DIRC Status: Cookies

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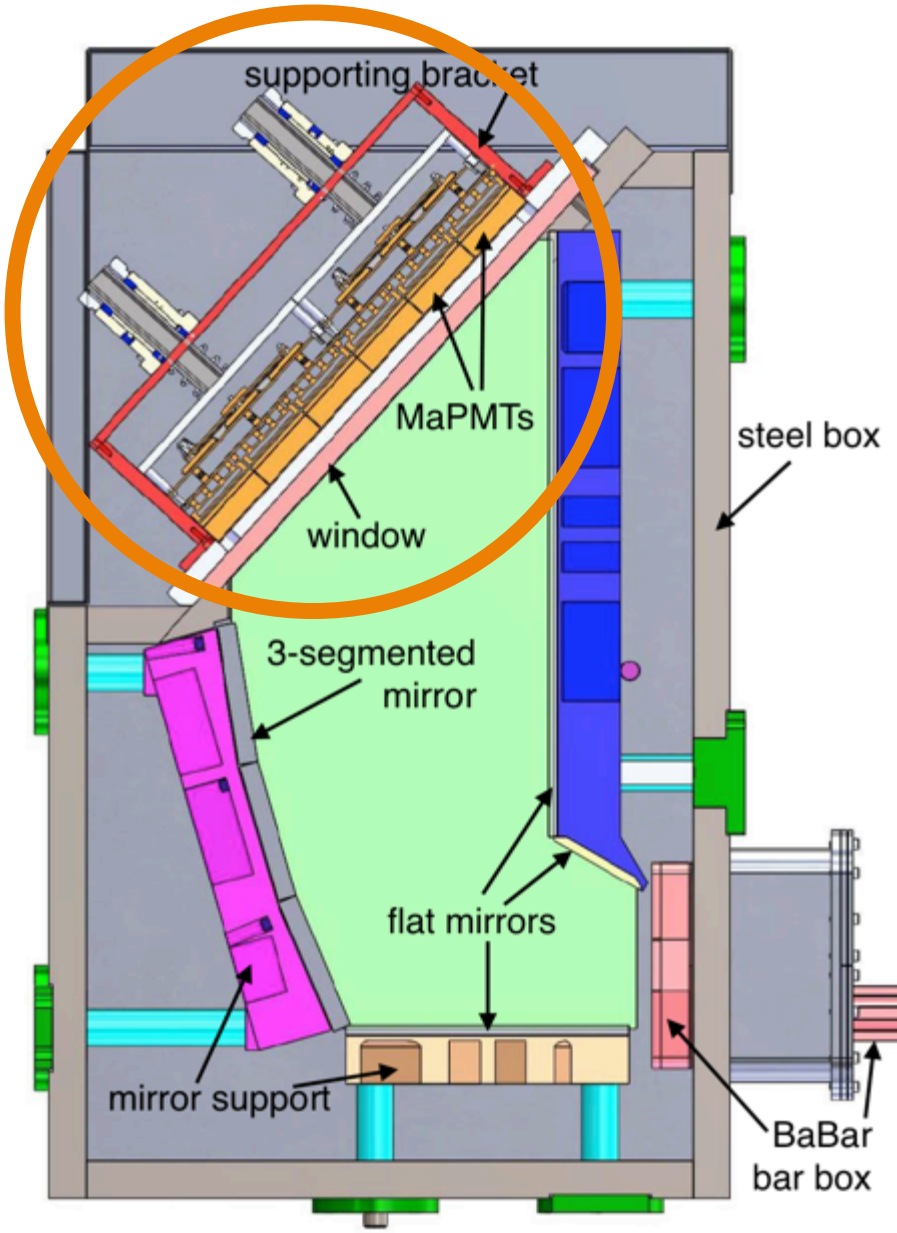
Objectives

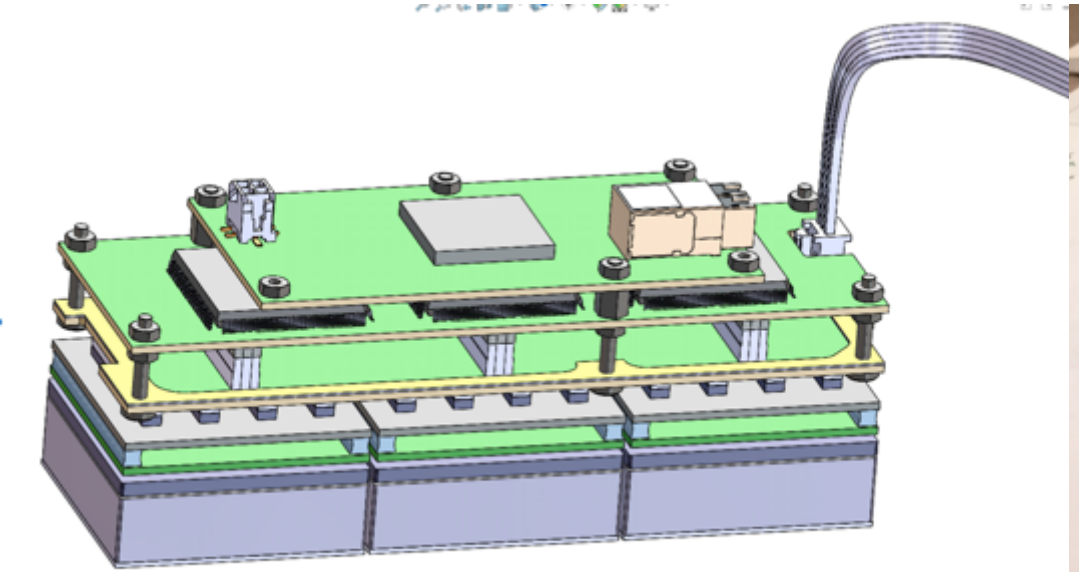
Ultimate goal: create silicone pads, which would be an effective optical coupling between the photosensors and the window, and can be produced in sufficient amount

