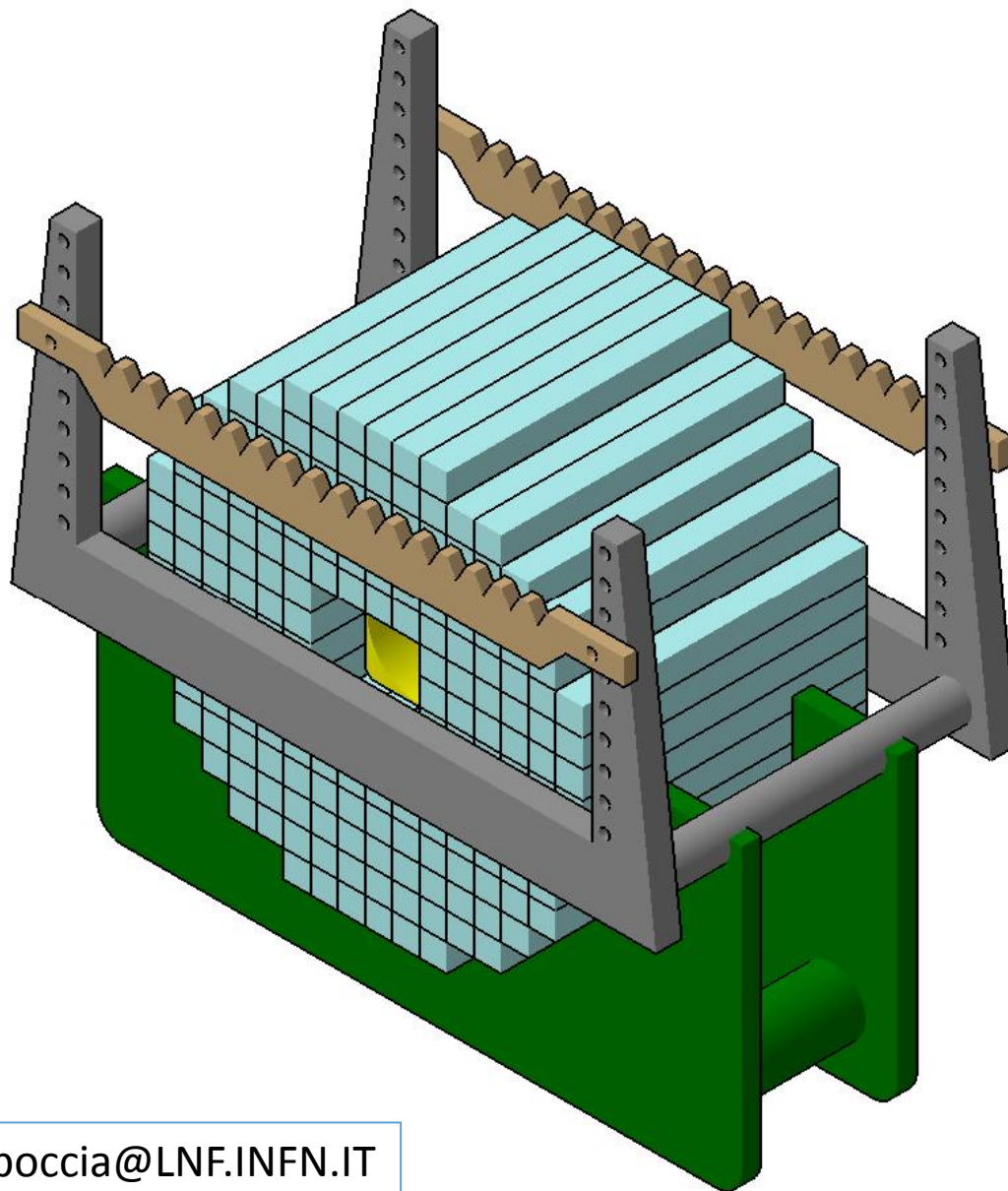
ASSEMBLING WITH 'RUBBER-Spot' SPACERS



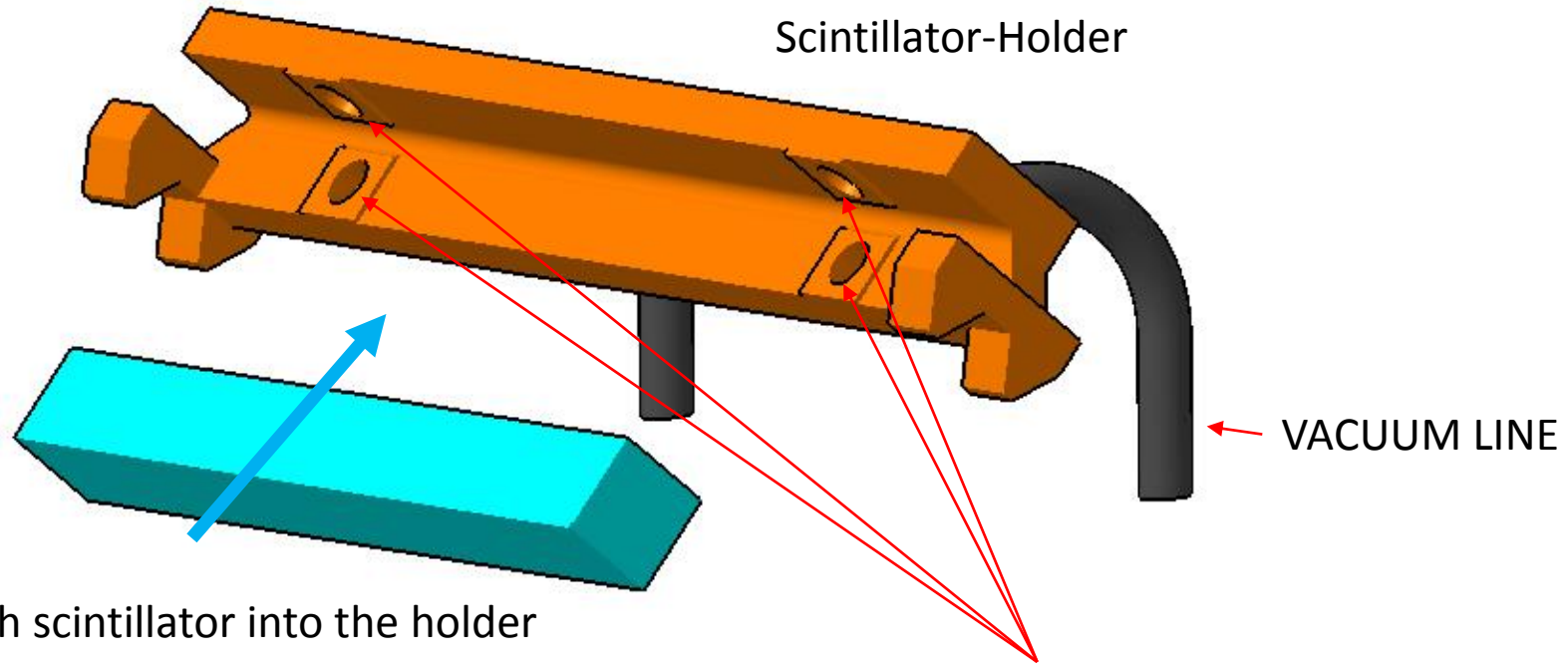
X – Y JIGGING



CALORIMETER ASSEMBLING INTO THE JIGGING...



