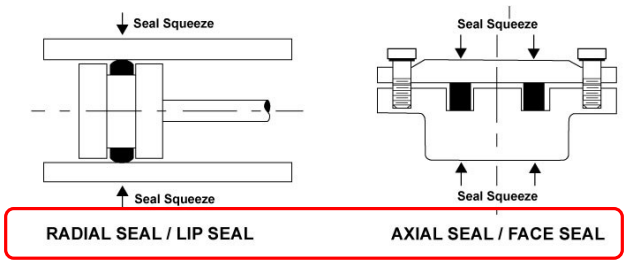
pfRICH Sealing Concept

Alex Eslinger (Jlab)

6-3-2024

Problem Overview

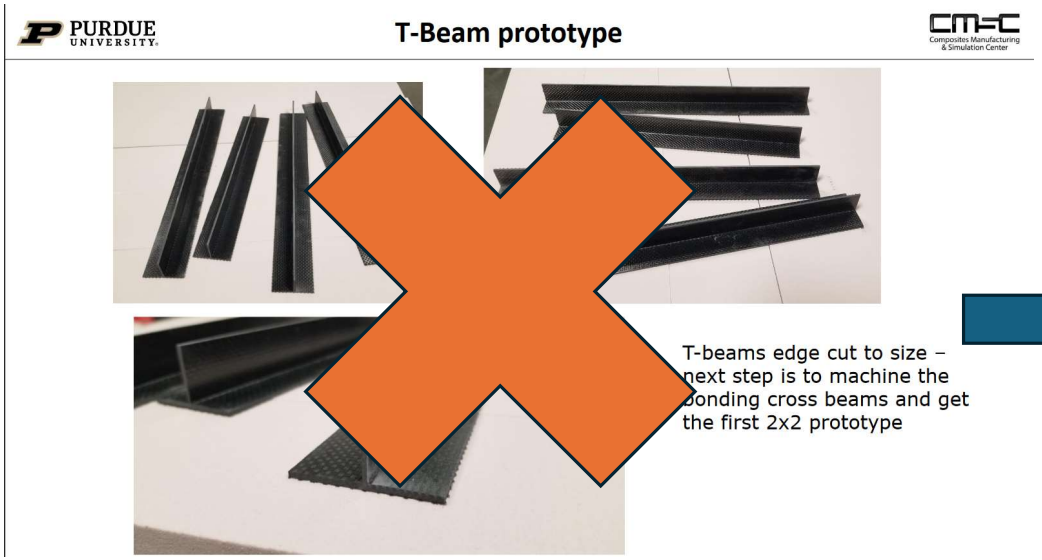


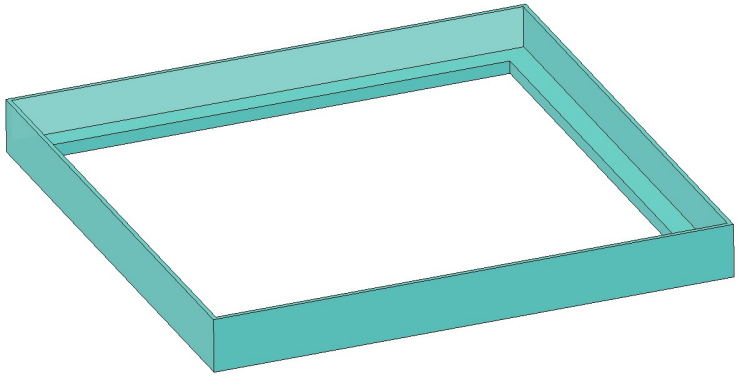
- An o-ring is the ideal sealing method for the HRPPD-to-Sensor plane interface.
  - If you use a face seal, you need a consistent number of fasteners around the perimeter of the HRPPD to apply a constant uniform pressure on the o-ring
  - If you use a radial seal, you can “design in” a taper that applies pressure to the o-ring seal during installation. Much less hardware is needed to get a uniform seal
- The maximum wall thickness between the tiles is 3mm. Any more thickness will mean the sensors pockets would run into our bolt circle/o-ring/end ring sealing area
- The HRPPDs for the prototype design have already been fabricated. We cannot go back and add an o-ring groove to the ceramic now to create a radial seal. (It might be possible to add it into the final design run?)

