

"Real Space Modeling – Cassini and Huygens"

3D printing is all the rage, but what can be done to make a printed model look better?

Here I try to make a NASA 3D printed model of the Saturn orbiter Cassini and Titan probe Huygens more accurate and detailed.

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IPMS/USA # 40350



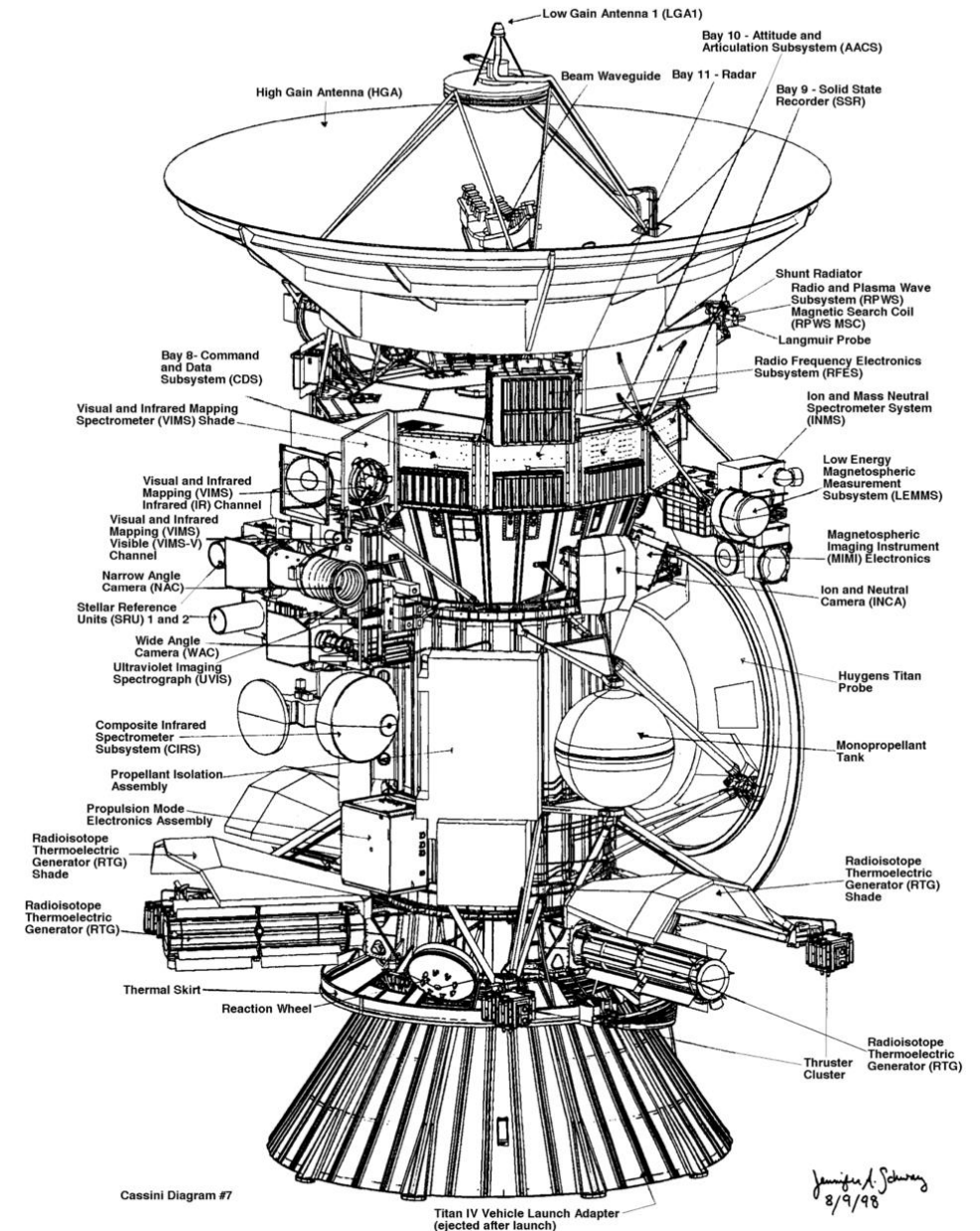
Cassini – Huygens Mission

- Cassini - Saturn orbiter
- Huygens - Entry probe for Titan
- Launch – October 15, 1997 (Titan IVB-B / Centaur D-1 T)
- Saturn orbit – July 1, 2004
- Huygens Titan landing – Jan. 14, 2005
- Destructive Saturn entry – Sep. 15, 2017



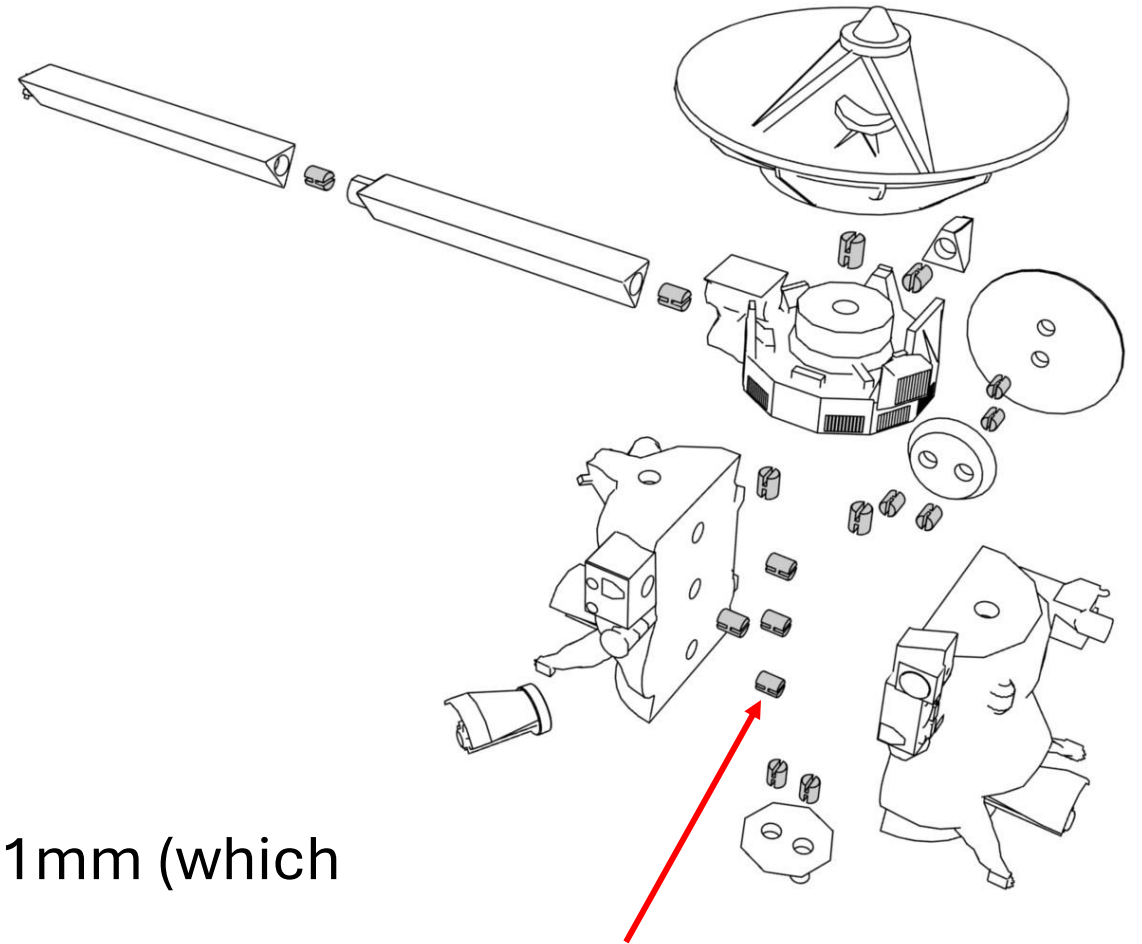
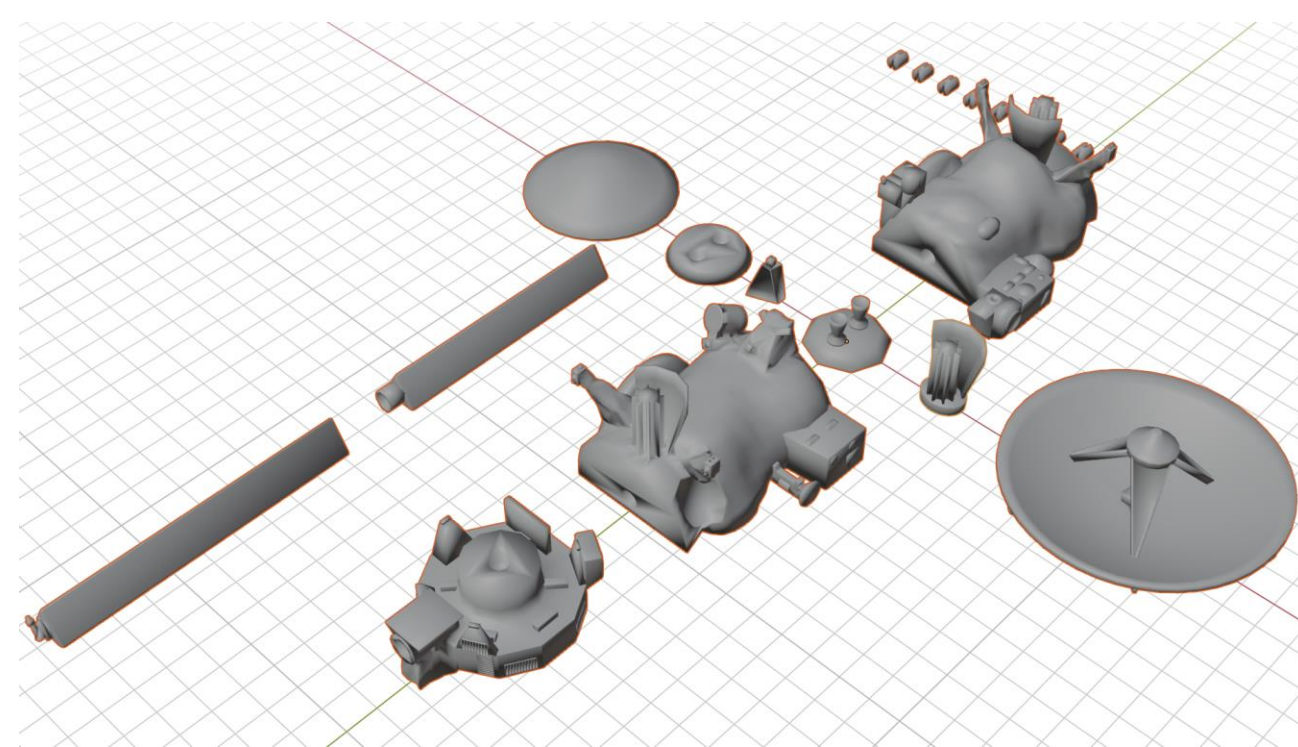
Cassini was a “Flagship”

- Very large spacecraft - Overall length 6.7m (22 feet)
- Weight - 5,712 kg (12,593 lbs.)
- Fuel - 2,950 kg (6,504 lbs.)
- High Gain antenna 4m dia. (13' 1.5")
- Huygens aeroshell 2.7m (8' 10") dia.
- Three F-series RTGs
- Imaging, fields/particles, radio science and radar
- Overall cost - \$3.9 billion
- NASA/JPL and ESA plus others



NASA Ames 3D model Cassini STL

<https://science.nasa.gov/resource/cassini-3-d-printer-model/>



Printing the file 'as is' the HGA diameter is 71mm (which works out to $4000 / 71 = 56.34$ scale).