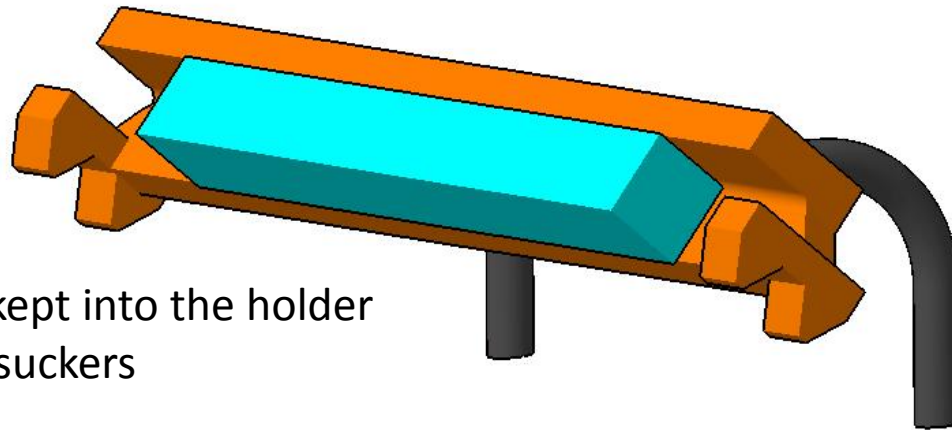
Scintillator-Holder



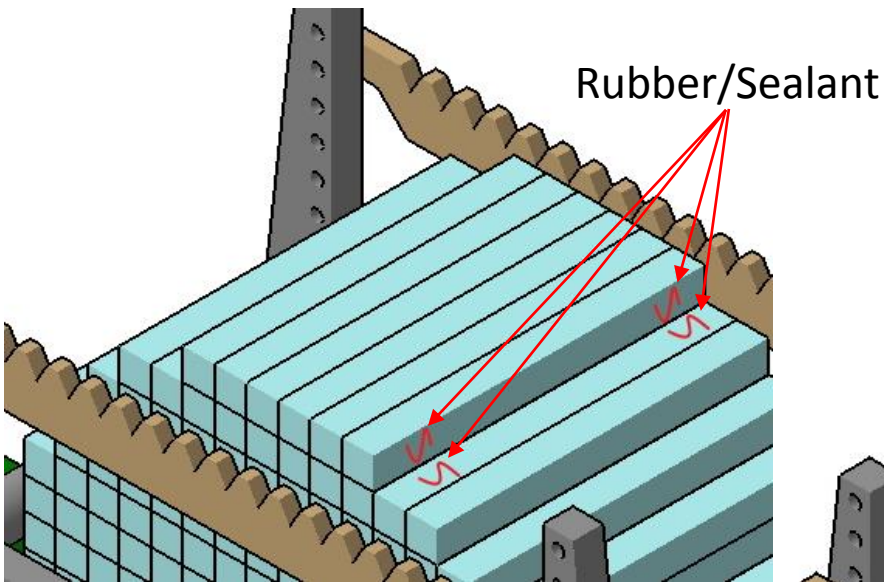
VACUUM LINE

Push scintillator into the holder

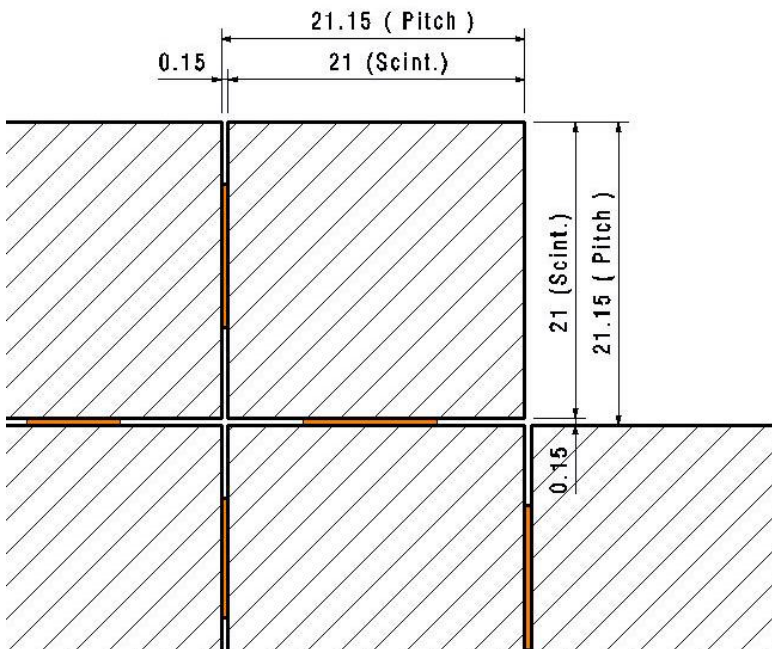
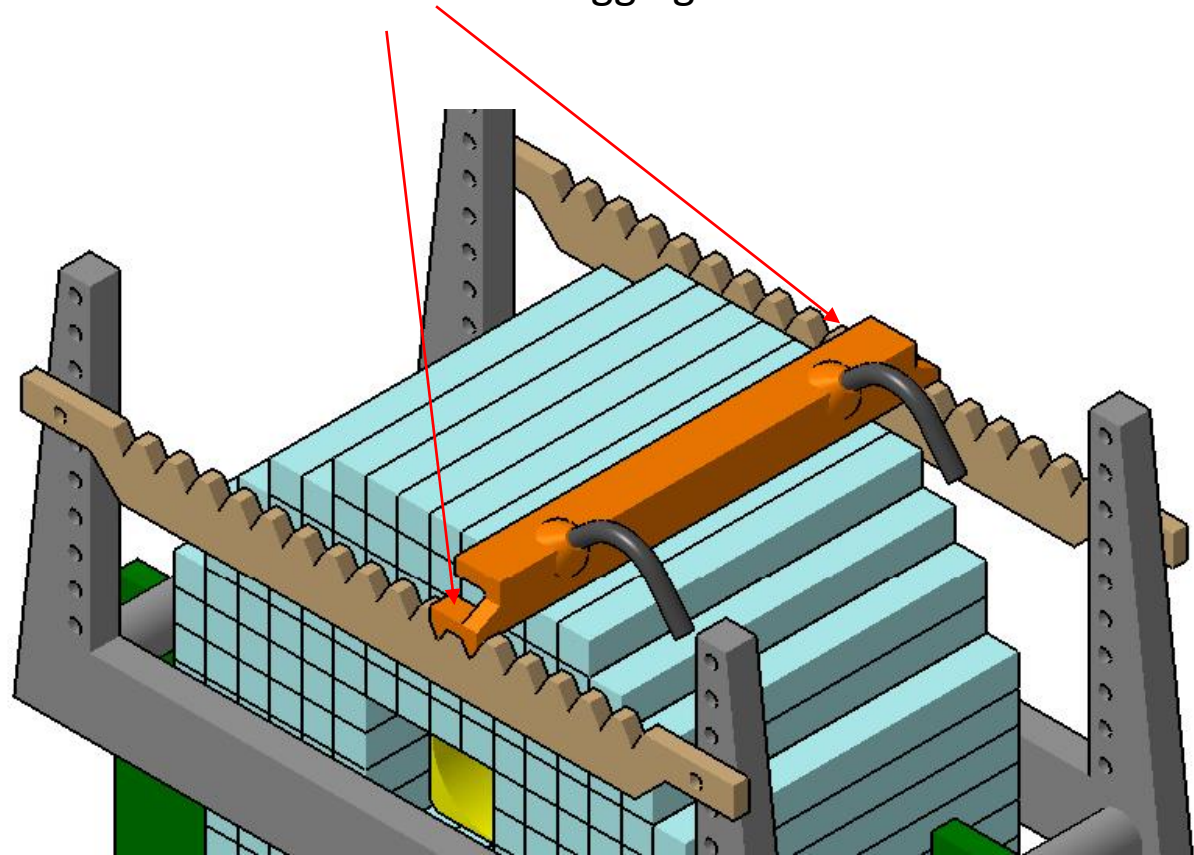
VACUUM SUCKERS