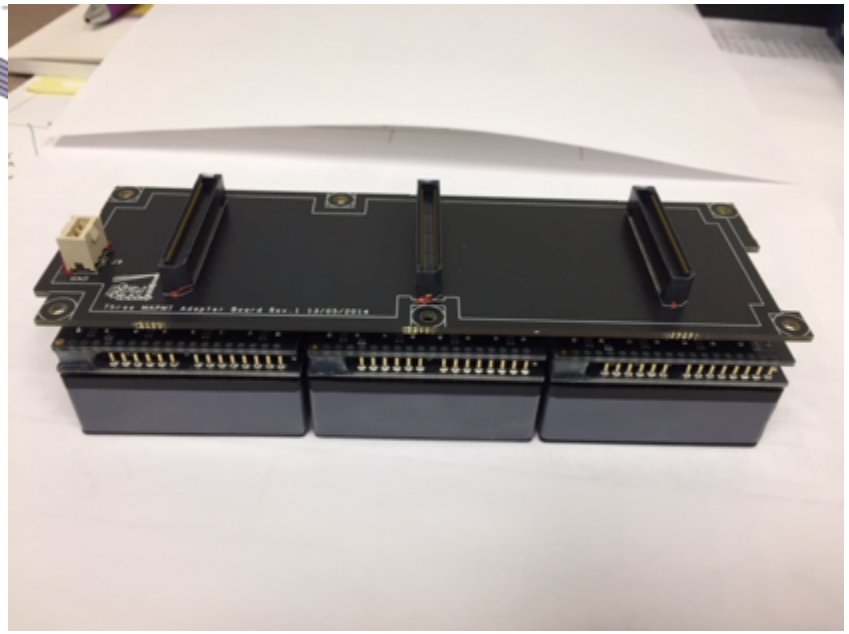
Plan:

1. Start with Belle II technology
2. Optimize transmittance
3. Optimize mechanical handling



One cookie for 3 photosensors

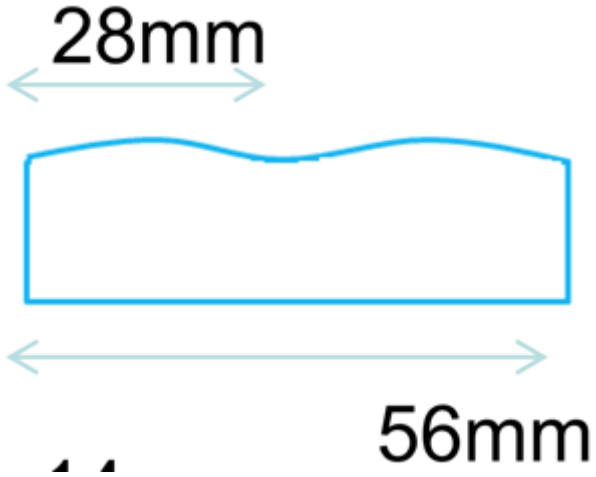




Belle II technology

Preparation of cookies

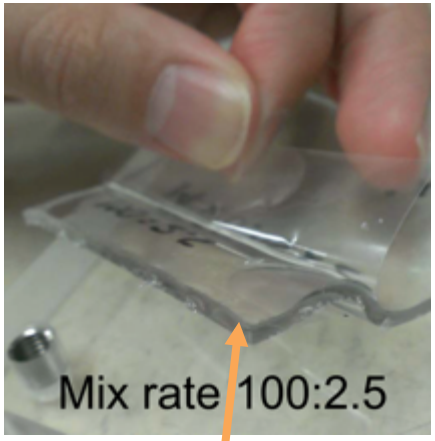
- Mix **TSE3032** material with ratio **100 : 2.5**
- Vacuum chamber to remove bubbles ~ 2h
- Pour into mold made of teflon and acrylic glass (cookie thickness is **2 mm**), put **plastic foil** between the silicone and the acrylic side to prevent sticking
- Curing at **40C for 24-48 h** (low temperature because of the plastic foil)



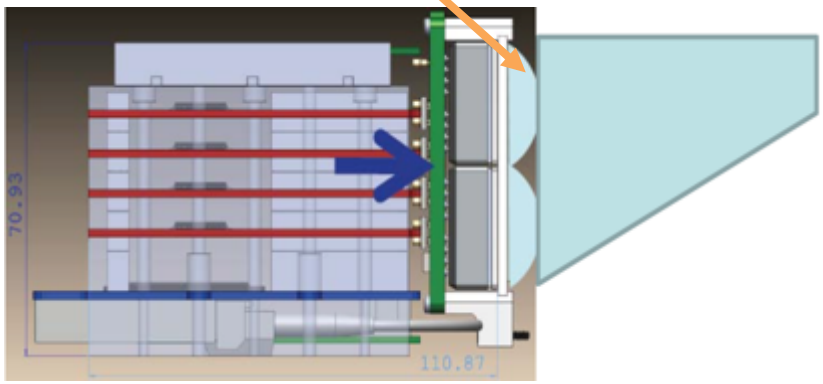
Application of cookies

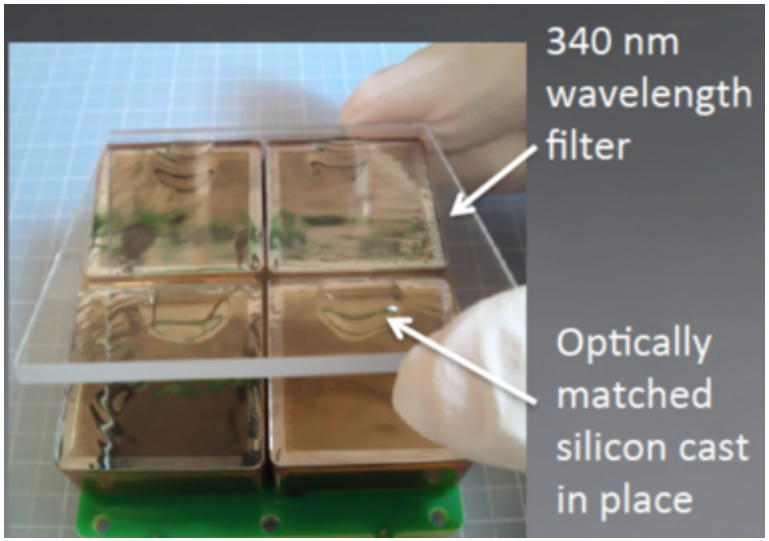
- Apply cookie using greasing oil **Nye OCF-446**
- Force **~ 10 kgf/PMT** by pogo pins