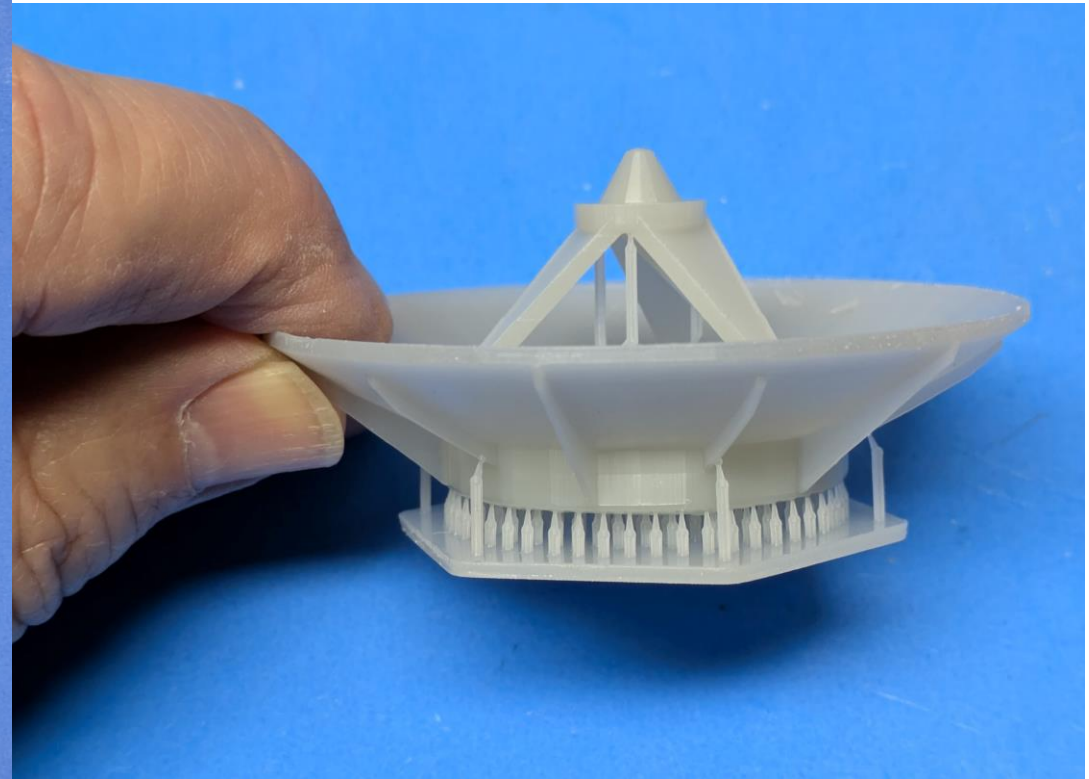
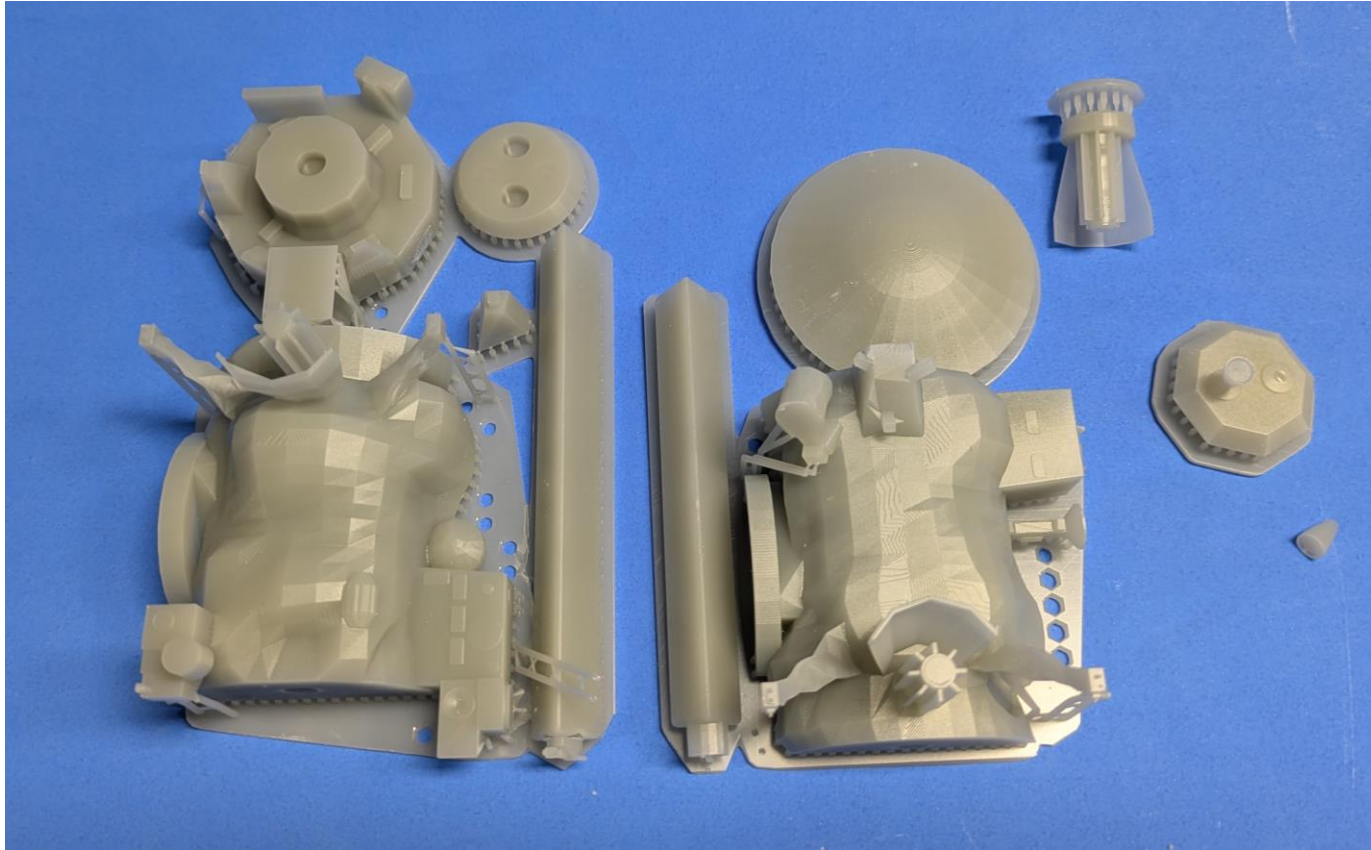
4mm (.157 inch) pins

What you get.

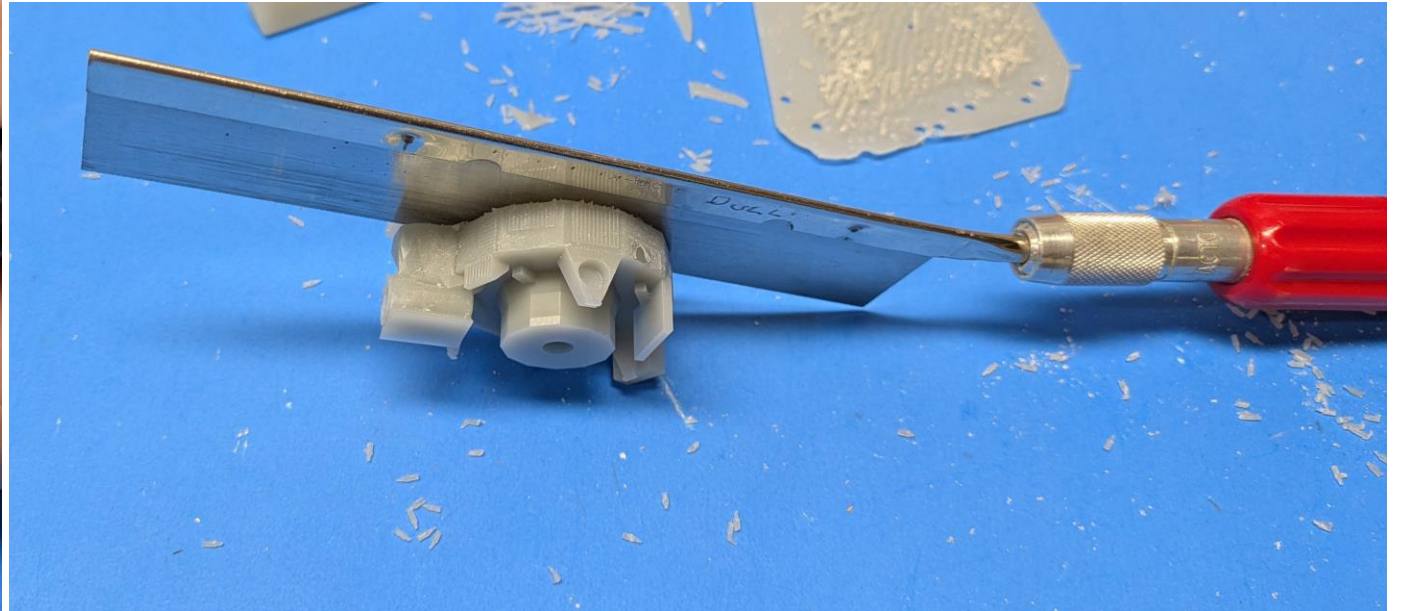
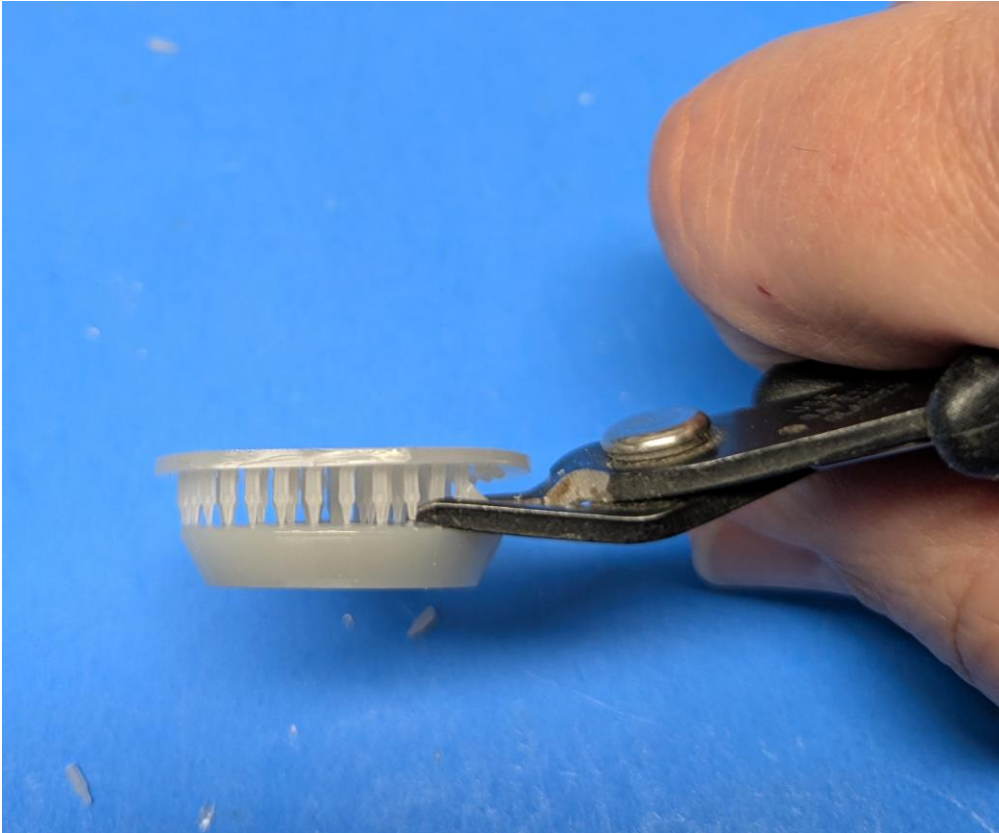