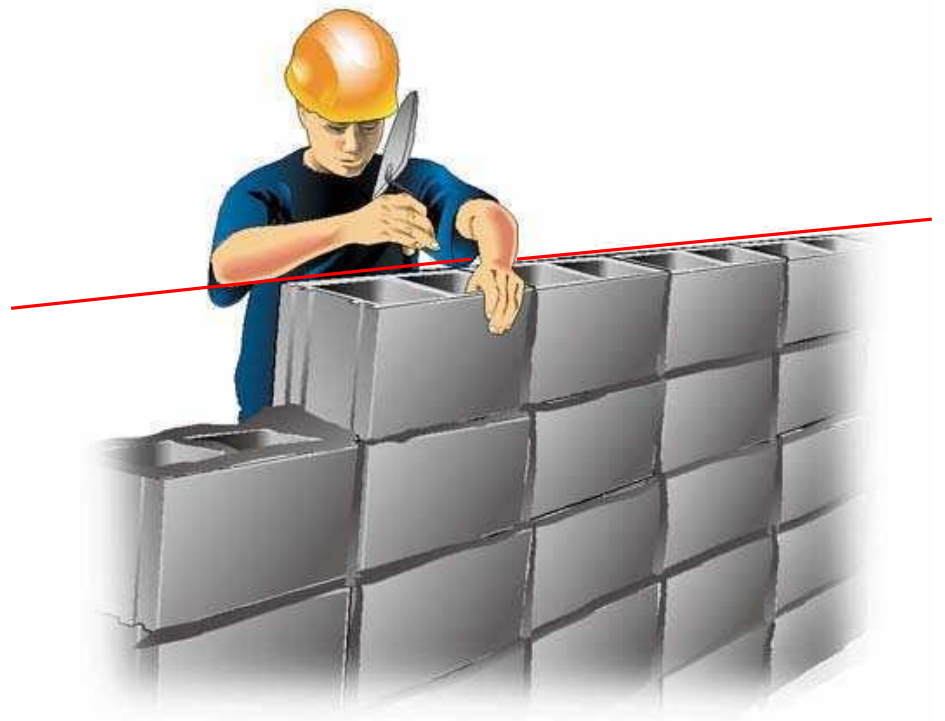
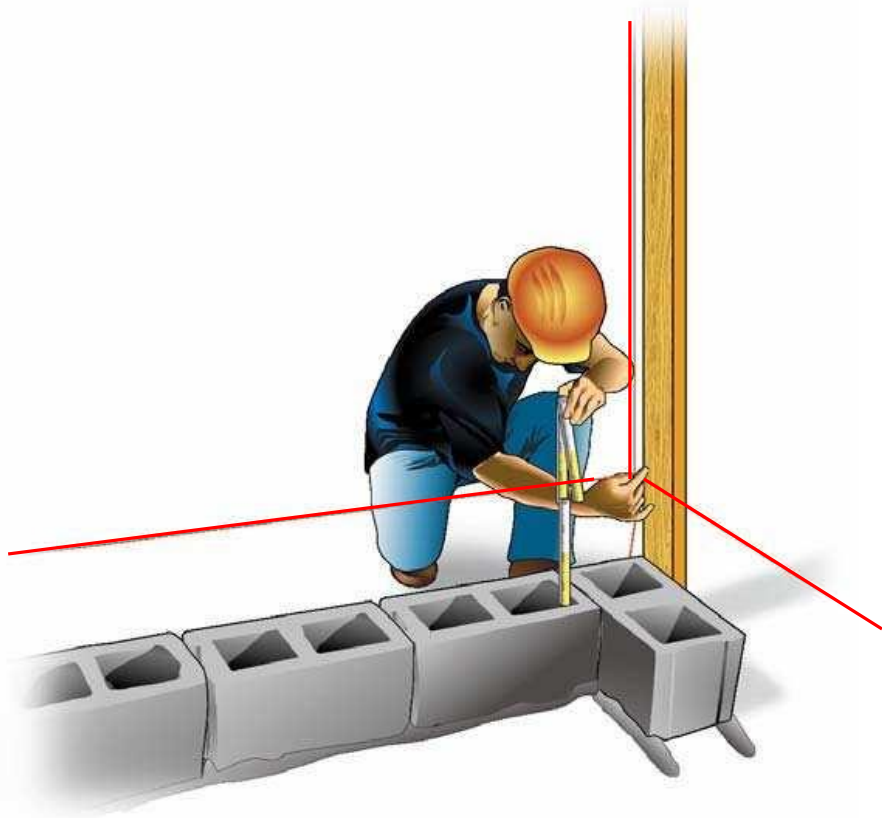


Scintillator kept into the holder
by vacuum-suckers



The new crystal is added by fixing its location (X-Y) by the references of Jigging





LOCTITE SI 5910

(Conosciuto come LOCTITE 5910)



Guarnizioni a bassa resistenza per flange flessibili. Buona resistenza agli oli e ai movimenti tra le parti.