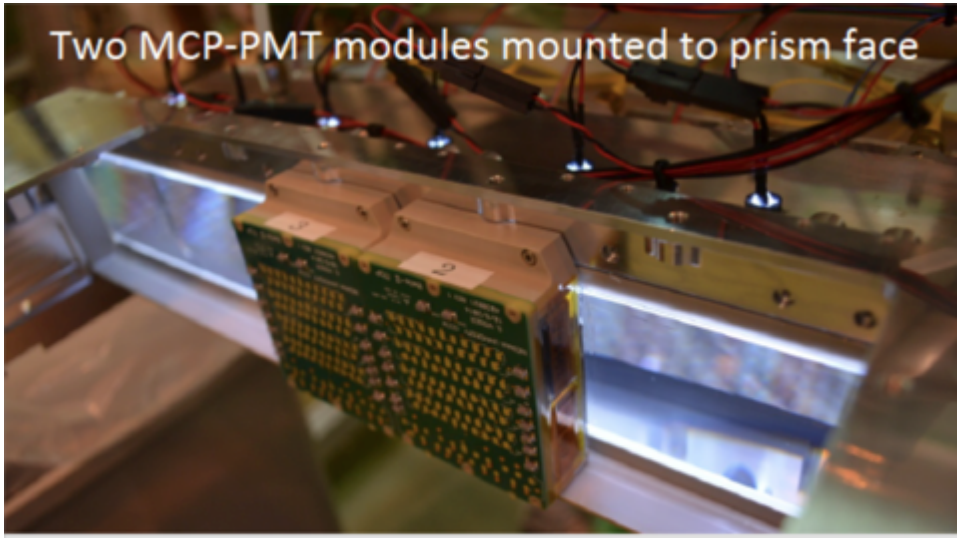
Belle II cookies



Cookie





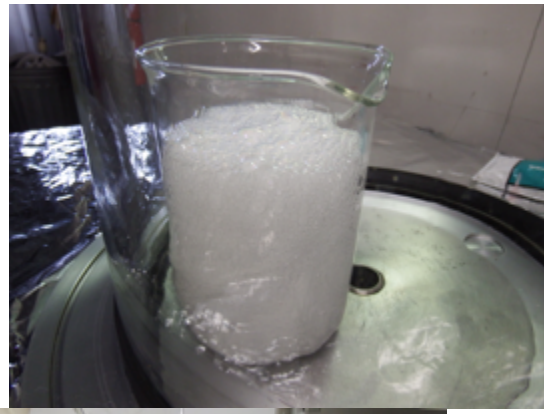


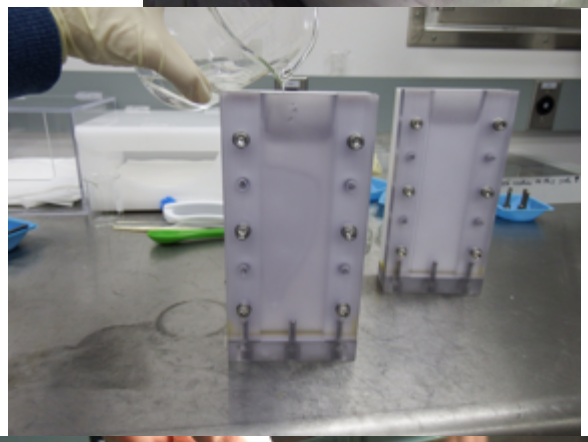
Removable optical coupling is made using a soft cast silicone cookie with a drop of optical oil to make a "bubble free" contact

GlueX technology

Preparation of cookies

- Mix silicone material (**RTV615**) with different ratios **100 : (2.5 - 4)**
- Vacuum chamber to remove bubbles ~ 2h
- Pour into mold (cookie thickness is **1 - 3 mm**), NO **plastic foil** between the silicone and the acrylic side
- Curing at **100C for 1 h** (convenient regime)