Problem Overview (Cont'd)

- We also need to ensure that the sensors aren't part of the loading path, meaning the sensor plane structure should stand on its own.
- The ideal location for any sensor hold down hardware also happens to be where the rigidity of our "t-beams" or "sensor grid" lies. Tapping into the sensor grid at these locations would weaken the structure by causing a large number of discontinuities in the fiber running from one side to the other.

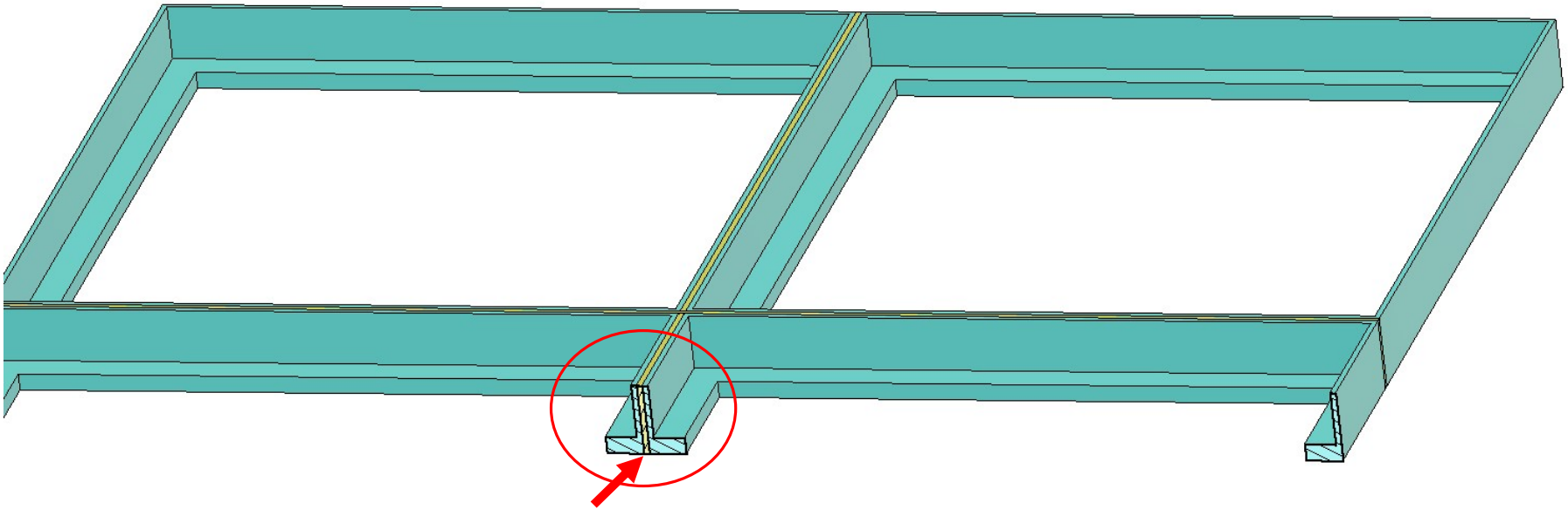