Cassini and Huygens IPMS/USA Fort Wayne Nats - August 2026

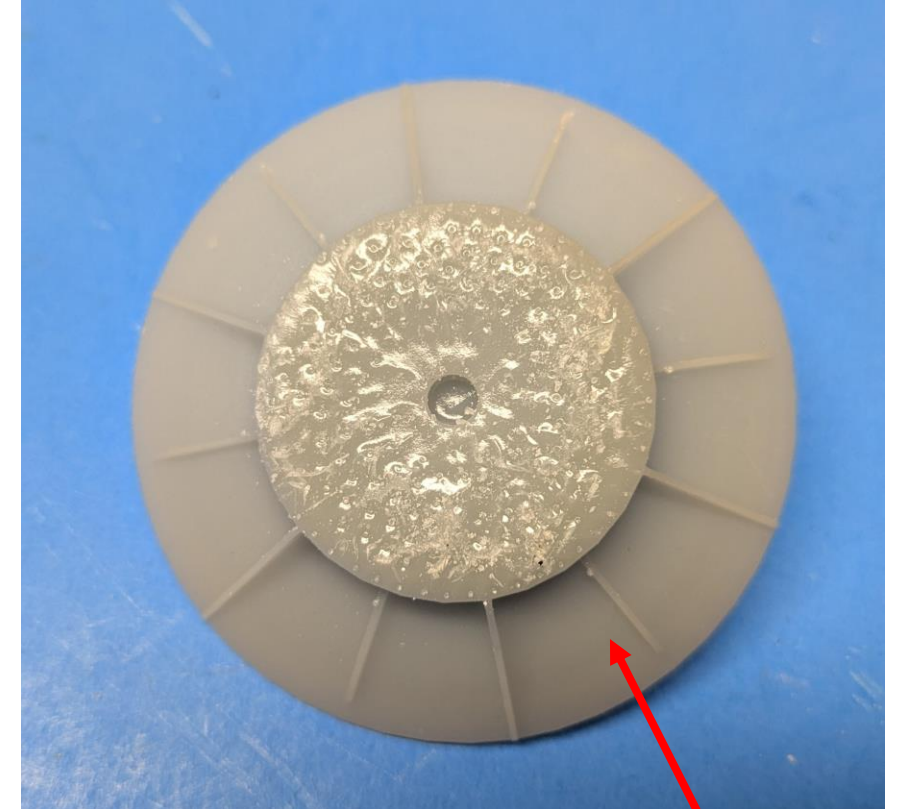
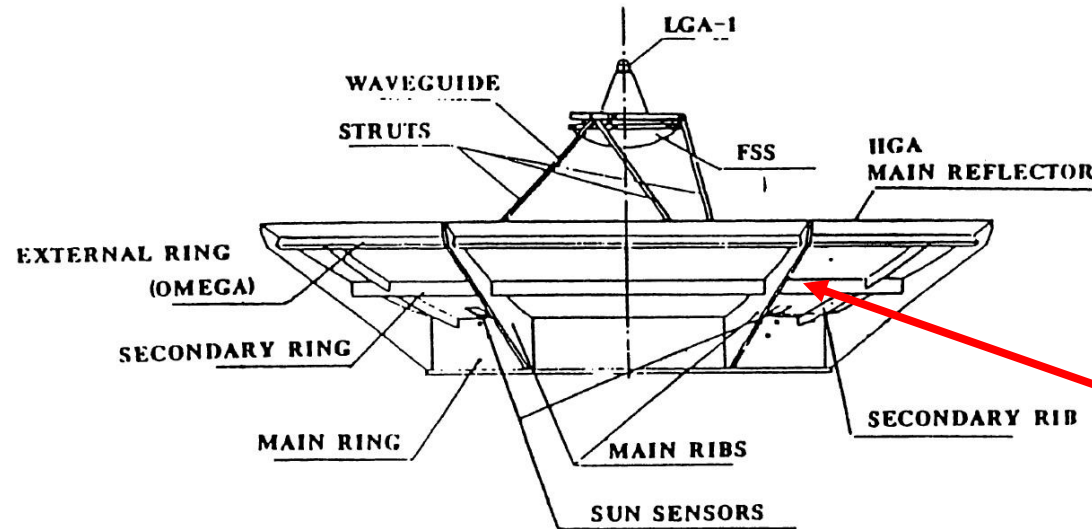
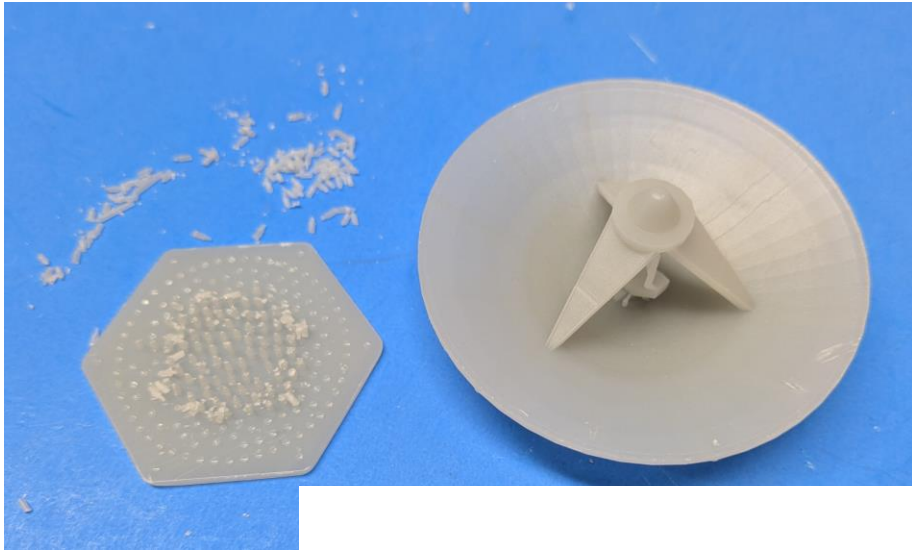
A friend printed the STL parts for me on his Anycubic M7 printer. This printer has a 14K resolution.



Removal of part supports. Sprue cutter and razor saw.

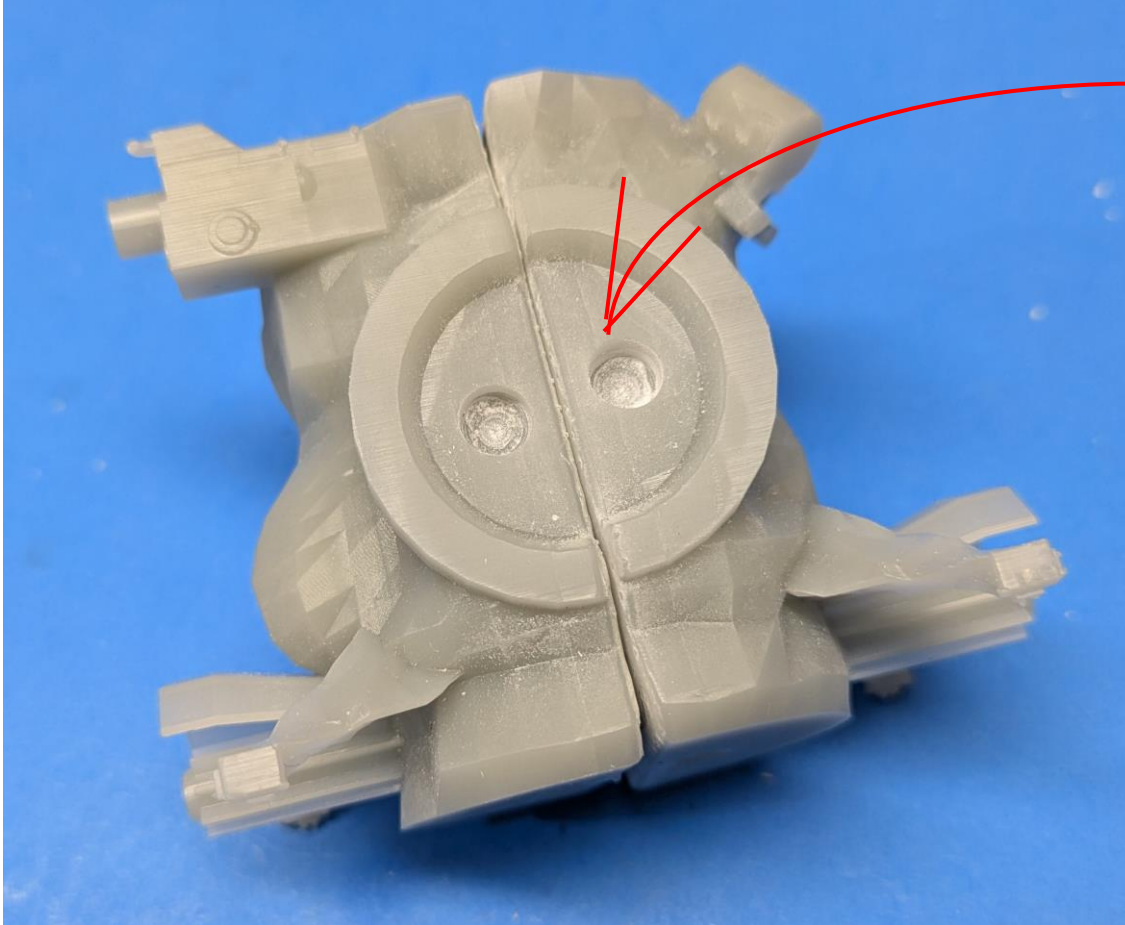


Clean up the parts. Part supports leave bumps.

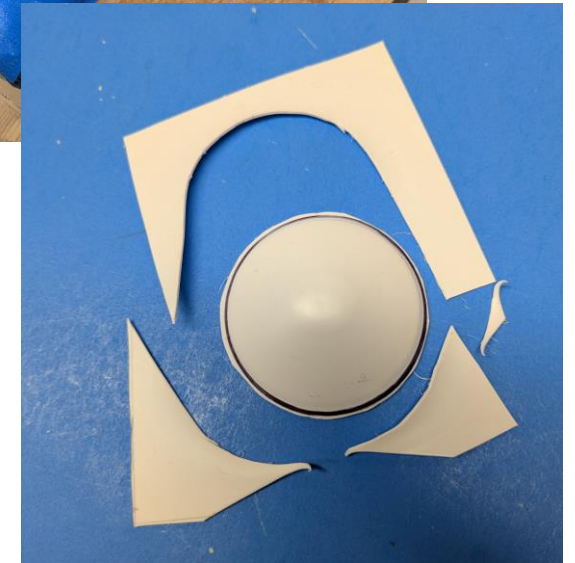
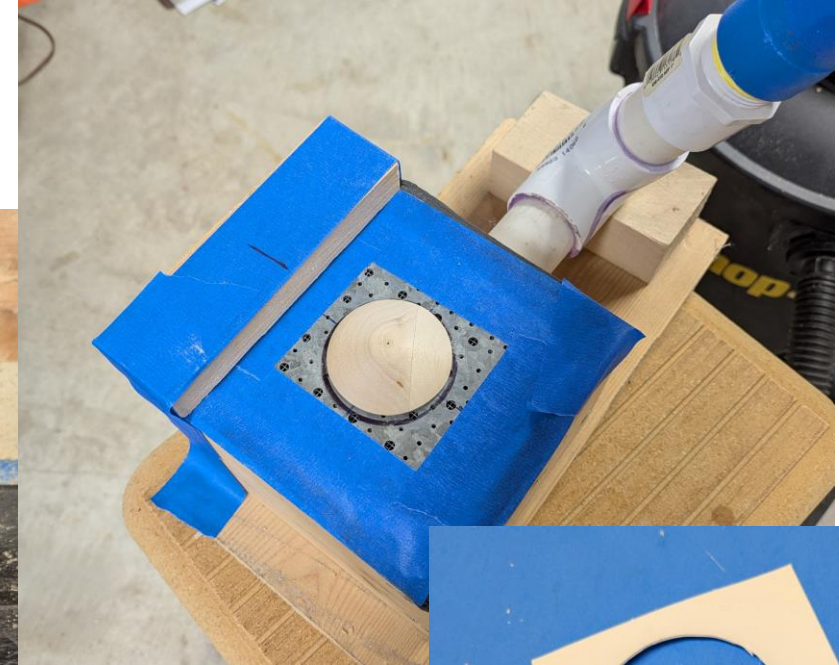
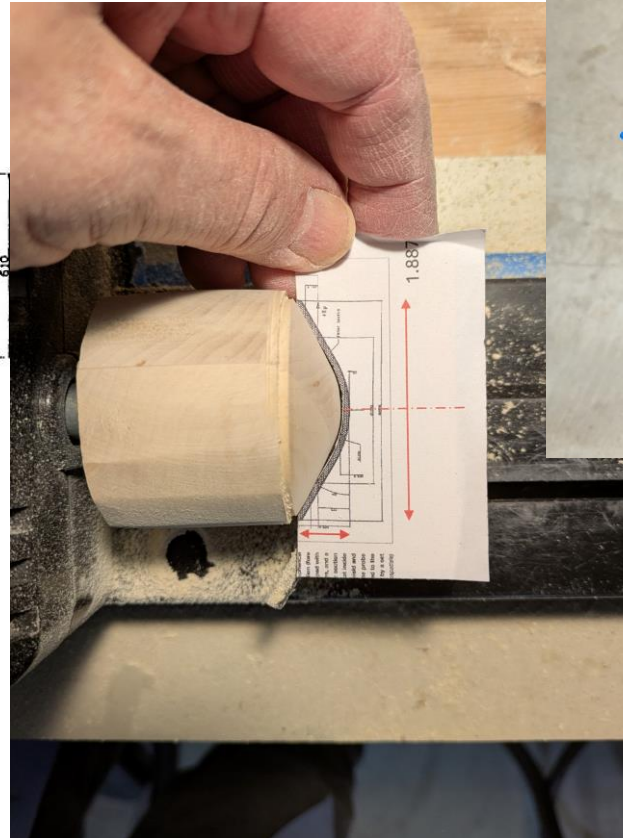
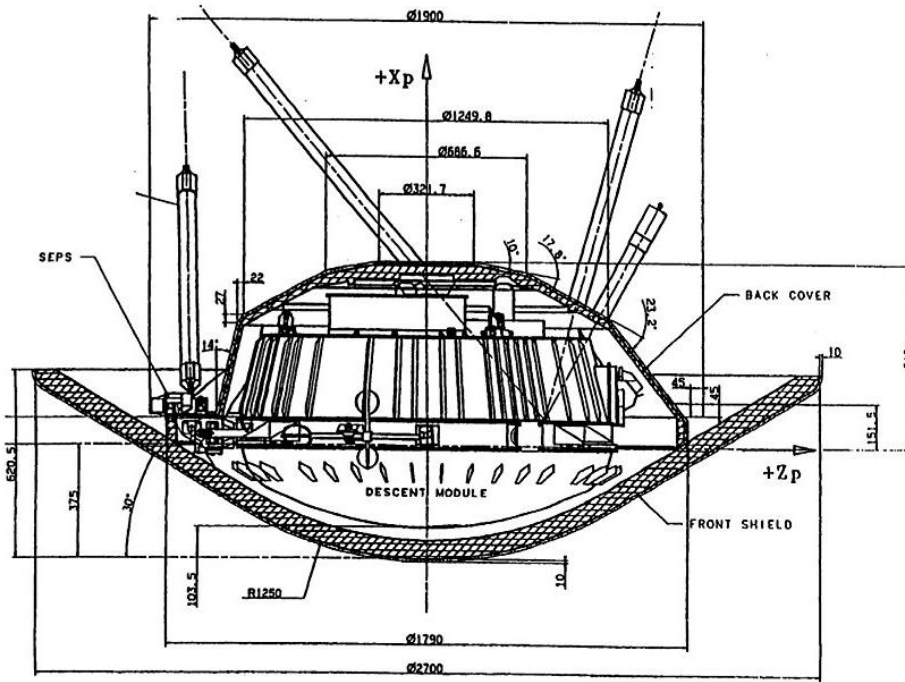