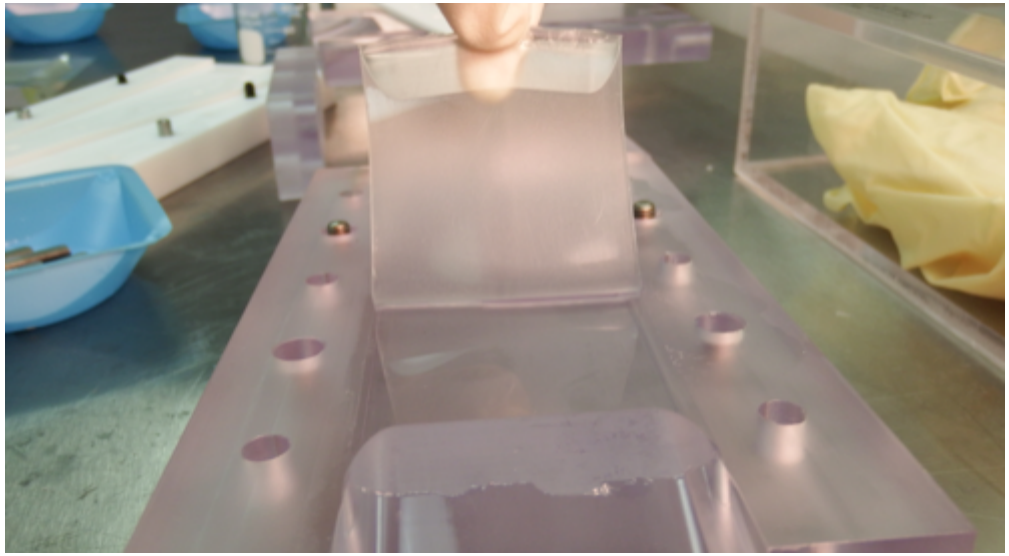


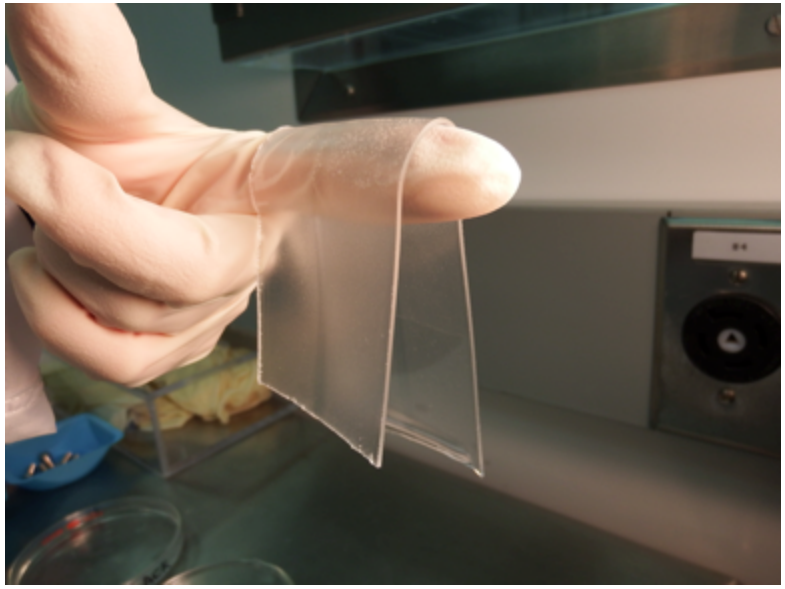


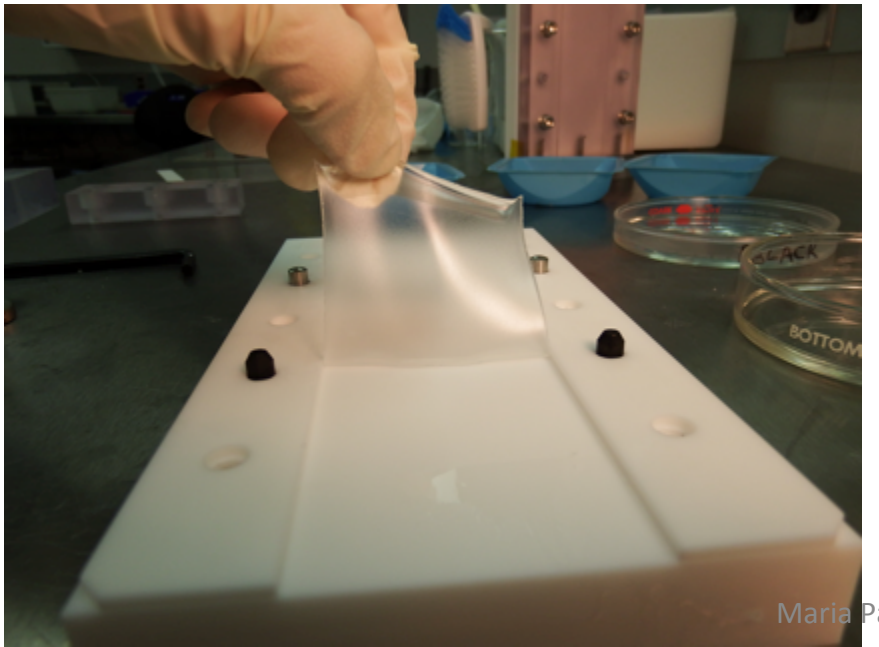
Application of cookies

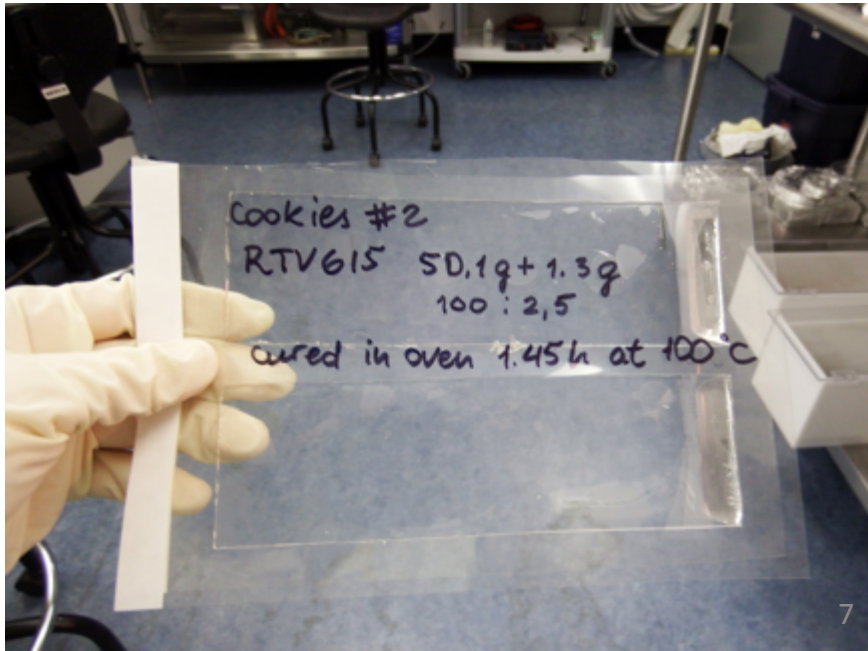
- Apply cookie using greasing oil **Nye OCF-446**

Cooking the cookies









Testing of cookies

- Transmittance measured:
  - In Jlab using Big Blue Box
  - In CUA using Greg's setup
- Mechanical tests:
  - Force needed to apply / detach
  - Handling in real environment

Goals for transmittance tests

- Custom vs. commercial cookies (e.g. TOF-like)
- Material: RTV vs. TSE
- Optimize procedure: curing conditions, mixing ratio, thickness

Label	Material	Mixing ratio	Masses mixed [g]	Curing temperature, C	Thickness [mm]
#5	RTV	100 : 2.5	70.0 + 1.8 = 71.8	100	3 and 3
#6	RTV	100 : 2.5	40.2 + 1.0 = 41.2	100	1 and 2
#7	TSE	100 : 2.5	40.0 + 1 = 41.2	100	1 and 2
#8	RTV	100 : 4	35.0 + 1.4 = 36.4	100	1 and 2
#9	RTV	100 : 3.2	100.5 + 3.2 = 103.7	150	1 and 2
#10	RTV	100 : 3.2	100.5 + 3.2 = 103.7	100	1 and 2
#13	TSE	100 : 3.2	70.0 + 2.2 = 72.2	150	1 and 2
#14	TSE	100 : 3.2	35.3 + 1.1 = 36.4	100	1 and 2
#15	TSE	100 : 3.2	92.0 + 2.9 = 94.9	150 for 0.5 h	3
#16	TSE	100 : 3.2	92.0 + 2.9 = 94.9	40 for 72 h	1 and 3