Proposed Solution





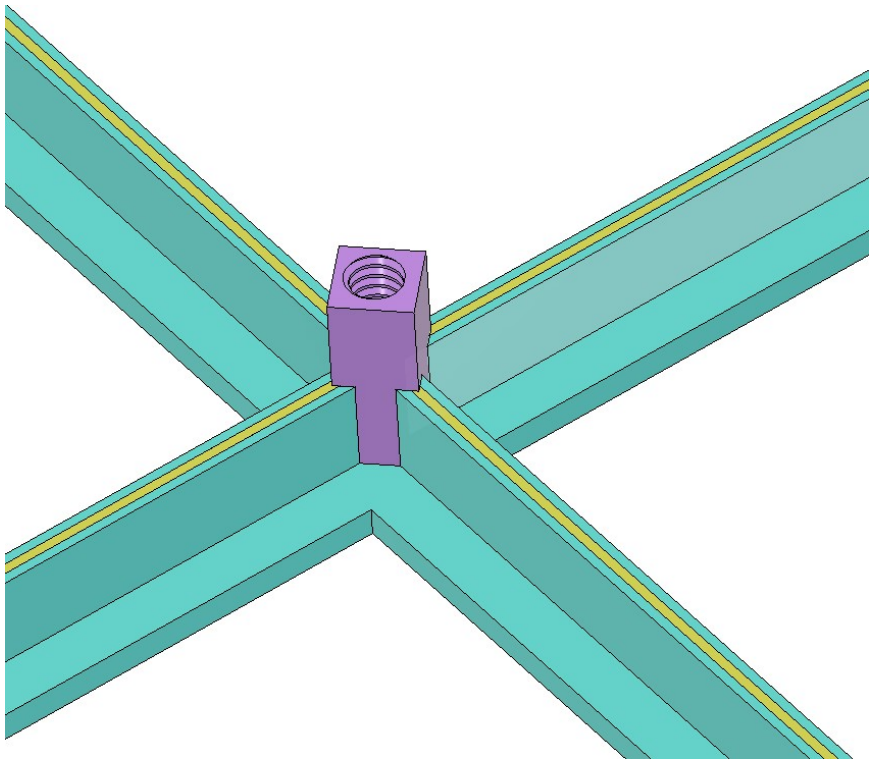
As proposed by one of the undergrads at Purdue, we could make “picture frames” instead of “T-Beams”

Proposed Solution (2)



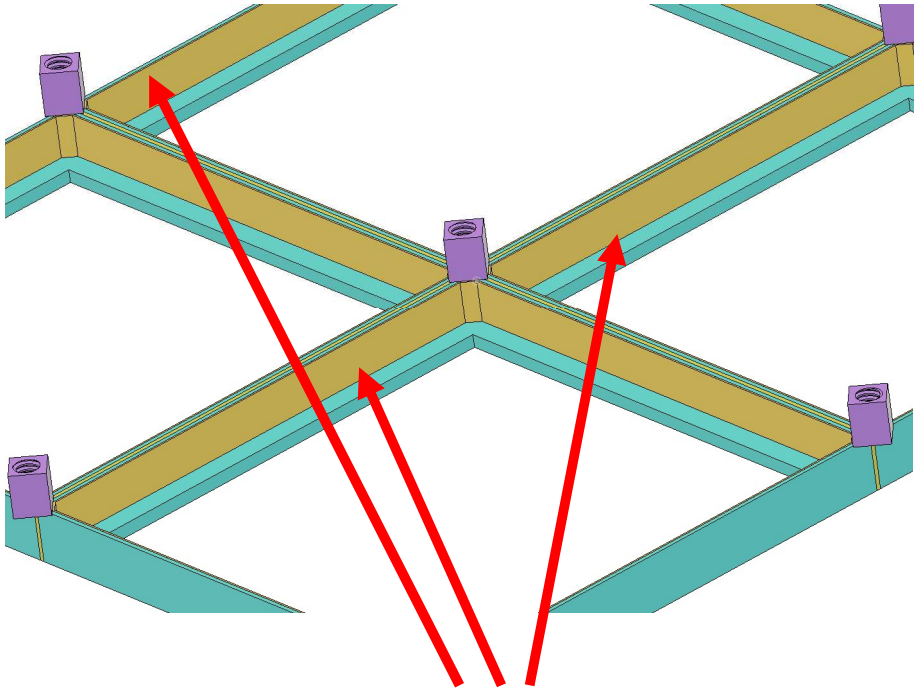
Seen here in cross section, you can tile the picture frames with a long, continuous “spacer” (yellow) that runs the length of the vessel in one direction providing stiffness where you need it while reducing some of the manufacturing complexities.