A lot of HGA ribs are missing.

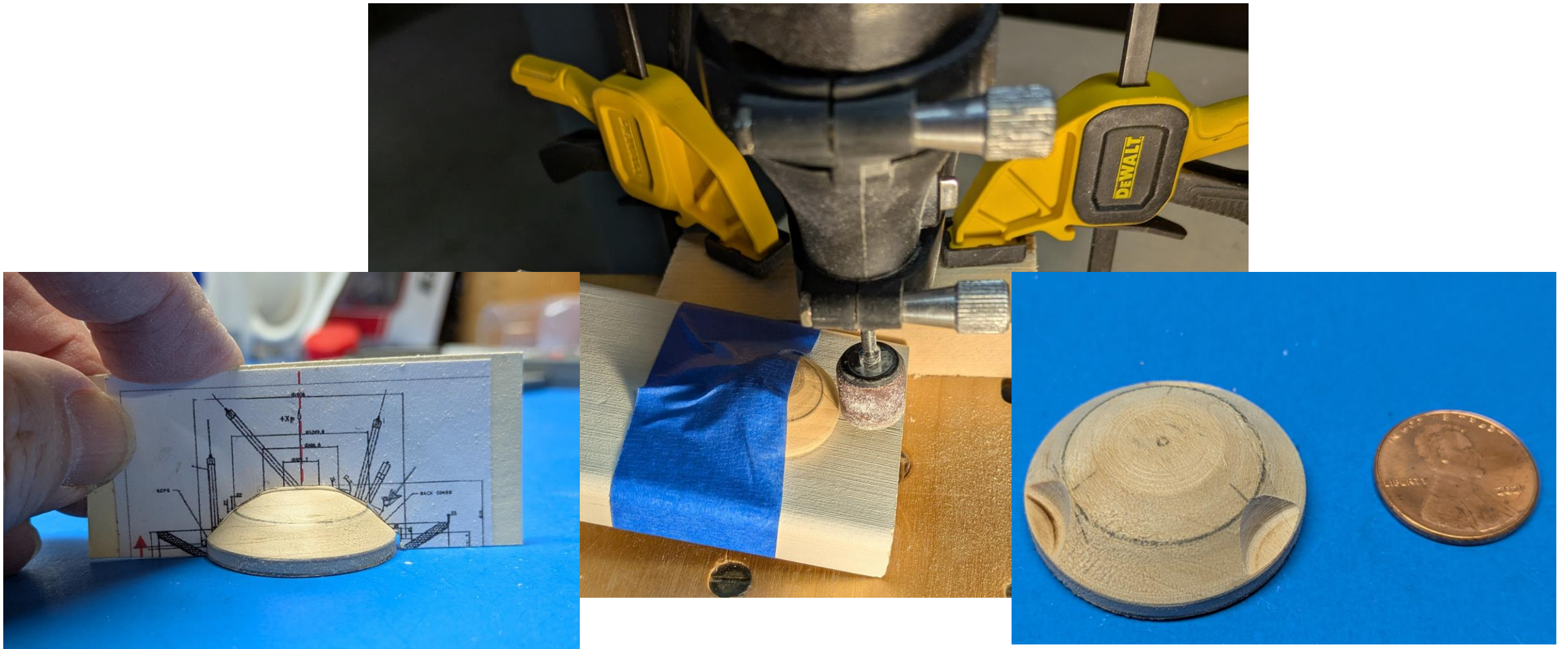
Solid Huygens aeroshell and the backshell is too small.



Vacform a new Huygens aeroshell.

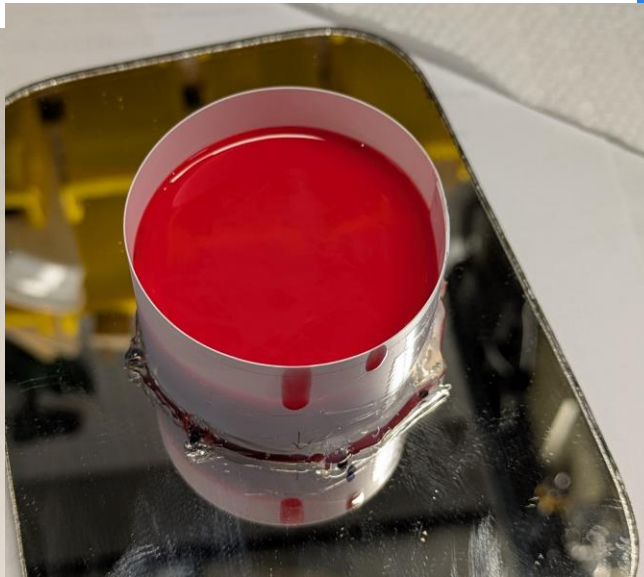
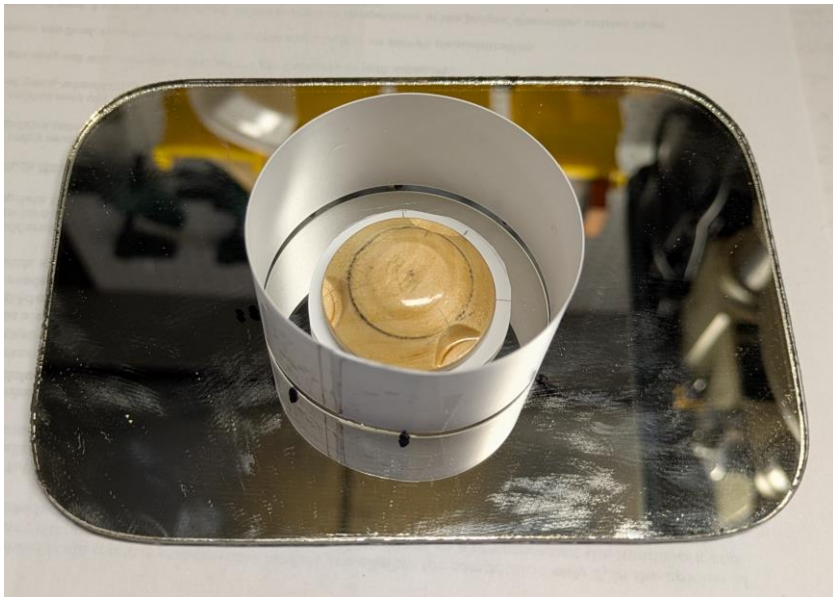


Make a new Huygens backshell.



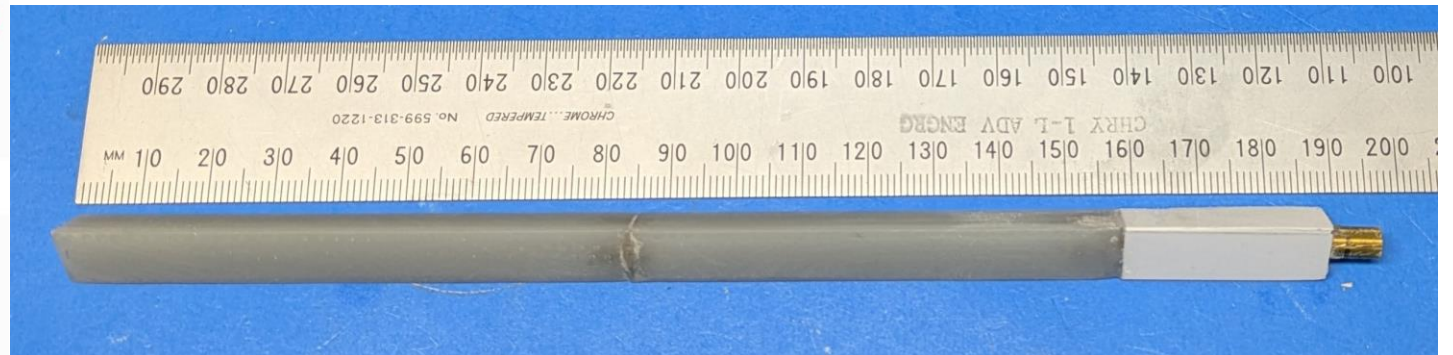
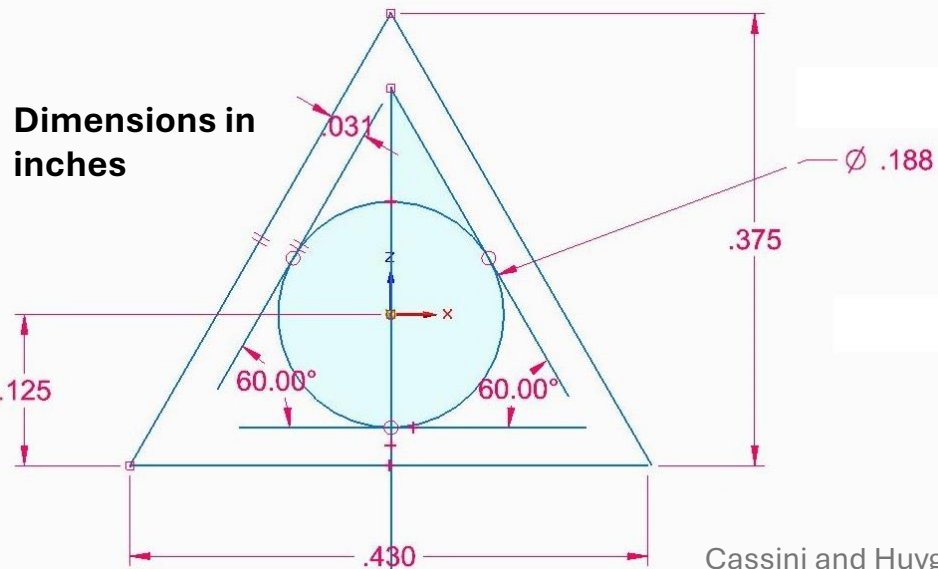
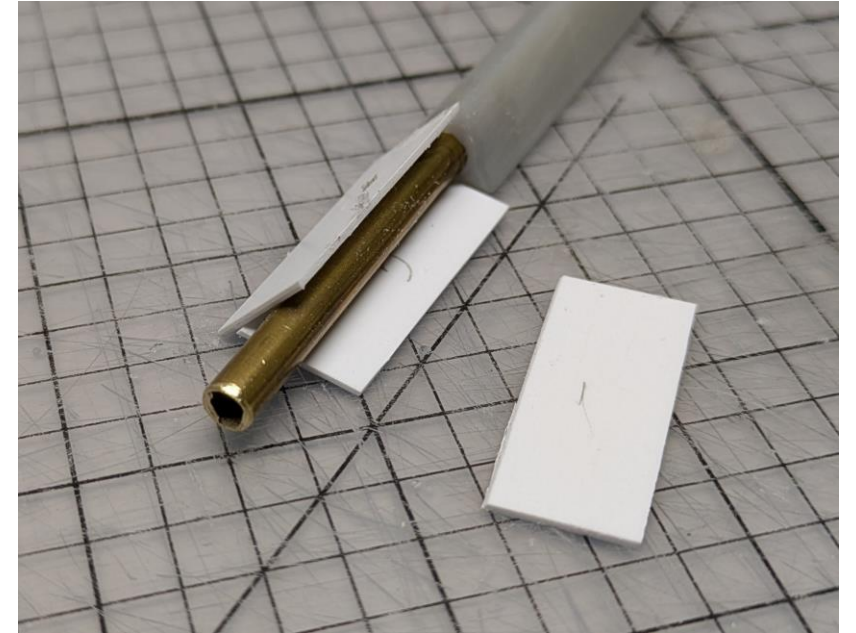
Created a resin copy in a one-part mold.