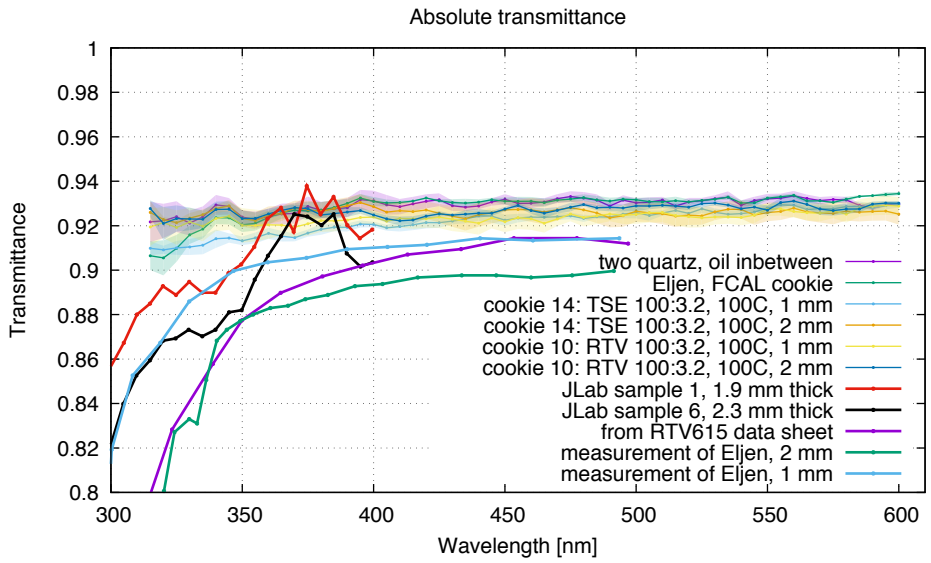
Subset of measured cookies

Eljen 560 FCAL cookie (2 mm)

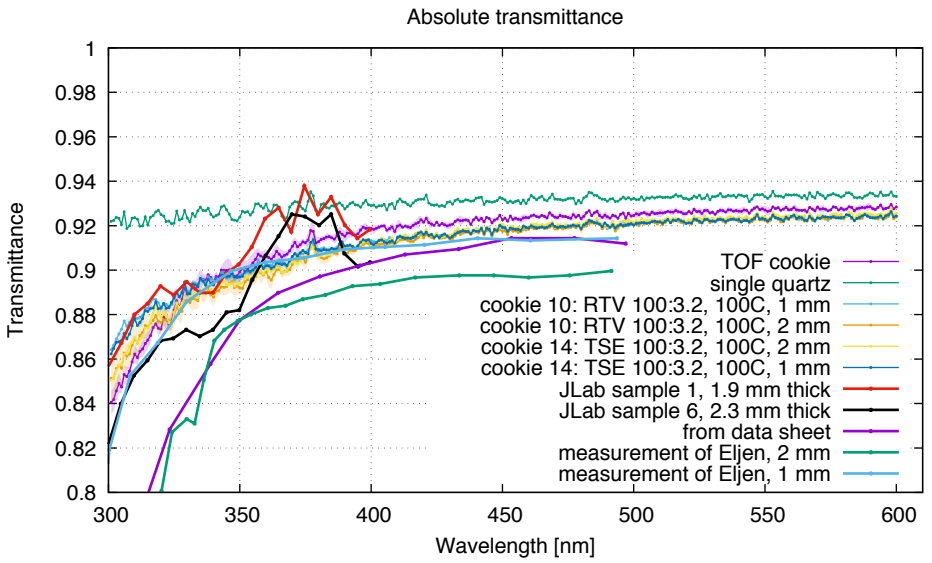
Eljen560 round cookies with thickness 1 mm and 2 mm

Our cookies have good transmittance

JLab



CUA (Greg)



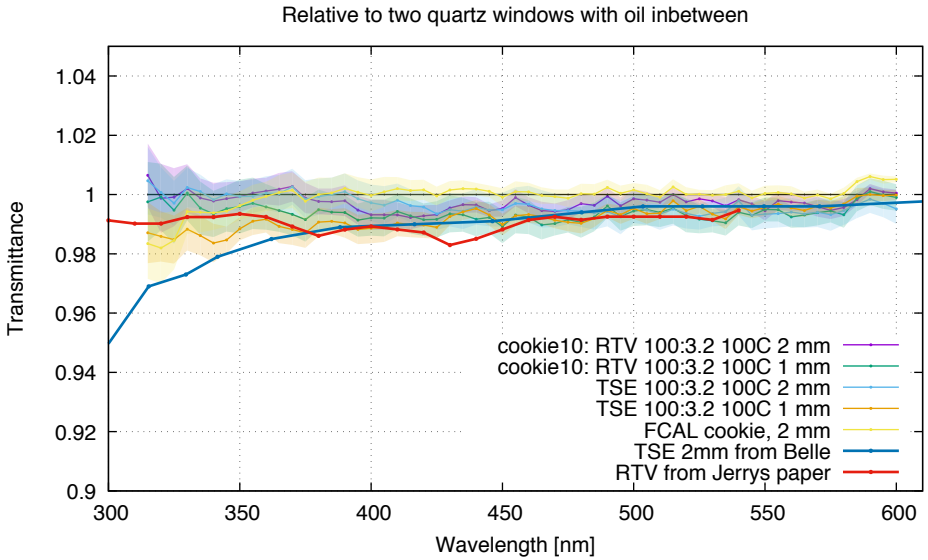
Sample:

Fused silica window – cookie – Fused silica window

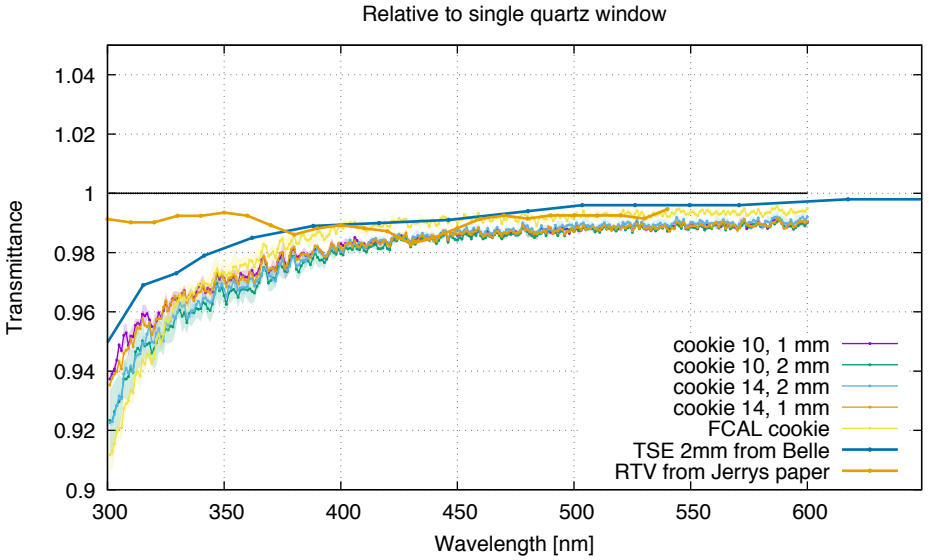
Next page: sample transmittance relative to just a window