Proposed Solution (3)

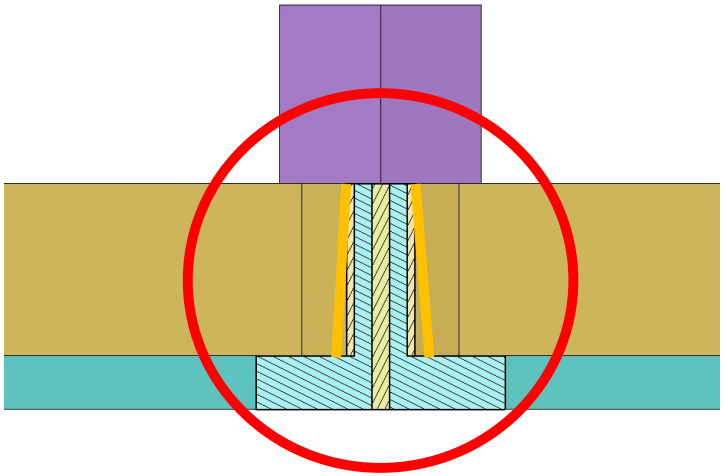


At the corners, in order to hold the sensors down, we can create a threaded boss that slips over the intersection. This piece can be 3d printed and epoxied into place. We can also use PEEK screws in order to reduce the overall material budget in this area.

Proposed Solution (4)

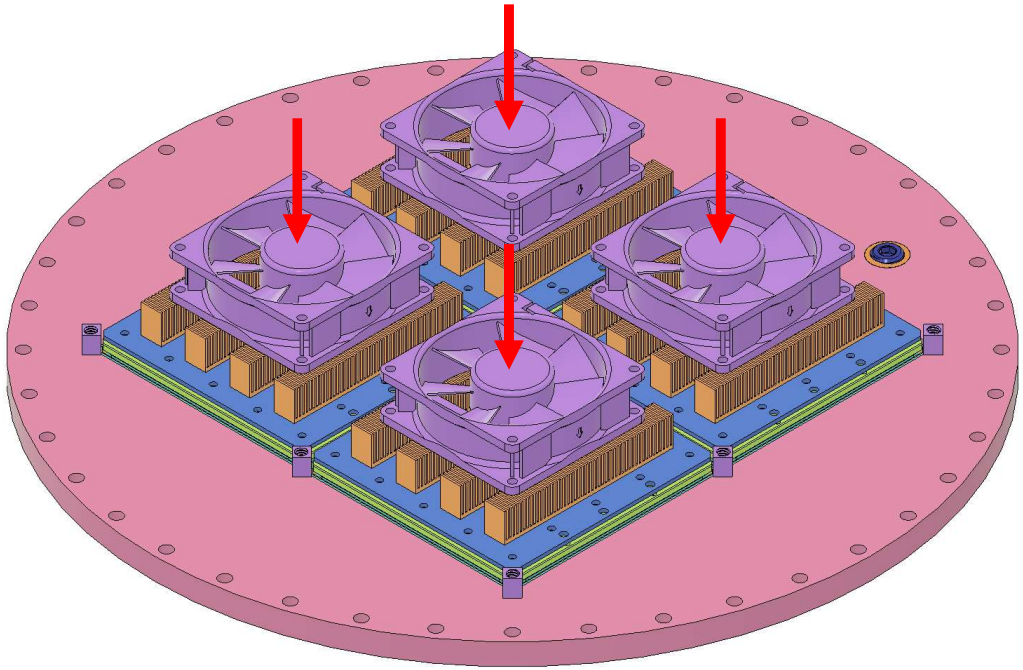


Cast platinum silicone seals could be added to take up the available gap between the sensor and the picture frames



Although not shown in this cross-section (drawn in orange), we can taper the seal in order to create a light press-fit as the sensors are being installed.