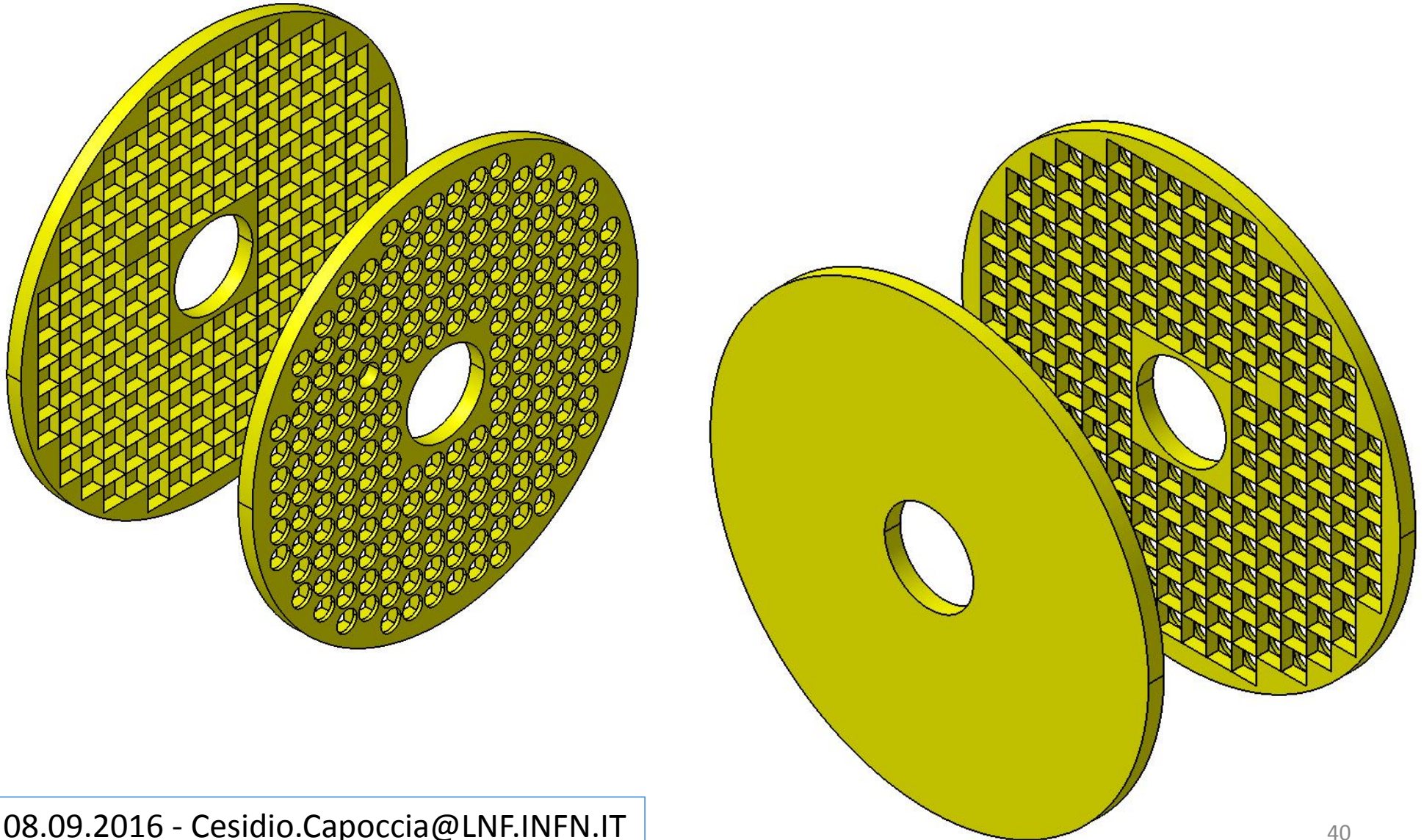
LOCTITE SI 5910 è guarnizione a bassa resistenza a base di silicone per flange flessibili con superfici lavorate o di fusione (metallo o plastica). E' indicato per giochi fino 1 mm e polimerizza in volume di 2,75 mm in 24 ore. Le applicazioni tipiche includono coperchi in metallo stampato (coperchi punterie e coppe dell'olio).