Our cookies have good transmittance

JLab



CUA Greg



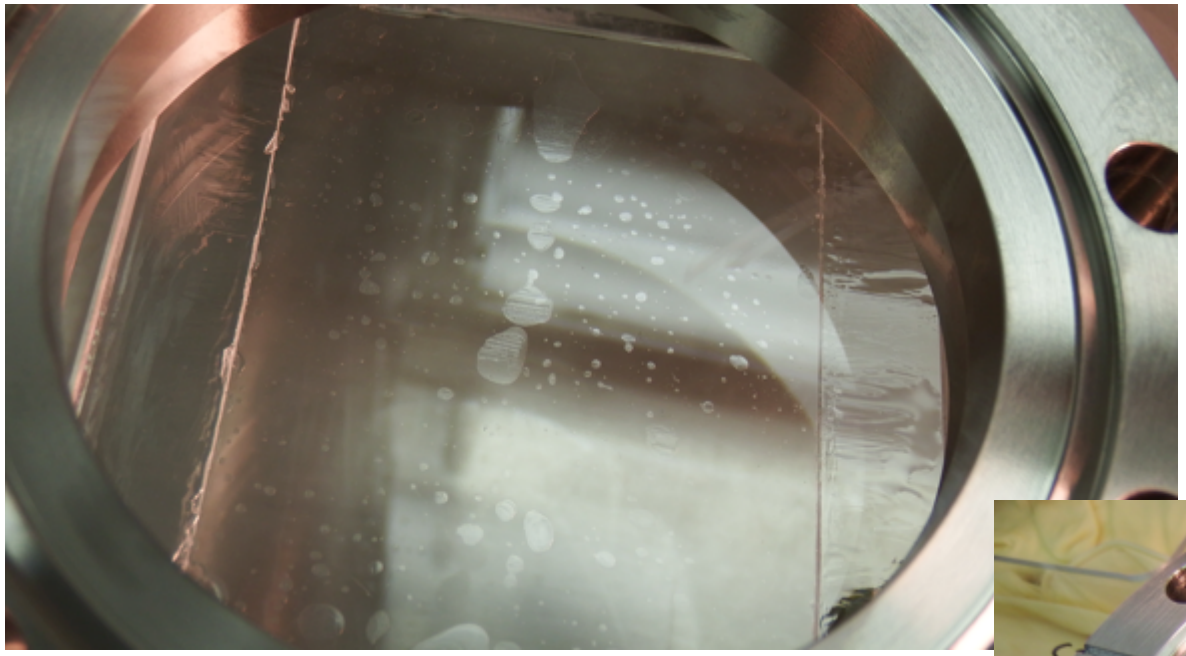
In spite of some dark current issues in Jlab setup, the conclusions are:

- Our cookies have absolute transmittance between 84% – 91%, relative – between 92% - 99%
- Our data agrees with other data from literature
- TSE and **RTV** materials perform the same
- Thickness/curing conditions do not matter much (**1.5 mm or 2 mm**)
- TOF cookie has slightly better transmittance

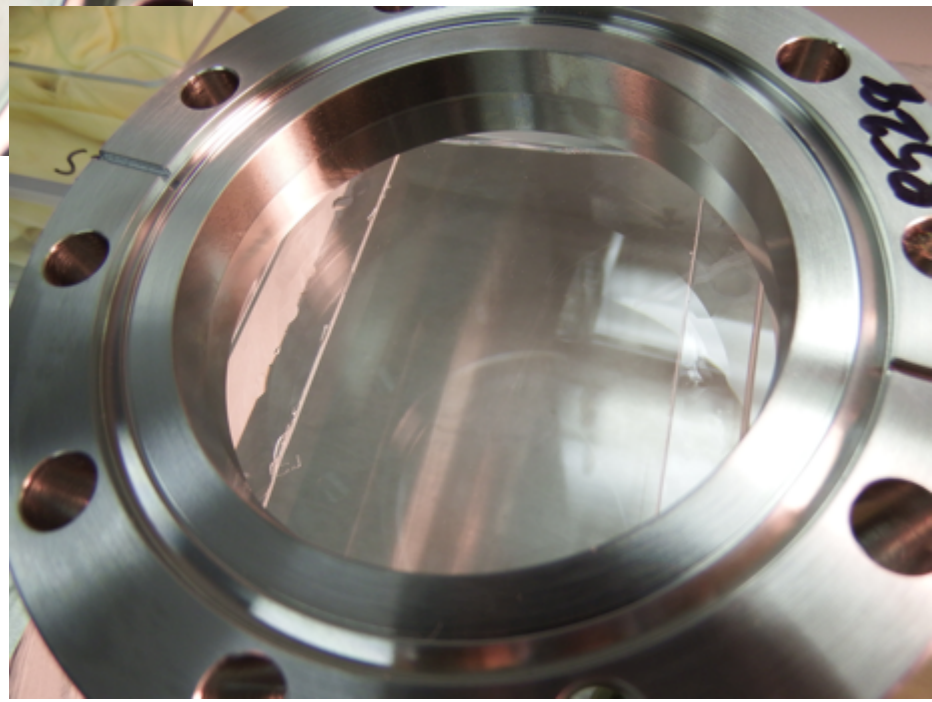
Goals for mechanical tests

- Finalize cookie recipe (thickness, mixing ratio)
- Help to optimize the support for the PMTs and electronic boards (see talk from Fernando Barbosa)
- Work out procedure to equip the GlueX DIRC with PMTs / exchange single PMTs