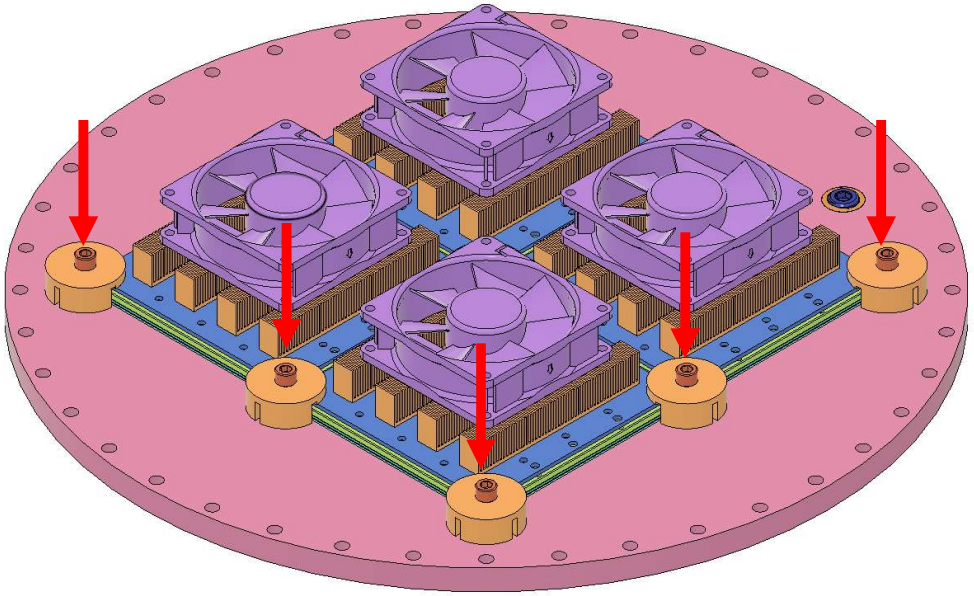
Proposed Solution (5)



Sensors can then be installed in the sensor plane

(Note: shown here is the “2x2 sealing prototype” which I will discuss later and HRPPDs equipped with fans which are not part of the final design)