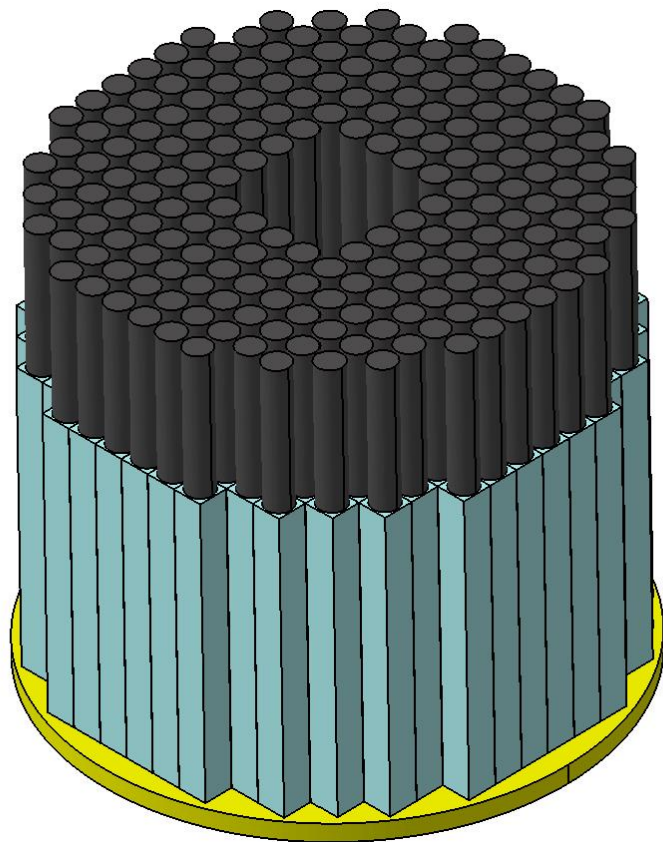
Vantaggi

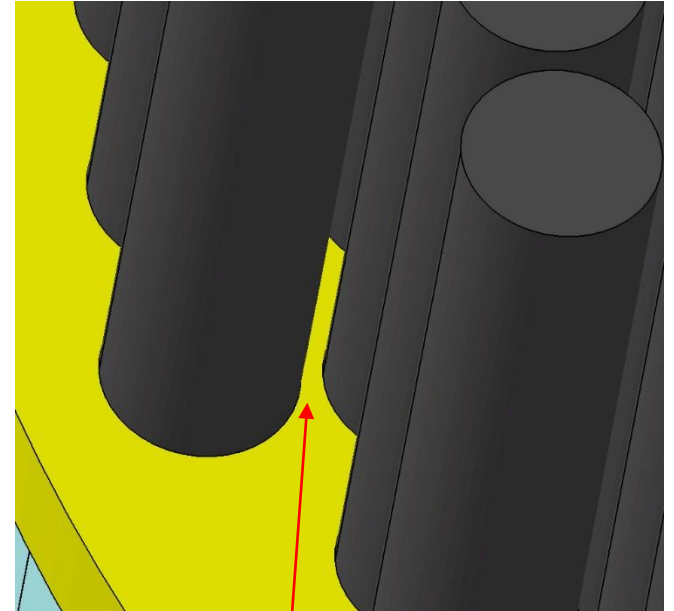
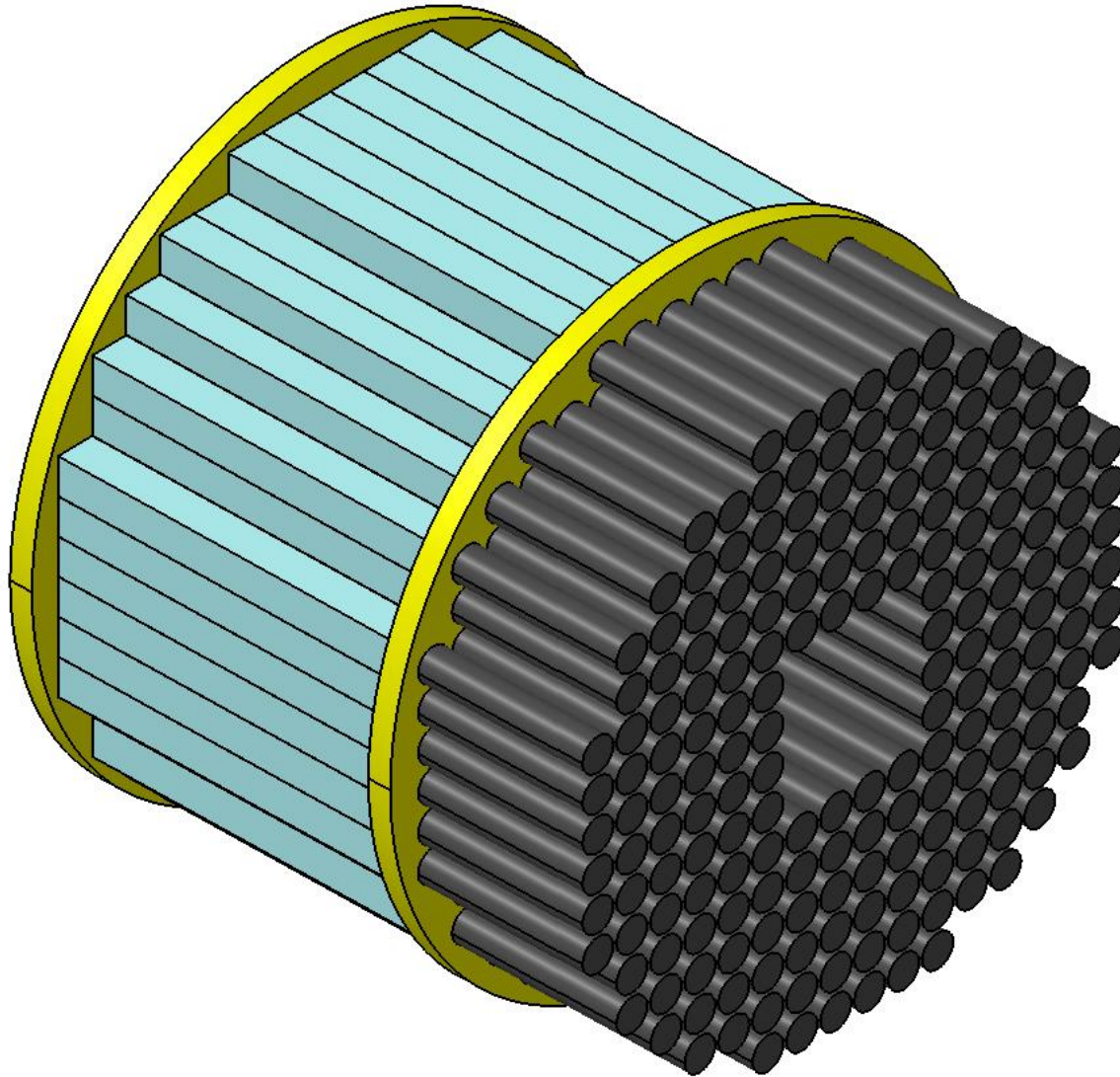
- Da usare su flange flessibili
- Buona resistenza agli oli e ai movimenti tra le parti
- Disponibile in cartucce, tubi e bombolette pressurizzate
- Riduce la migrazione di liquidi dopo l'applicazione