- Alumilite mold material and casting resin.
- Super easy.
- Casting the part in a cool basement made the resin cure sloooowlly...



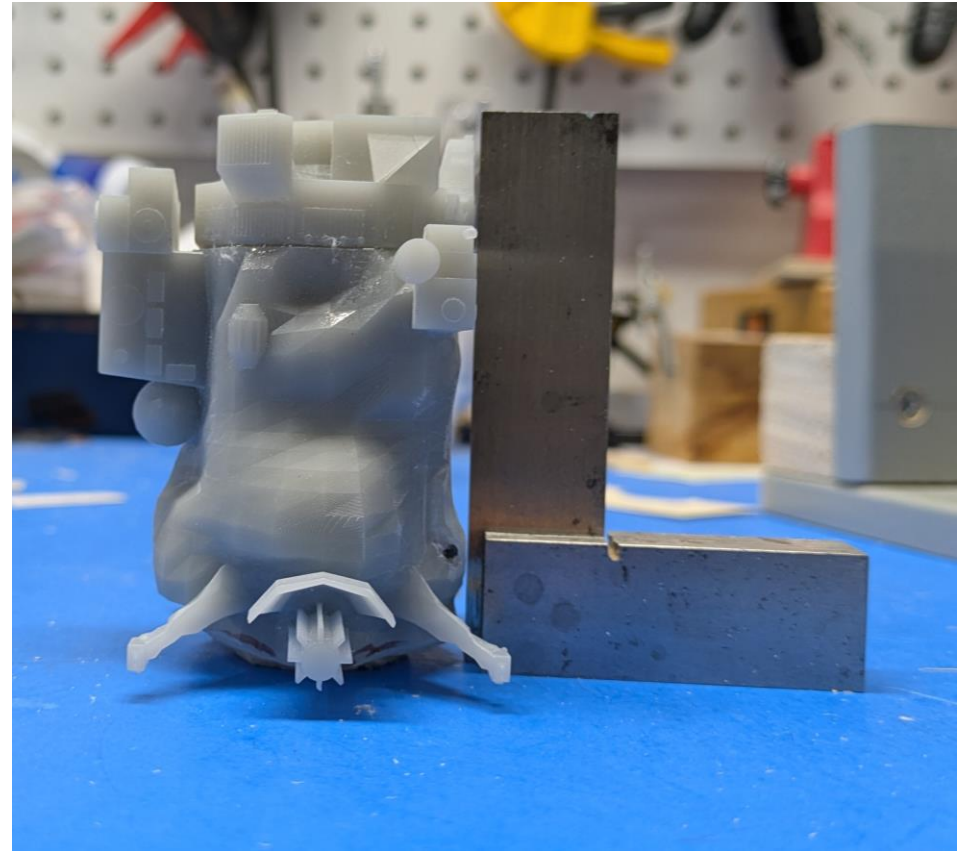
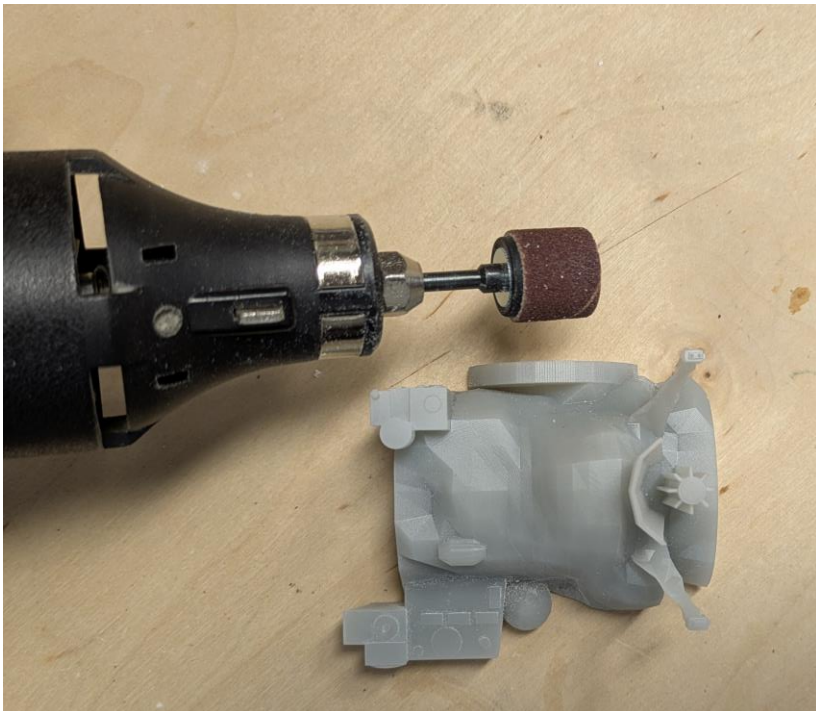
Magnetometer boom was too short

- Every reference said the boom was 10m long, but I found one magnetometer instrument reference that said it extended 10.5m from the bus.
- There was no 'step' at mid boom.
- A brass 3/16 inch tube plated with 0.030 styrene lengthened the parts and gave me a stiff attachment to the bus.



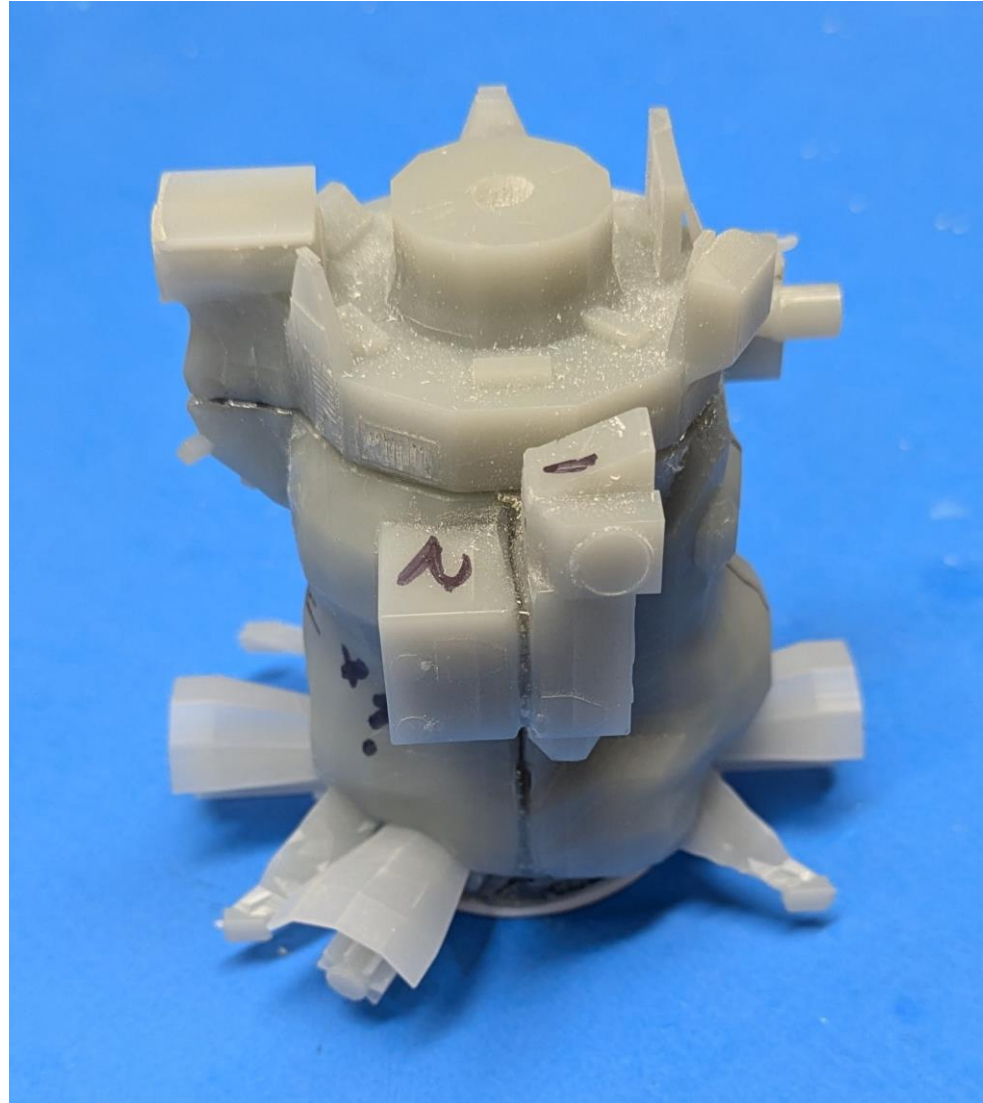
Modifying the bus

- Using a coarse Dremel drum sander I removed the printed Huygens support ring and deepened that area.