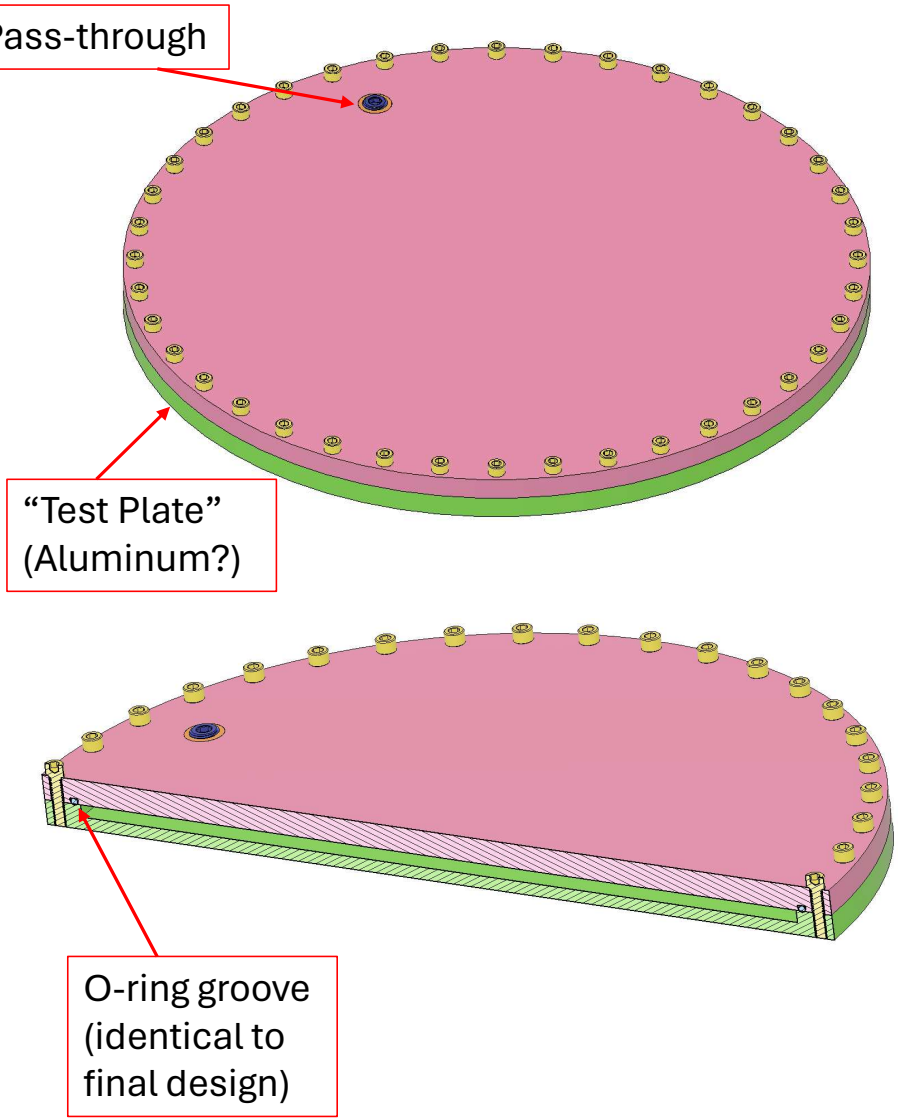
Proposed Solution (6)



Sensor hold-downs can be installed, holding the sensors in place, sealing them to the plane.