SOLUTION WITH FRONT & BACK CASES



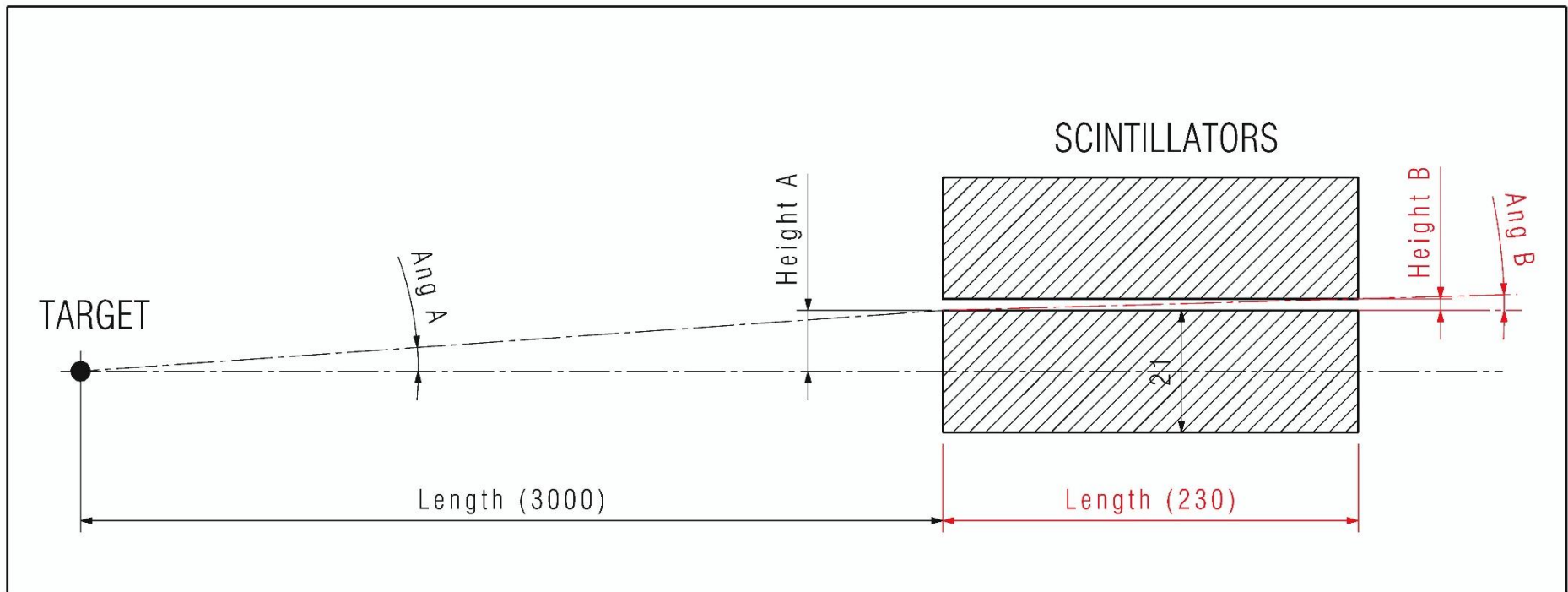




Not enough space!
Considering tollerances,
we have less than one
millimeter available.

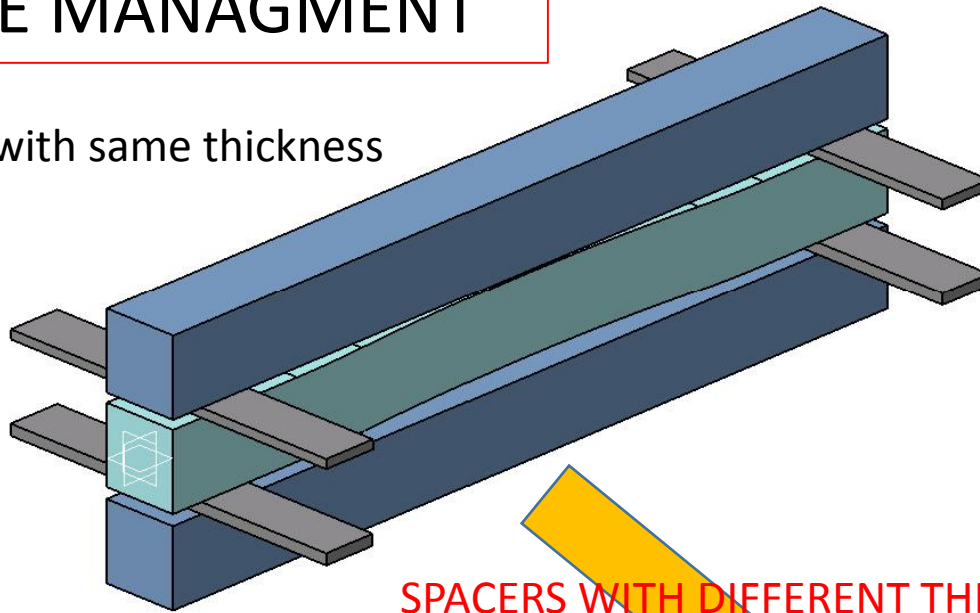
ANGLES

Length	Height	Rad	mRad	Deg
3000	10,5	0,00350	3,50	0,201
230	0,3	0,00130	1,30	0,075
230	0,6	0,00261	2,61	0,149
230	0,8	0,00348	3,48	0,199