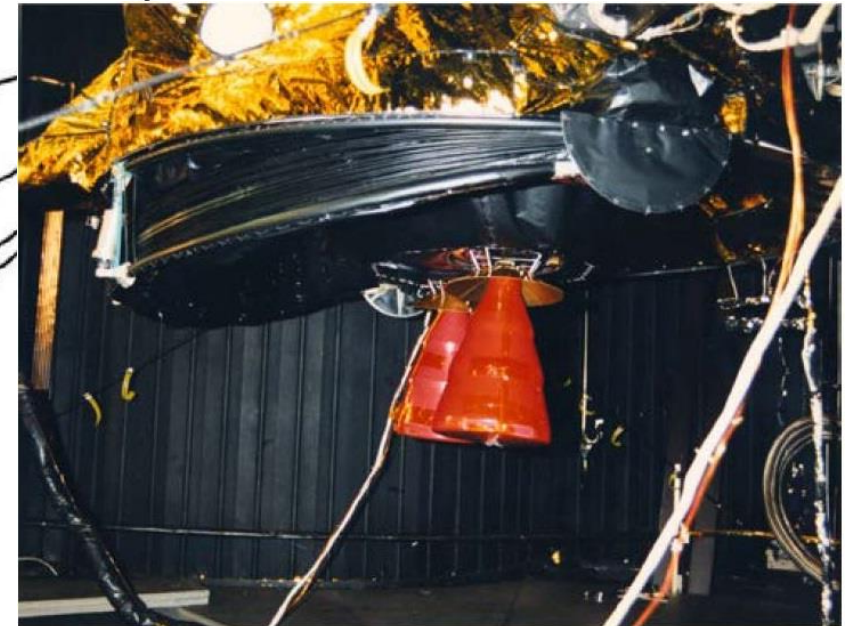
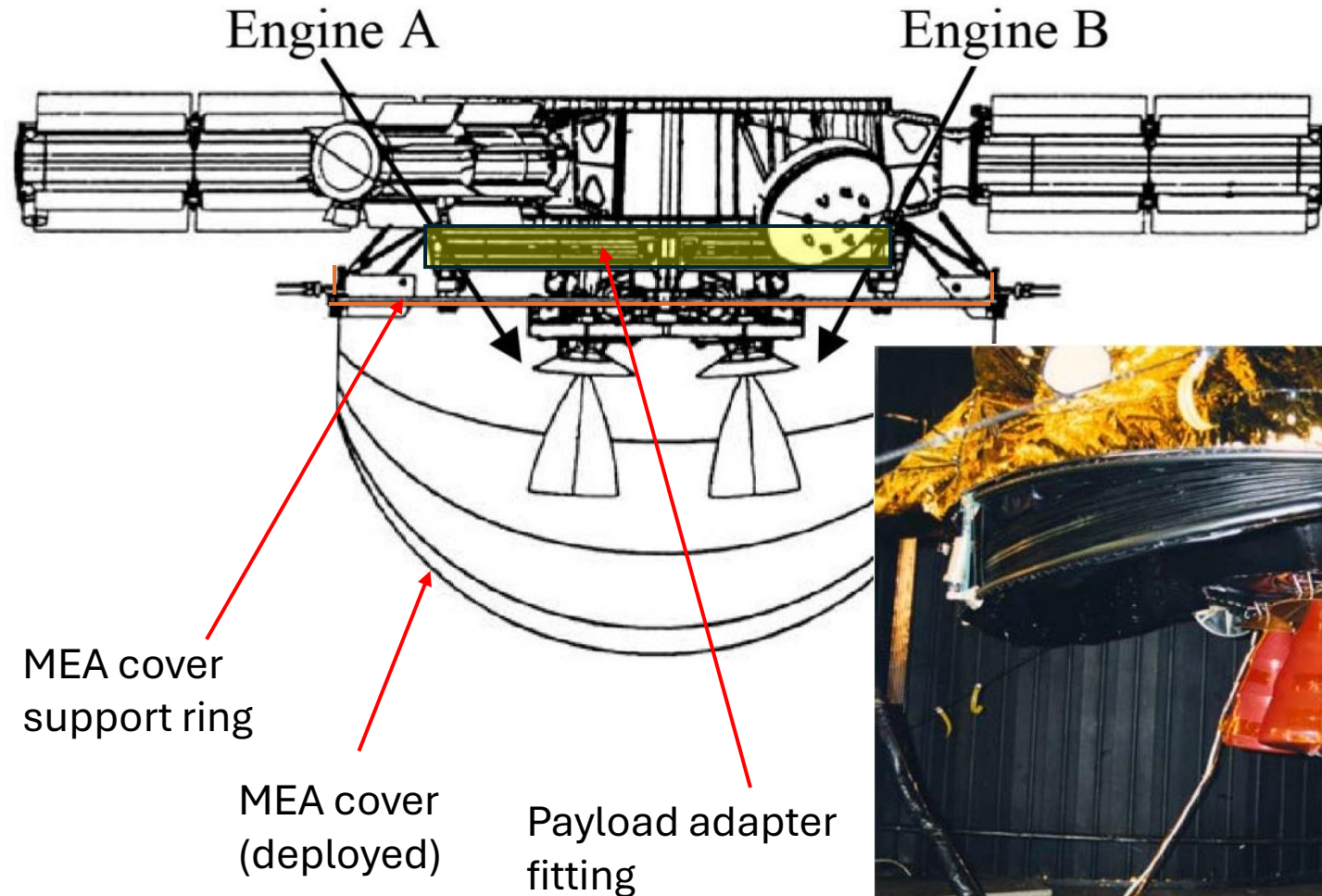
Bus assembly

- Sanded the mating surfaces flat.
- I glued the bus halves and the instrument bus together (5-minute epoxy).
- Filled the joints with epoxy or CA, depending on width and depth.



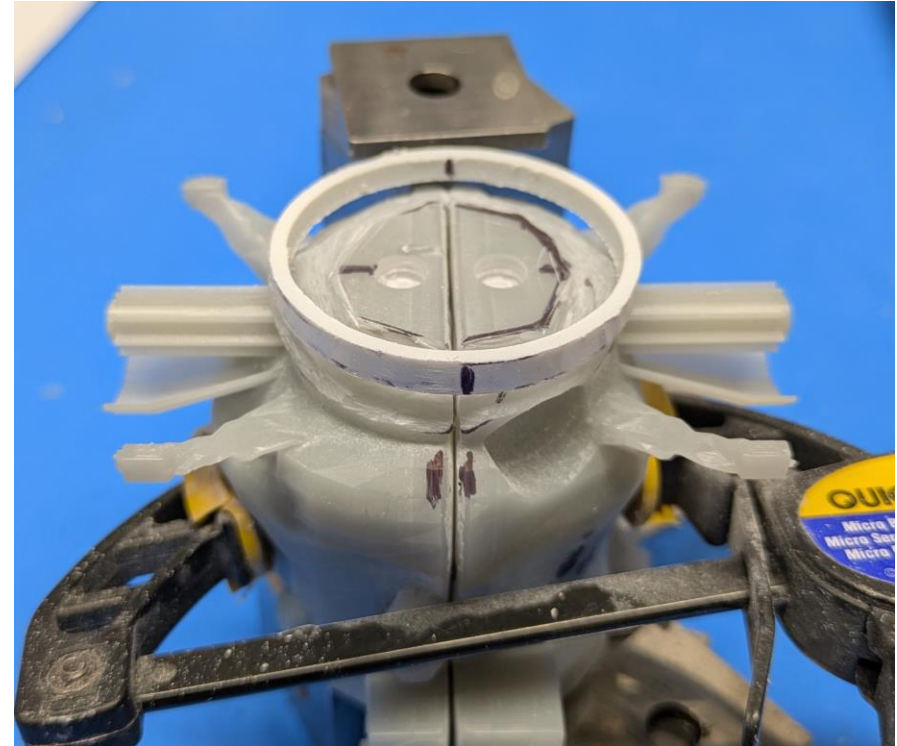
Main engine assembly (MEA) cover.

- I needed a bus aft end recess surrounded by a ring, not a flat ledge.
- The 3D parts included tiny conical engine bells but no motor engine assembly (MEA) cover.
- If I wanted to show the engine bells exposed, then I needed to create that cover (stowed).

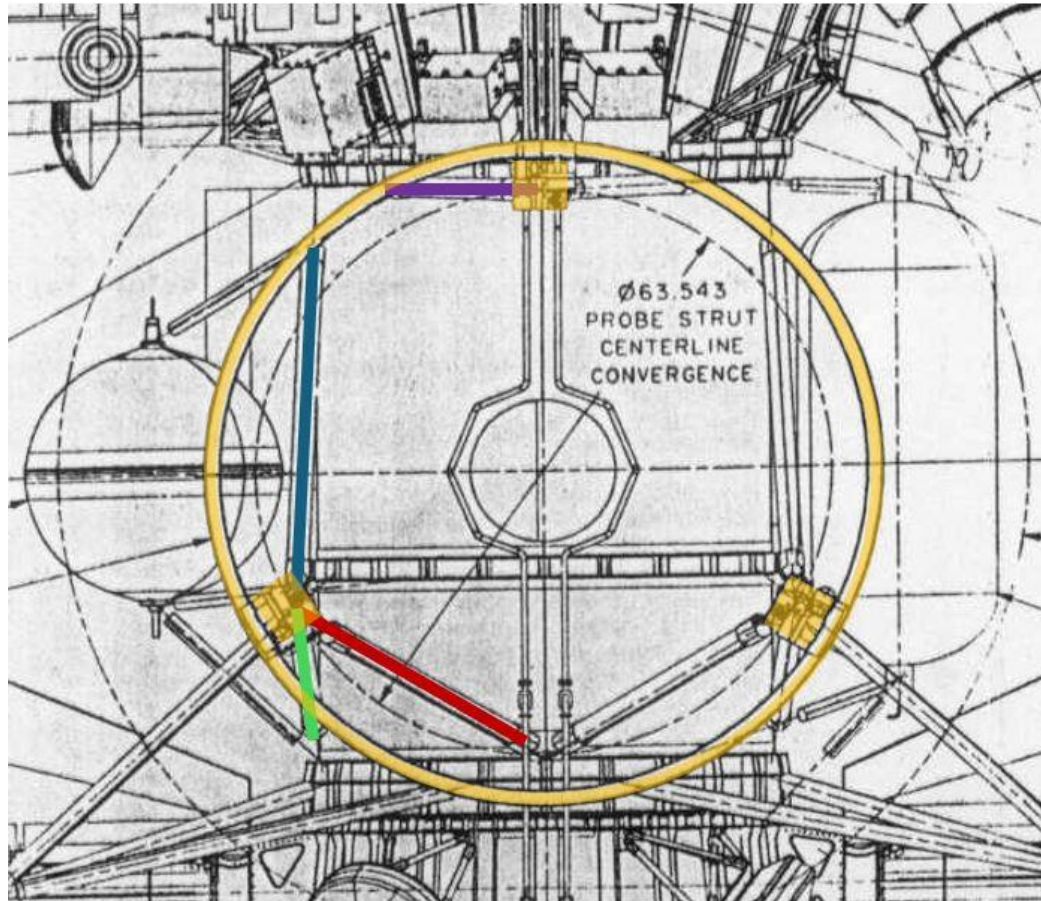


Creative destruction.

Sanded away the bus periphery.



Huygens mounting ring and supports



Support ring

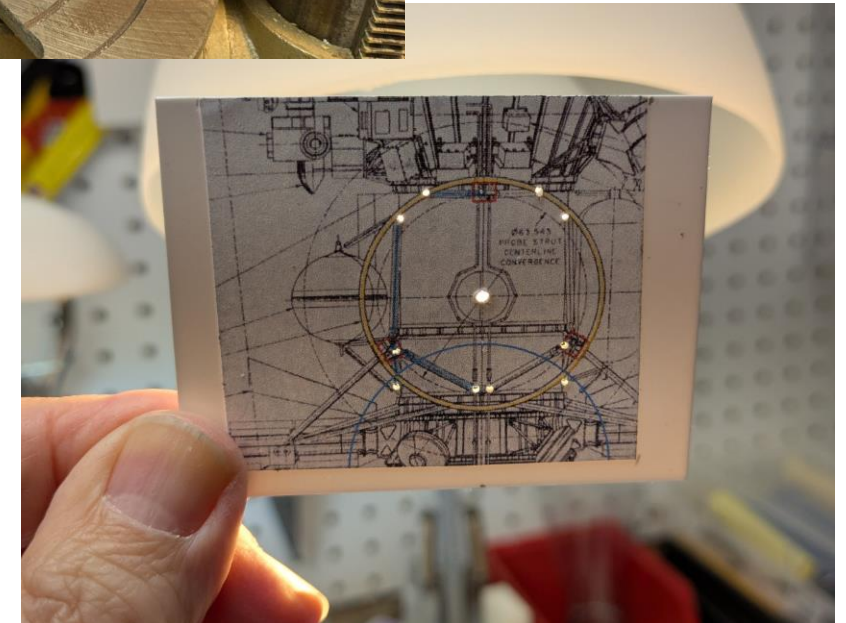
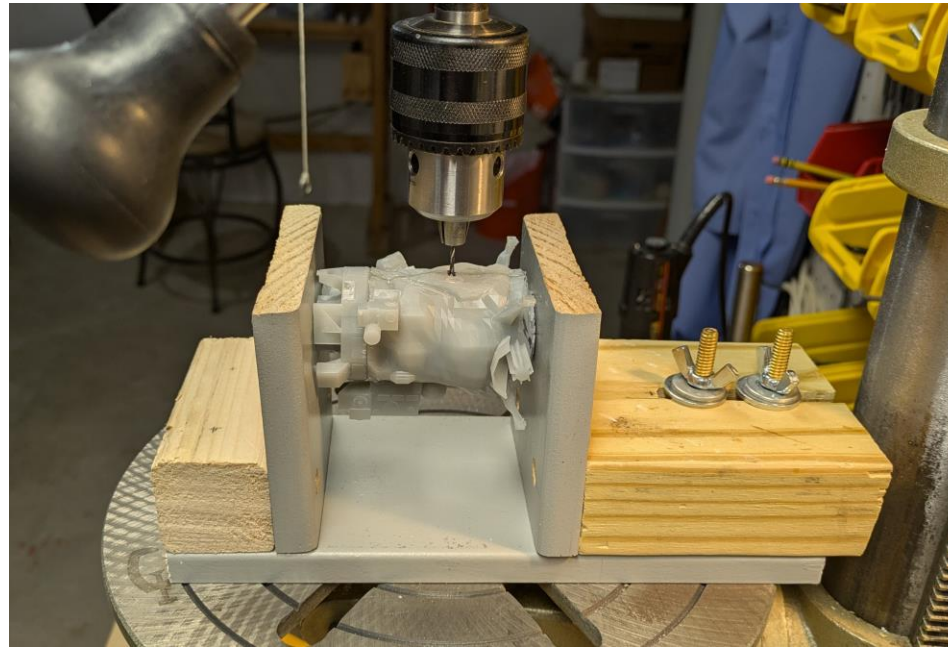
Bottom bipod
(1 per side)

Diagonal brace
(1 per side)