Establish the optical coupling



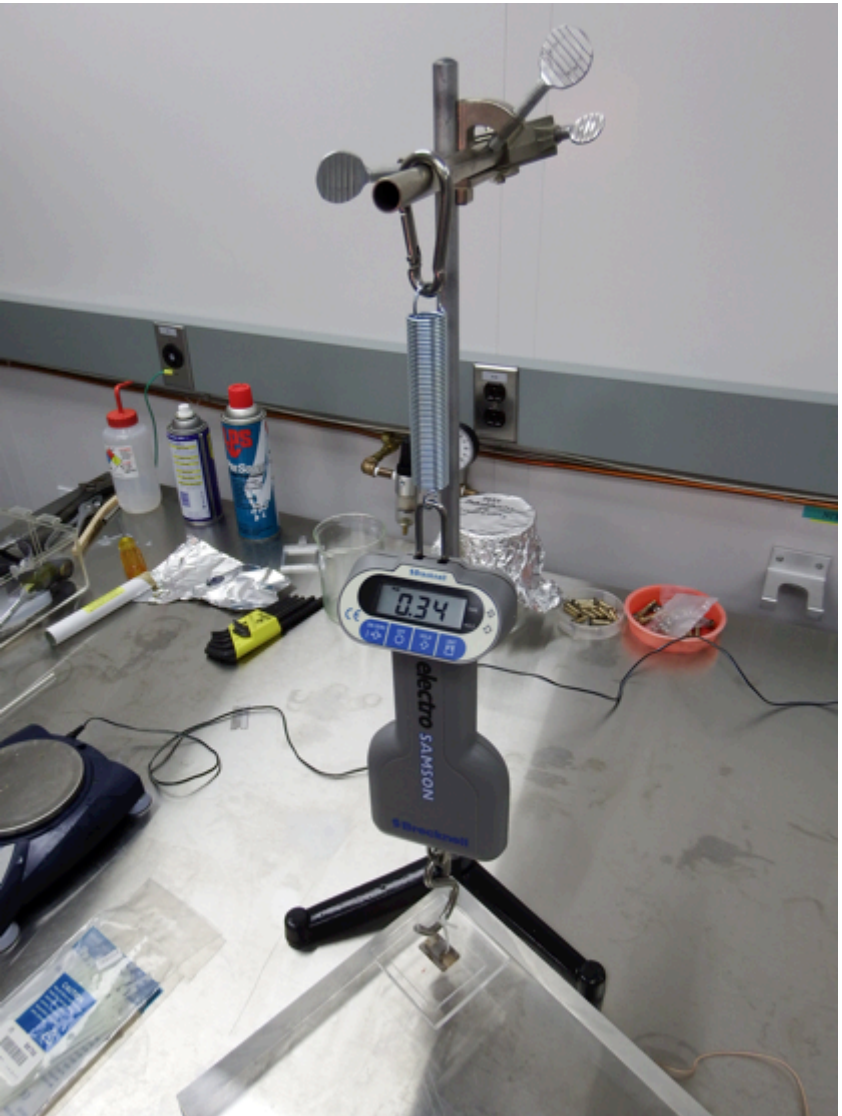
2 mm thick cookie just applied



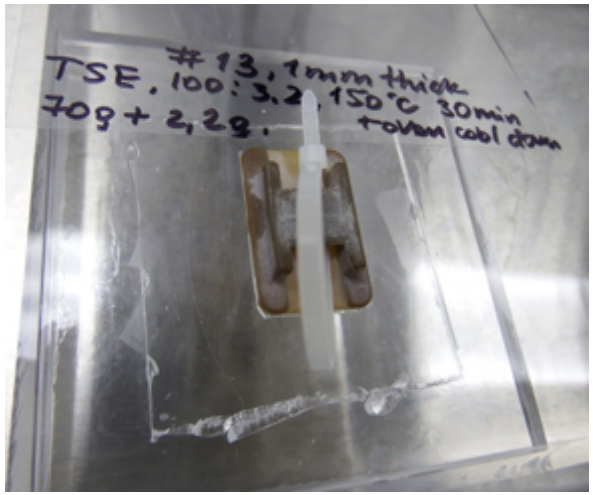
After 2 days under 852 g

Force needed to apply / detach cookies

Important for design of the support for PMTs and electronics



Curved cookies → bad coupling at the rim:



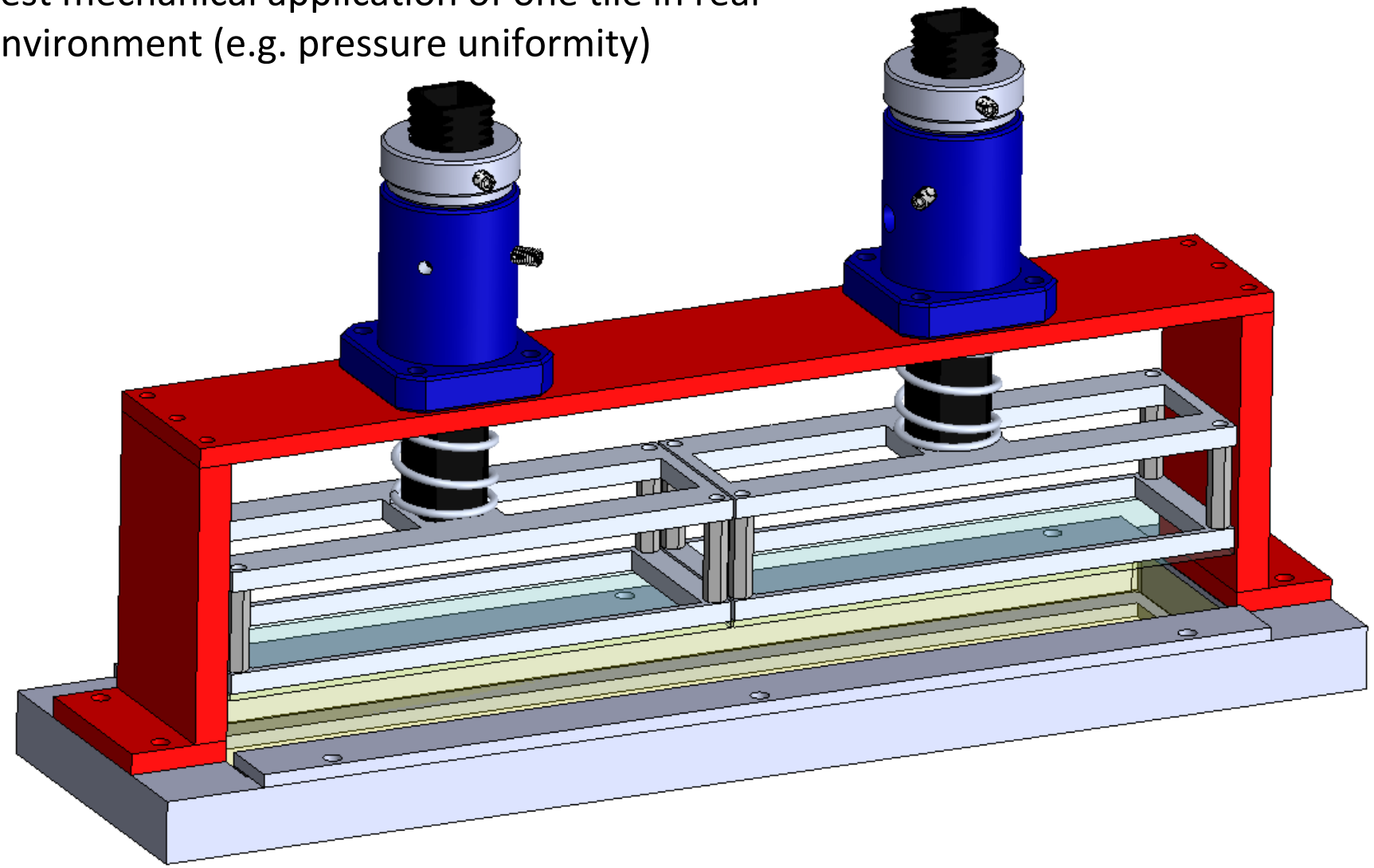
→ Need molds with flat sides

Force to apply: < 0.5 kg / PMT

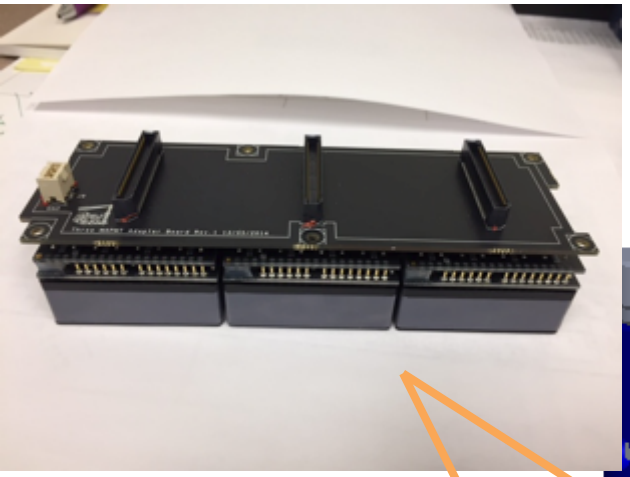
Force to detach (after 2 month): 2.5 kg / PMT
→ Need a tool to insert under PMT while detaching

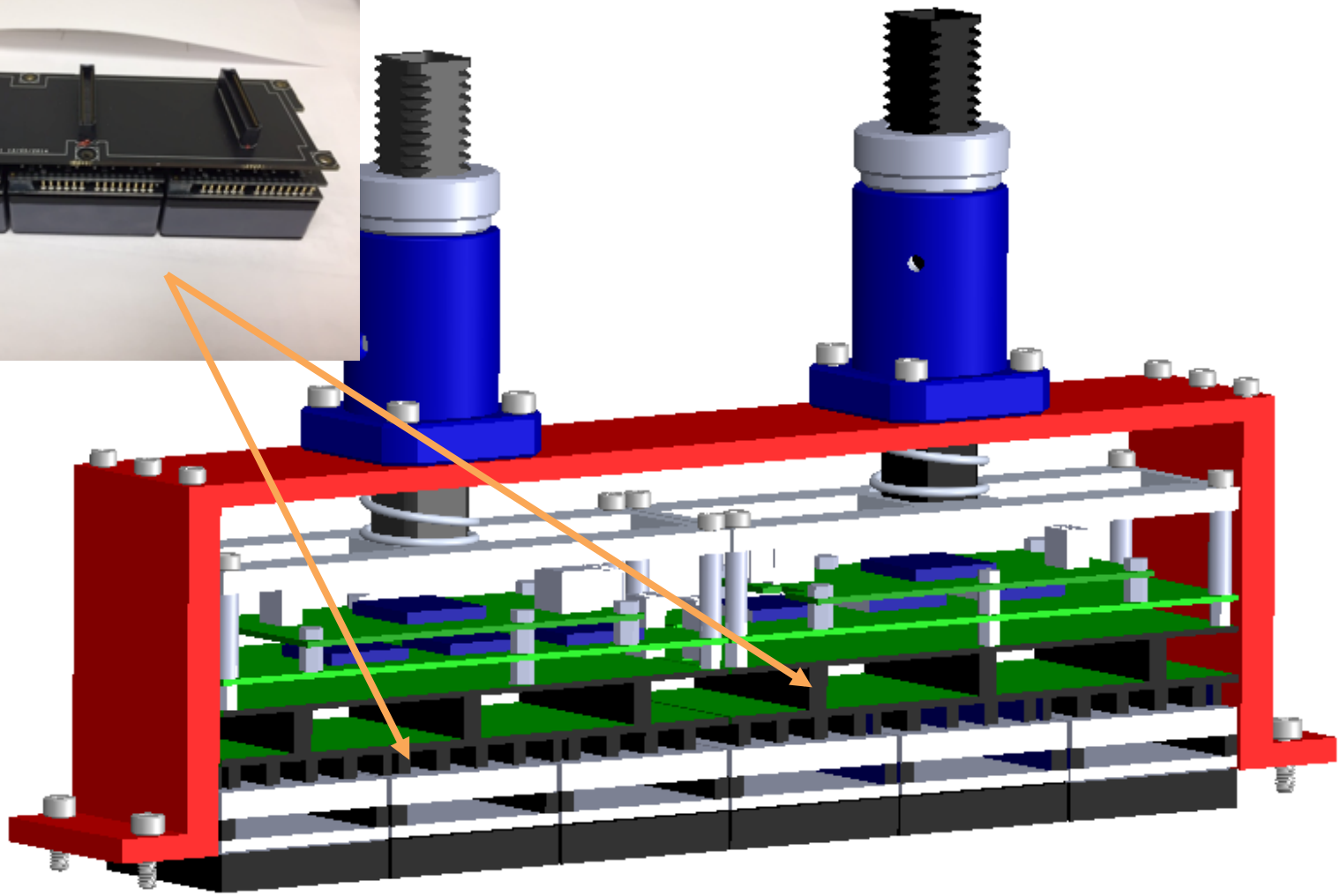
Red bracket is under development

Test mechanical application of one tile in real environment (e.g. pressure uniformity)



Red bracket with PMTs and electronics





Results:

- A procedure to produce cookies is developed based on the experience of Belle II
- We decided on RTV615 silicone, 1.5 mm or 2 mm thickness, cure at 100°
- Cookies with good transmittance were produced, they should be pushed with < 0.5 kg/PMT

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- A procedure to produce cookies is developed based on the experience of Belle II
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Coming soon:

- New batch using flat cheaper molds and RTV material
- Some pre-made Eljen560 cookies to compare
- Red bracket + real tile (Fernando) to finalize
  - design of the support for electronics
  - cookie recipe

Molds

- 2 molds for 1x3 PMT array each
- Easy disassembling using extraction screws
- Teflon side has wavy shape developed by Belle II (depth = 0.05 mm)
- Different spacers - cookies with thickness of 1 mm, 2 mm, or 3 mm can be molded