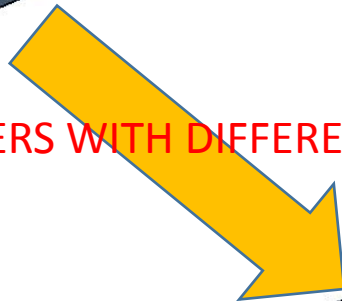


ANGLE MANAGMENT

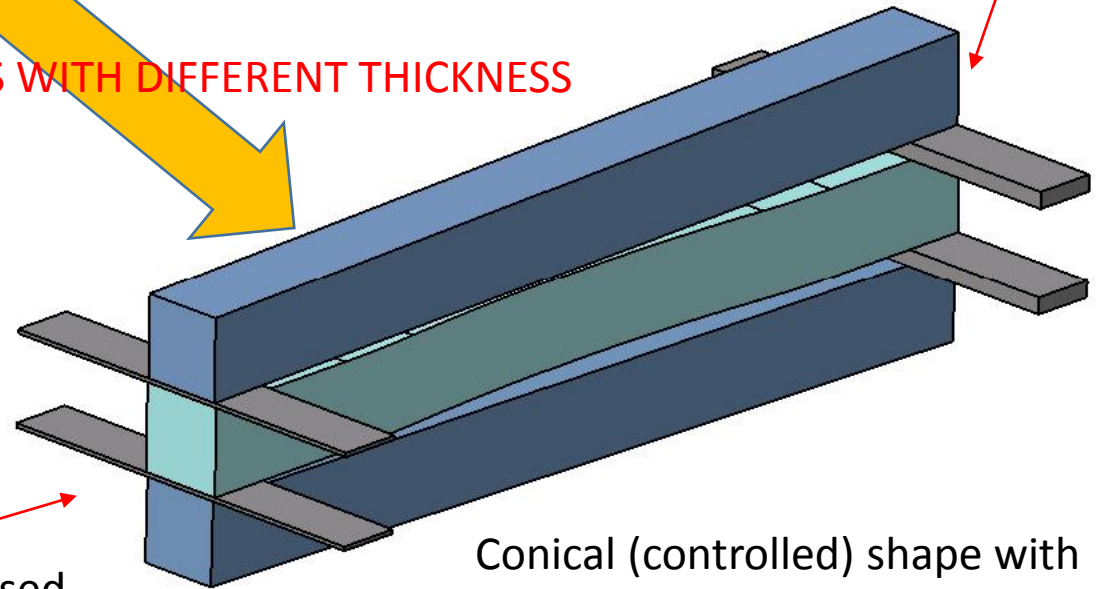
Spacers with same thickness



SPACERS WITH DIFFERENT THICKNESS

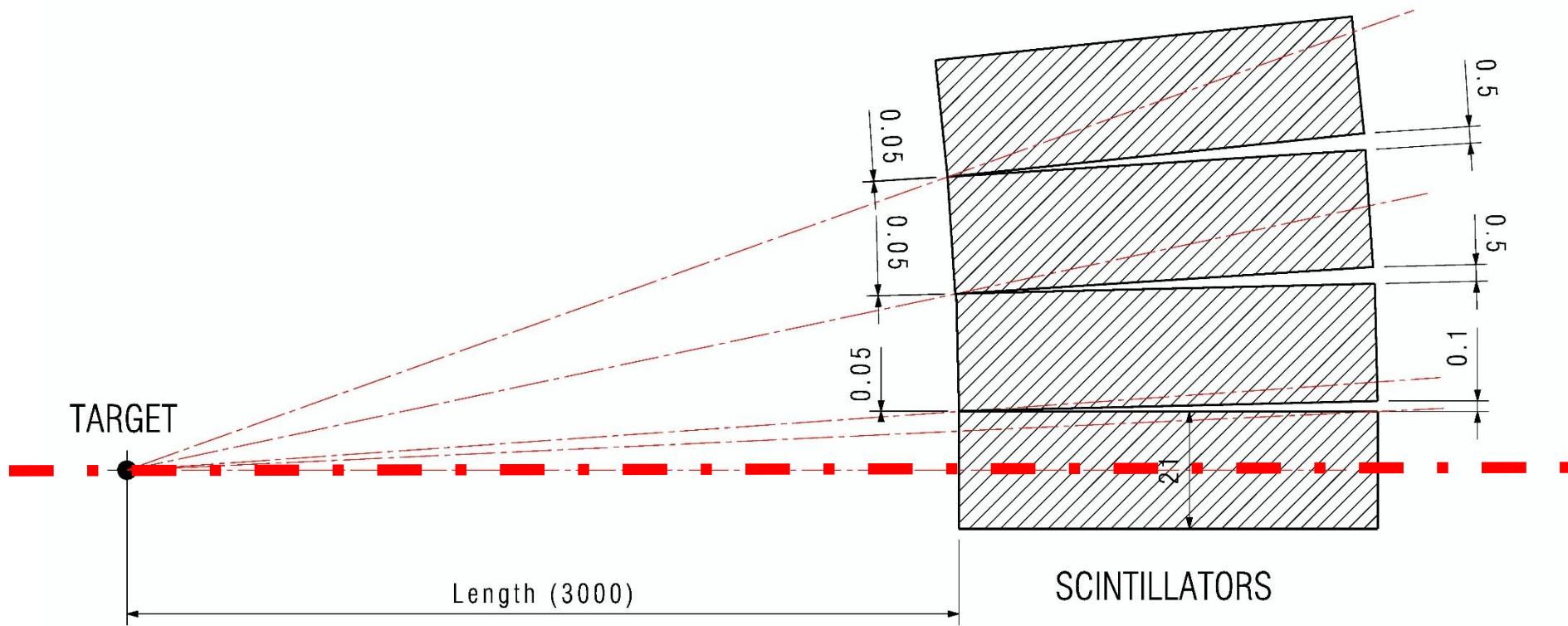


Back side more opened



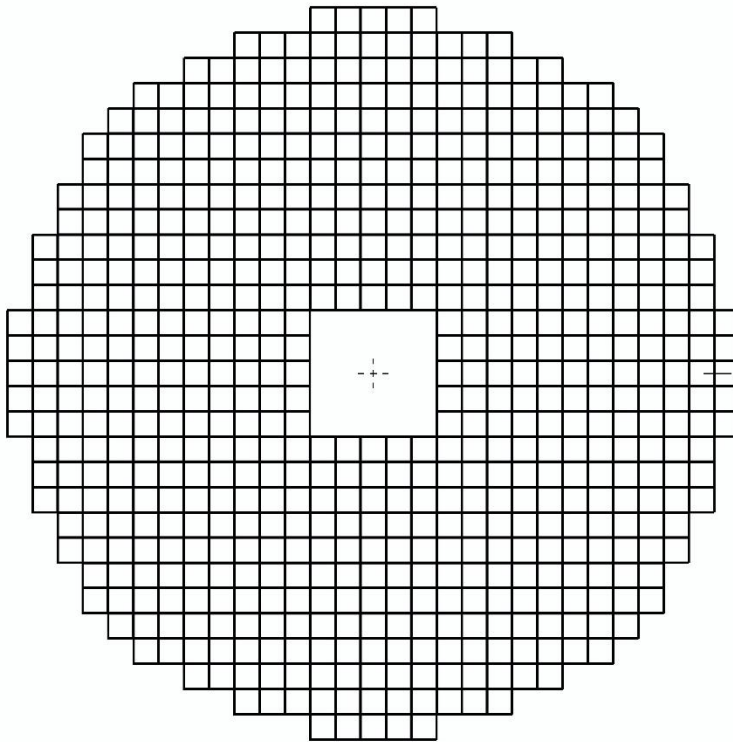
Front side more closed

Conical (controlled) shape with same effect about structure.