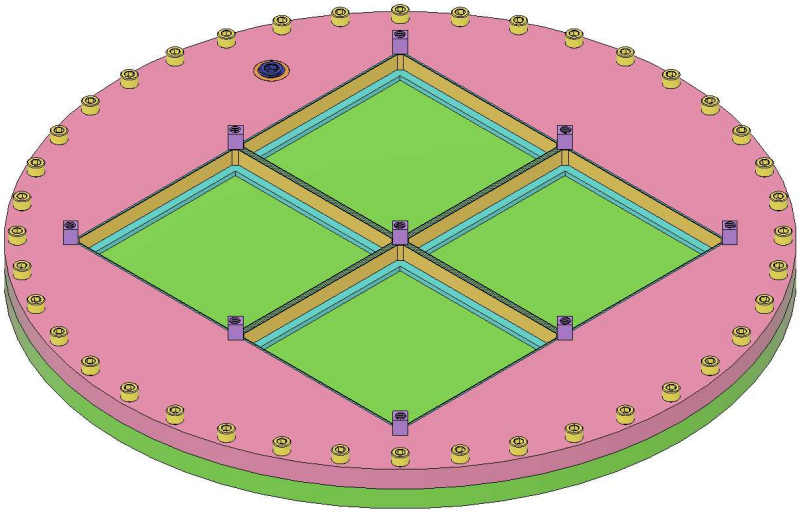
Putting it Together…

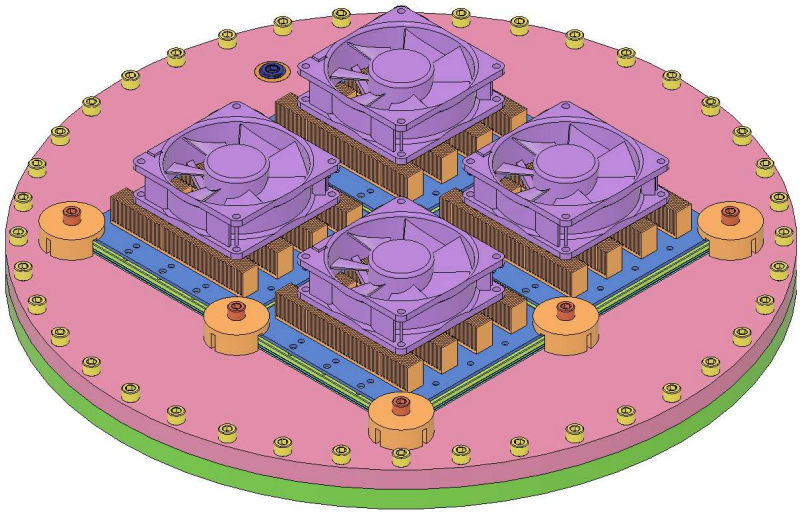
- To get a baseline for sealing, we could create and test the prototype sealing in two steps.
- We could test our o-ring and pass-throughs separately from the sensor sealing test
- Shown on the right would be the first test.



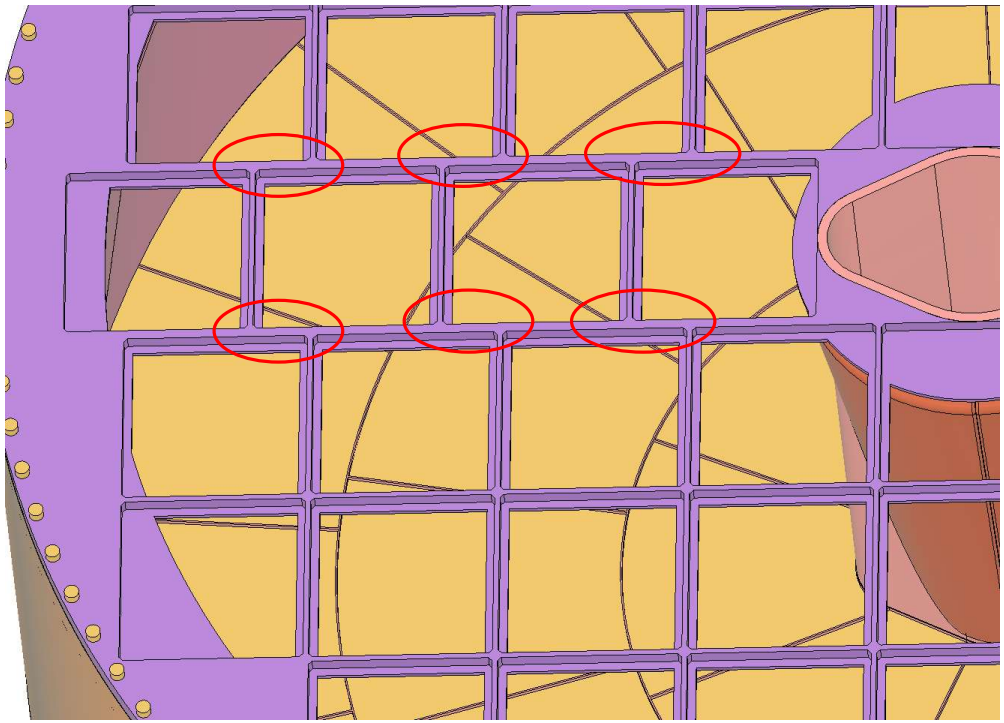
Final Sealing Test

- Once we have a baseline sealing result, we can make any design adjustments needed. Then, we can machine the square hole out of the disc, add in our picture frames and “dummy” sensors.
- Then, we can test the sealing that we have and make any further adjustments.
- (Shown on the right are HRPPD models filling the holes. For this prototype we could 3D print some “dummy” sensors that are of the same dimensions as the real ones and fill them to be of the same weight as the final HRPPDs. These will be useful when we perform later tests.





Future…



- This concept should work for the prototyping effort. However, in the final design, the sensor tiling shifts to accommodate the “avocado-shaped” beam pipe.
- Therefore, we’ll have to find an alternative hold-down solution for this area (possibly a CF beam across the sensors affixed on each end?)

Questions?