Top bipod

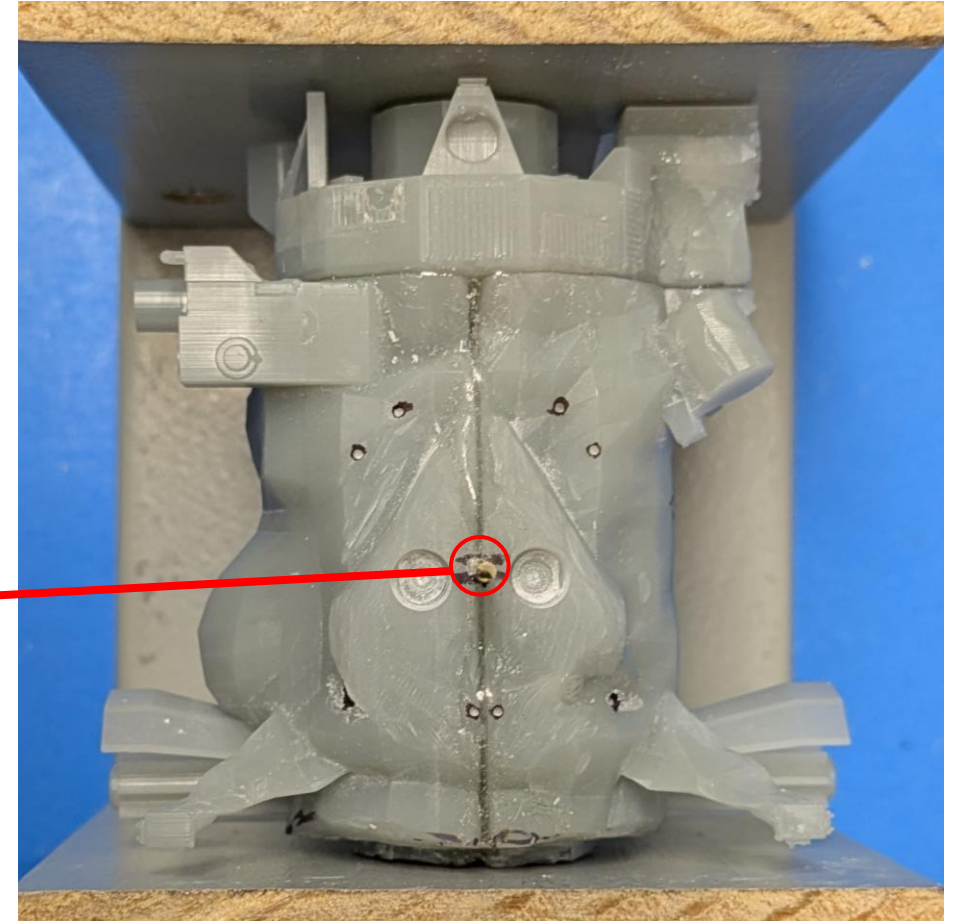
Jigs and fixtures.

- To locate the holes for the Huygens support ring I created a jig to hold the model.
- 1/16" brass pins anchor the bus on center.
- I scaled down a drawing of the support ring and supports, using that to drill holes in the bus for the Huygens ring supports.



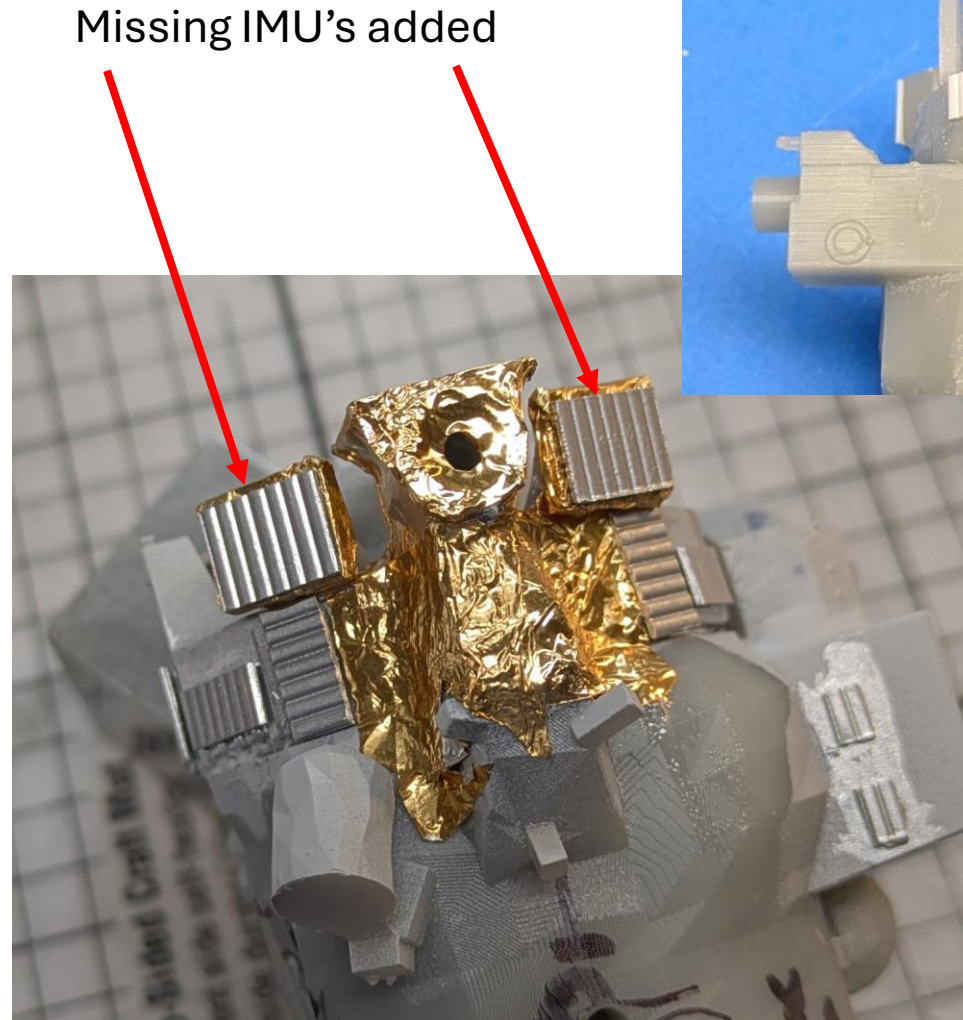
Jig drilling

- I used my drill press, a mini chuck and a 0.36" drill bit to drill the ring mounting holes.
- Brass pin (see arrow) was my master locator.



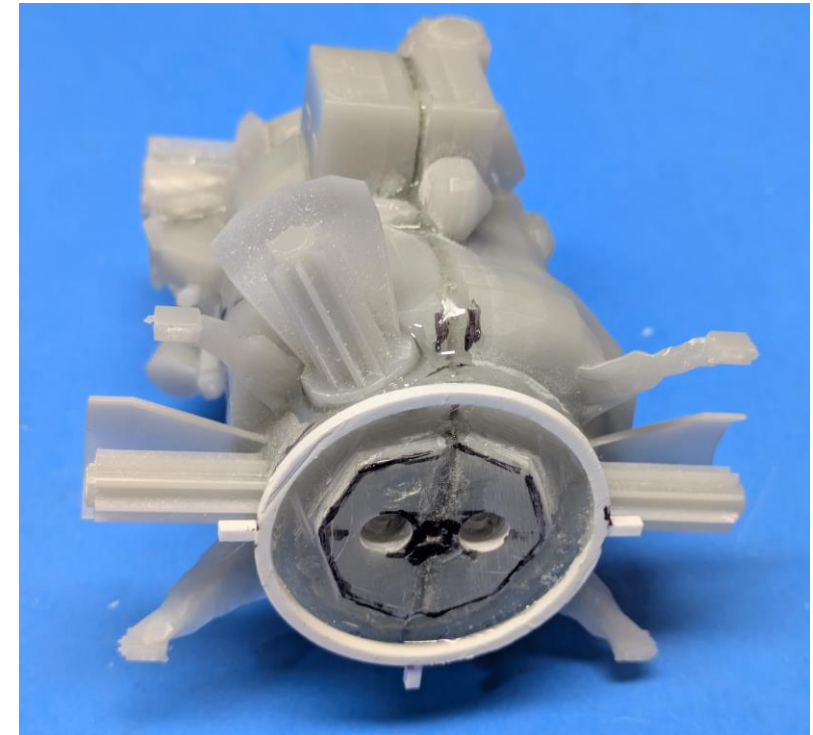
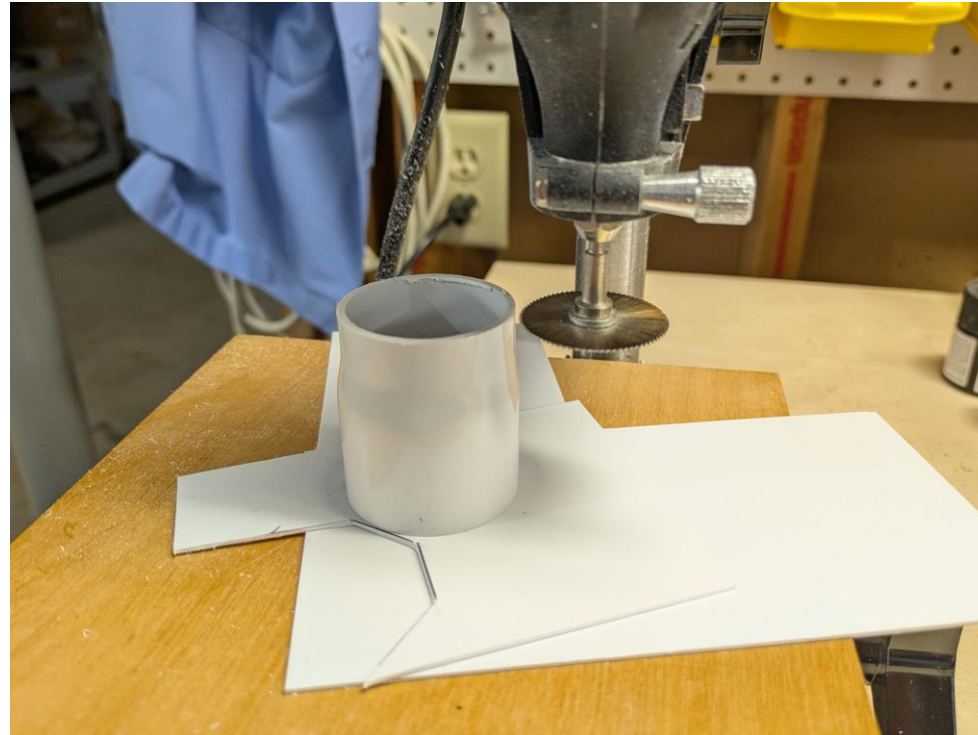
Bus details

- Added N-gauge corrugated sheet to represent the thermal louvers.
- Created missing IMU's from styrene sheet.