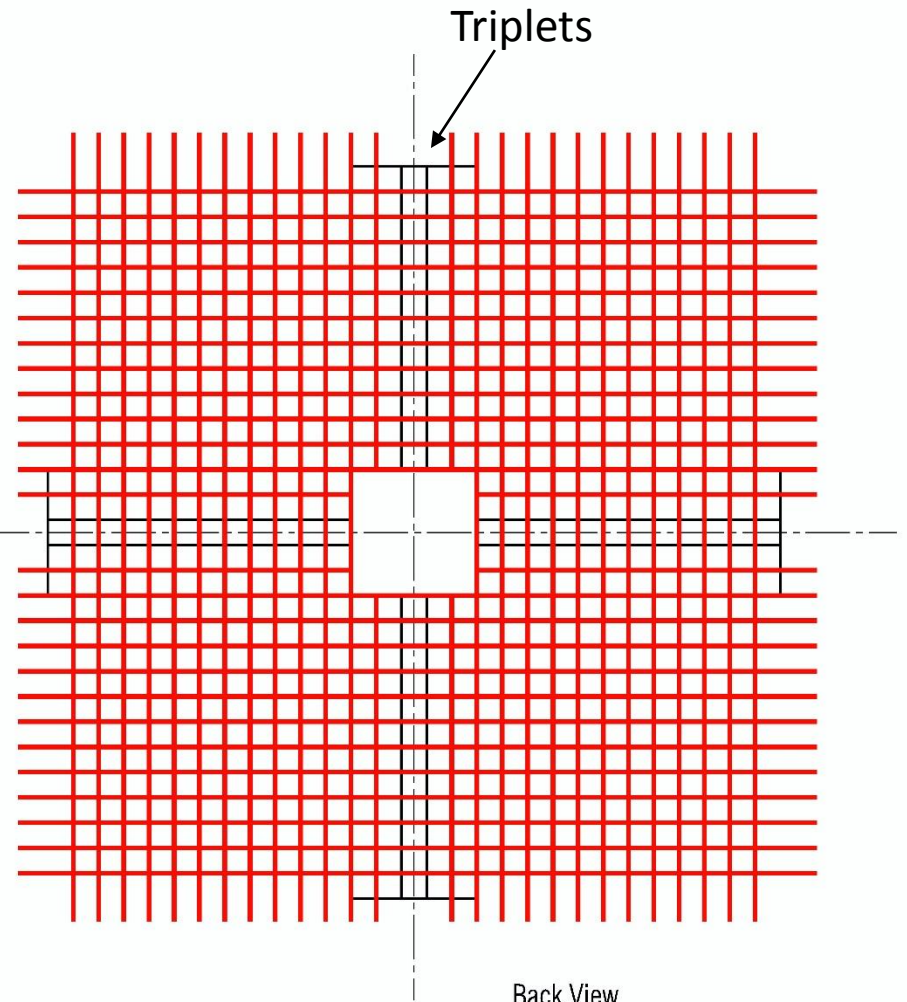


BLACK LINE = 0,05 mm

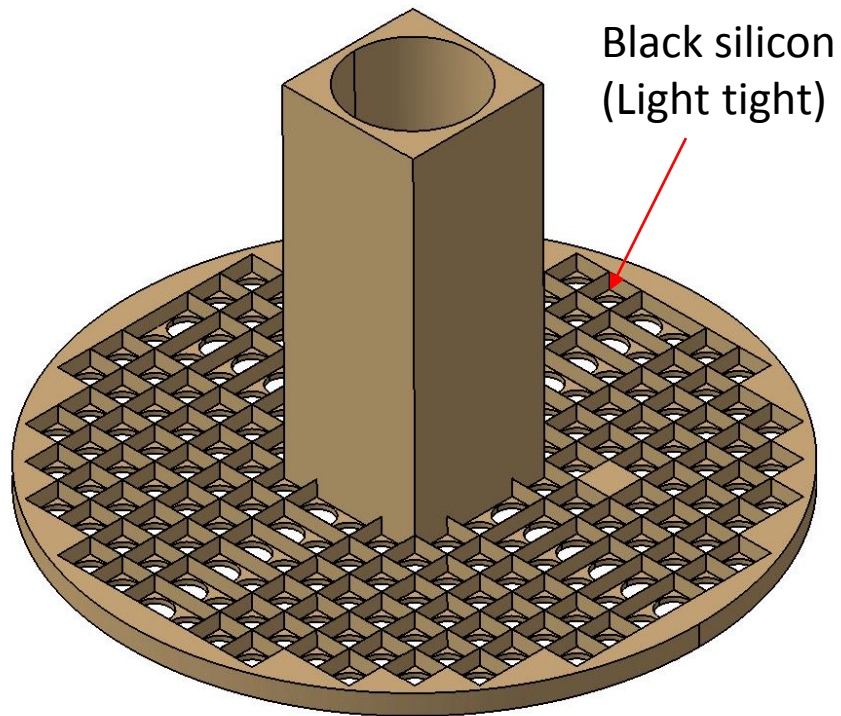
RED LINE = 0,5 mm



Front view
Scale: 1:5

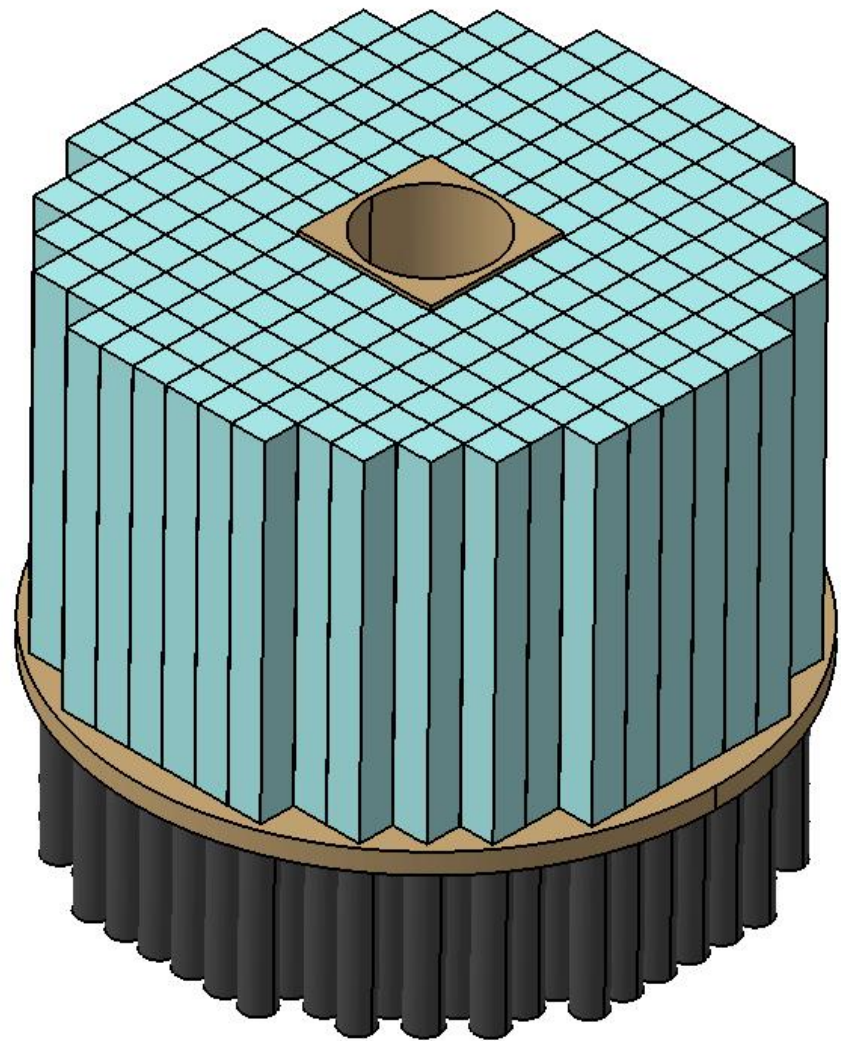


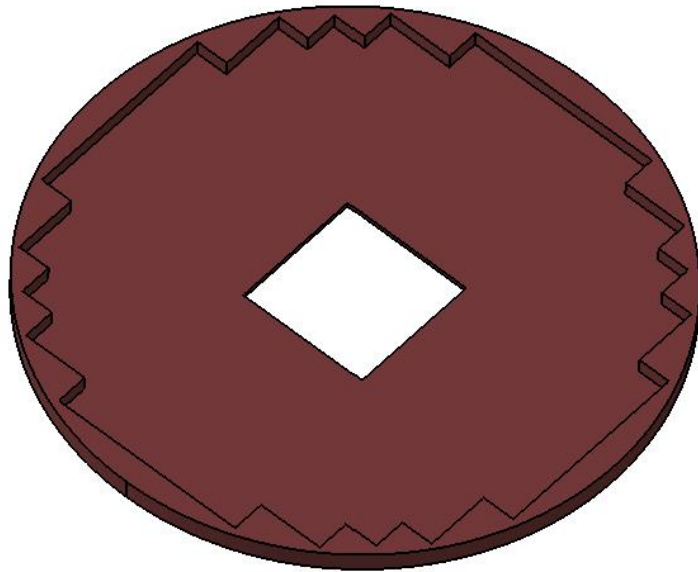
Back View
Scale: 1:5



Black silicon
(Light tight)

BACK COVER
(ASSEMBLING REFERENCE)





FRONT COVER