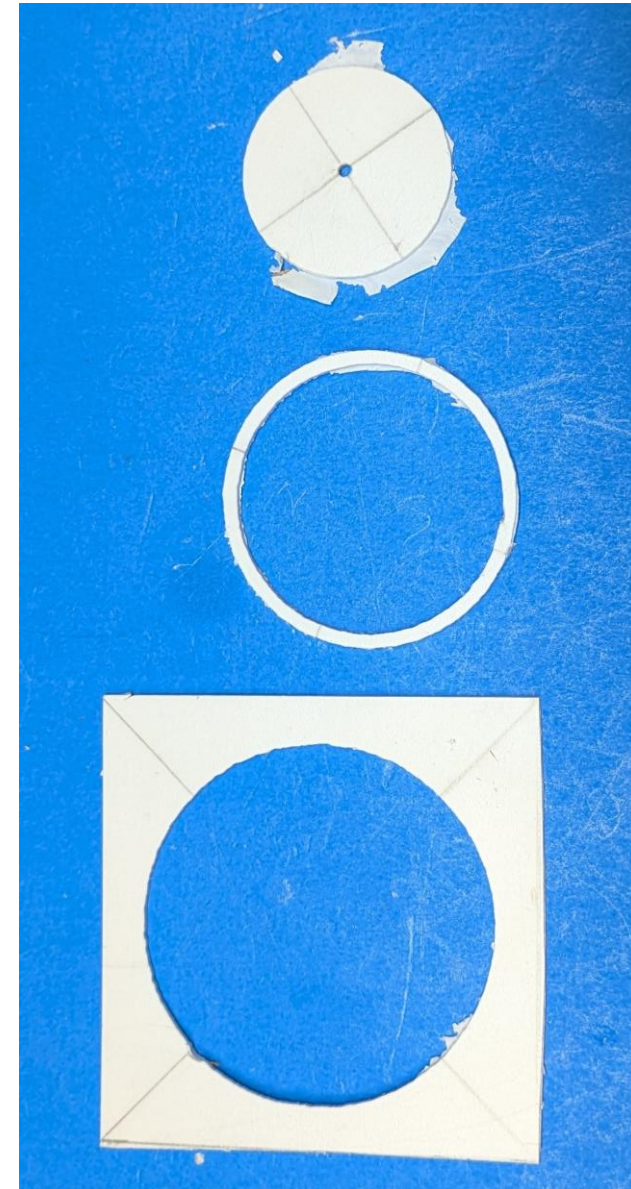
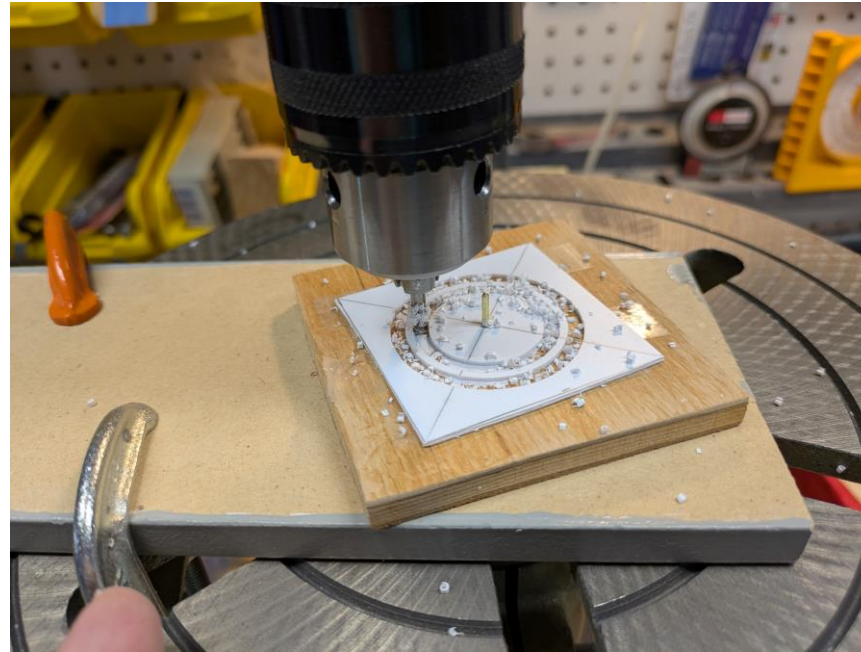
MEA cover

- Late in the Cassini development they realized that the main engine inside coating could be damaged by dust impacts.
- A protective cover was designed.
- I used a PVC sink tailpipe (1.5" diameter x .06" wall) for the MEA cover support.



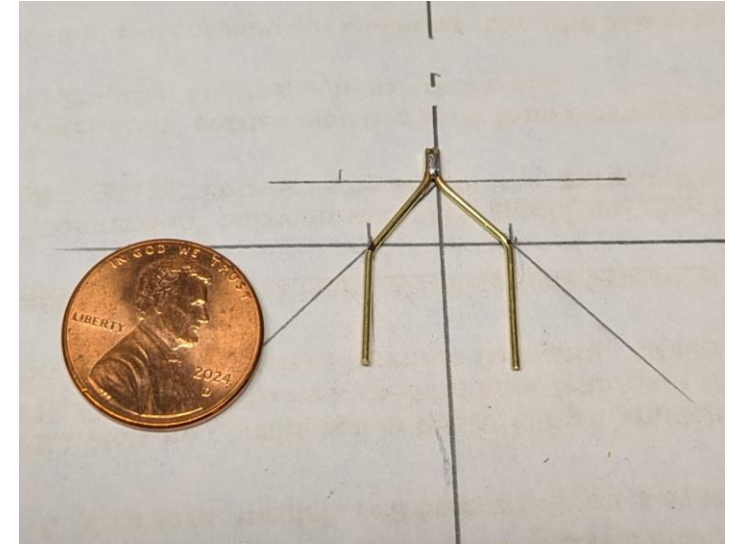
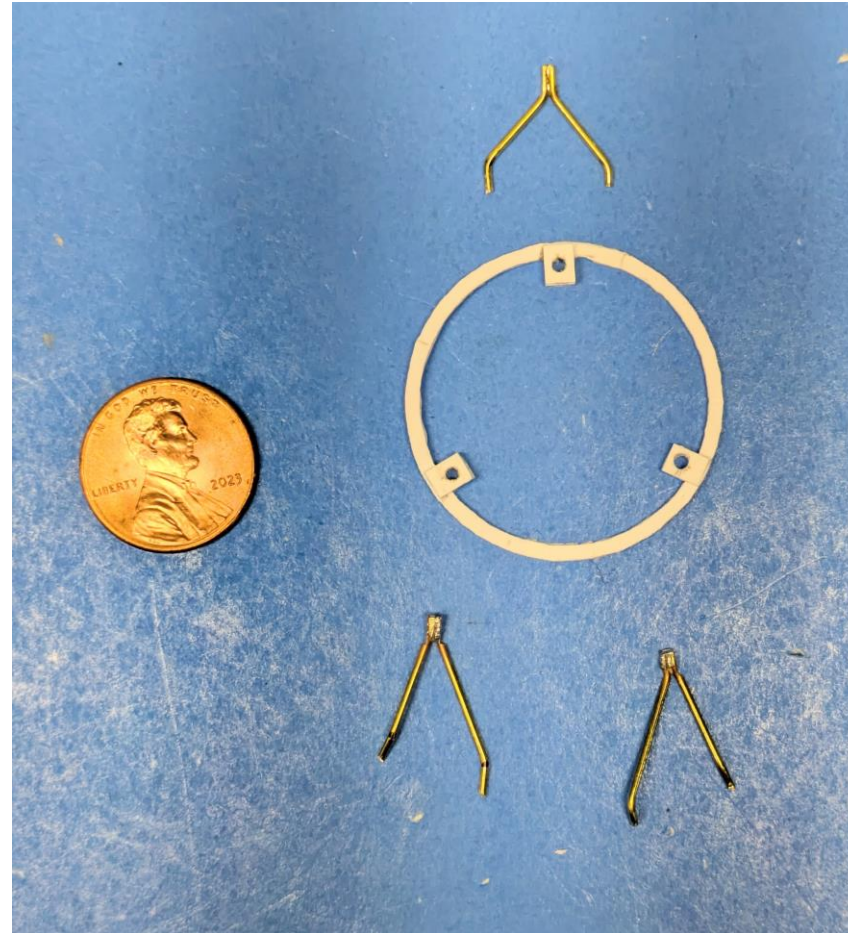
Huygens support ring

- With a 2-flute small router bit, using a slow speed in my drill press, I routed out a ring the proper size.
- Wood blocks pinned with a nail was my circle jig.
- I used Scotch double-faced tape to hold the styrene sheet to the top (rotating) block.



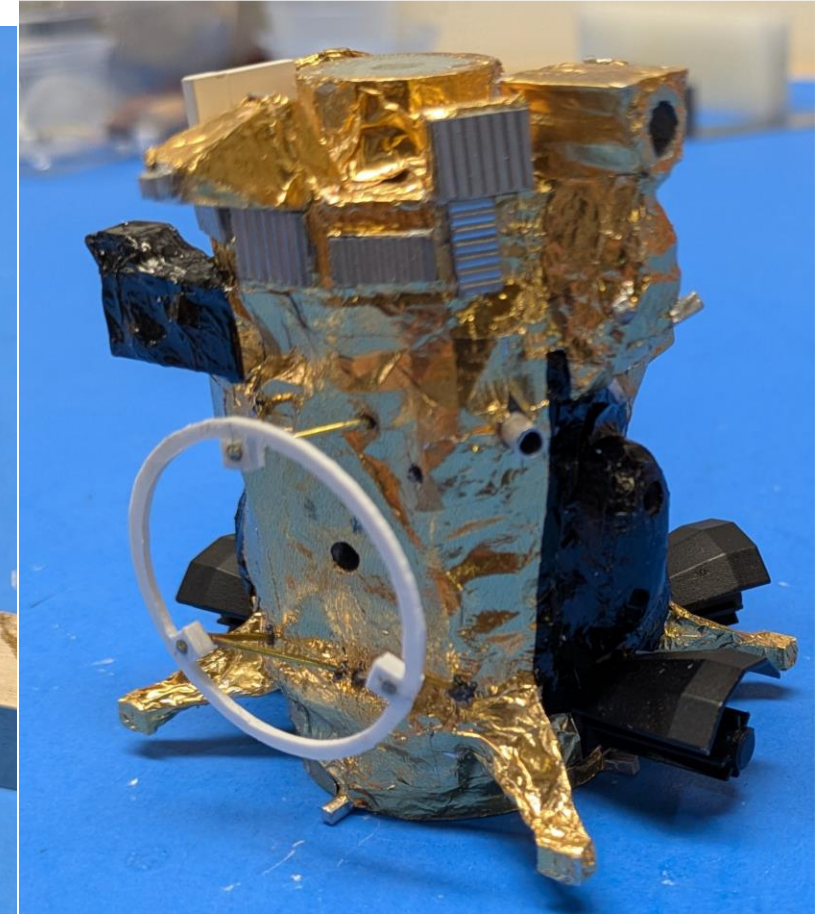
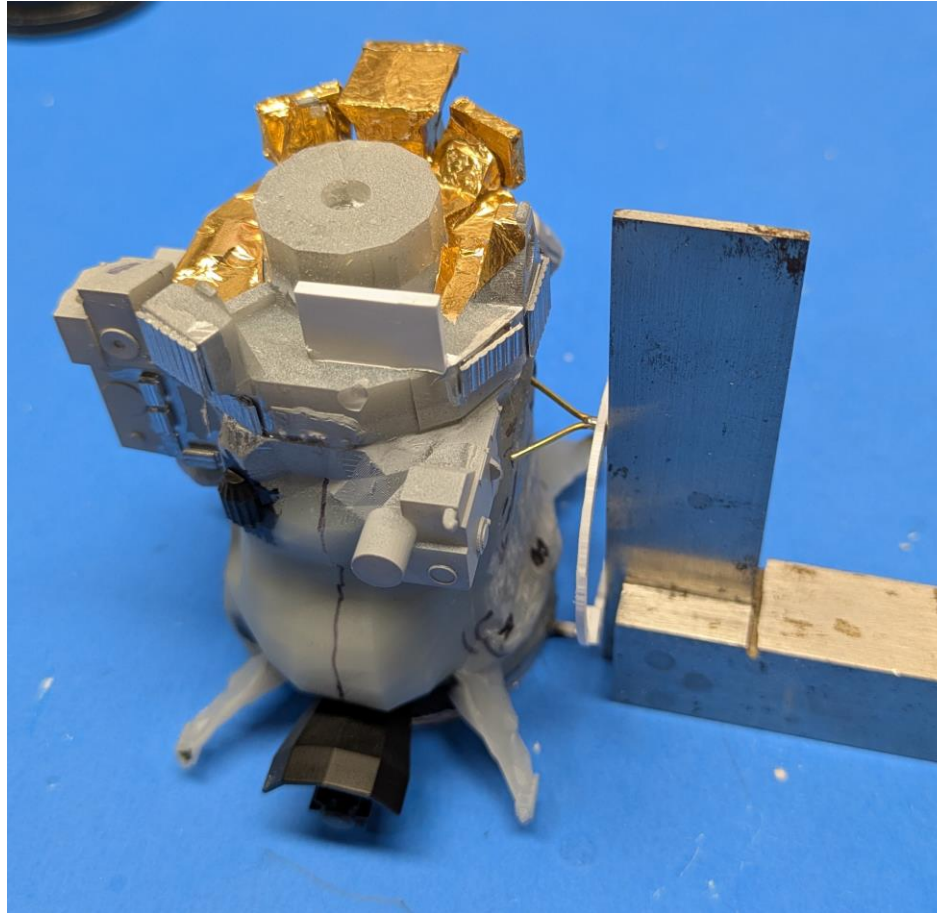
Huygens ring supports

- I made tiny bipods from 0.032" brass wire.
- Soldered the ends.
- Glued 3 styrene tabs inside the ring.
- Drilled 0.060" holes for the supports.
- Bent/cut the bipods to suit.
- Fiddly work.



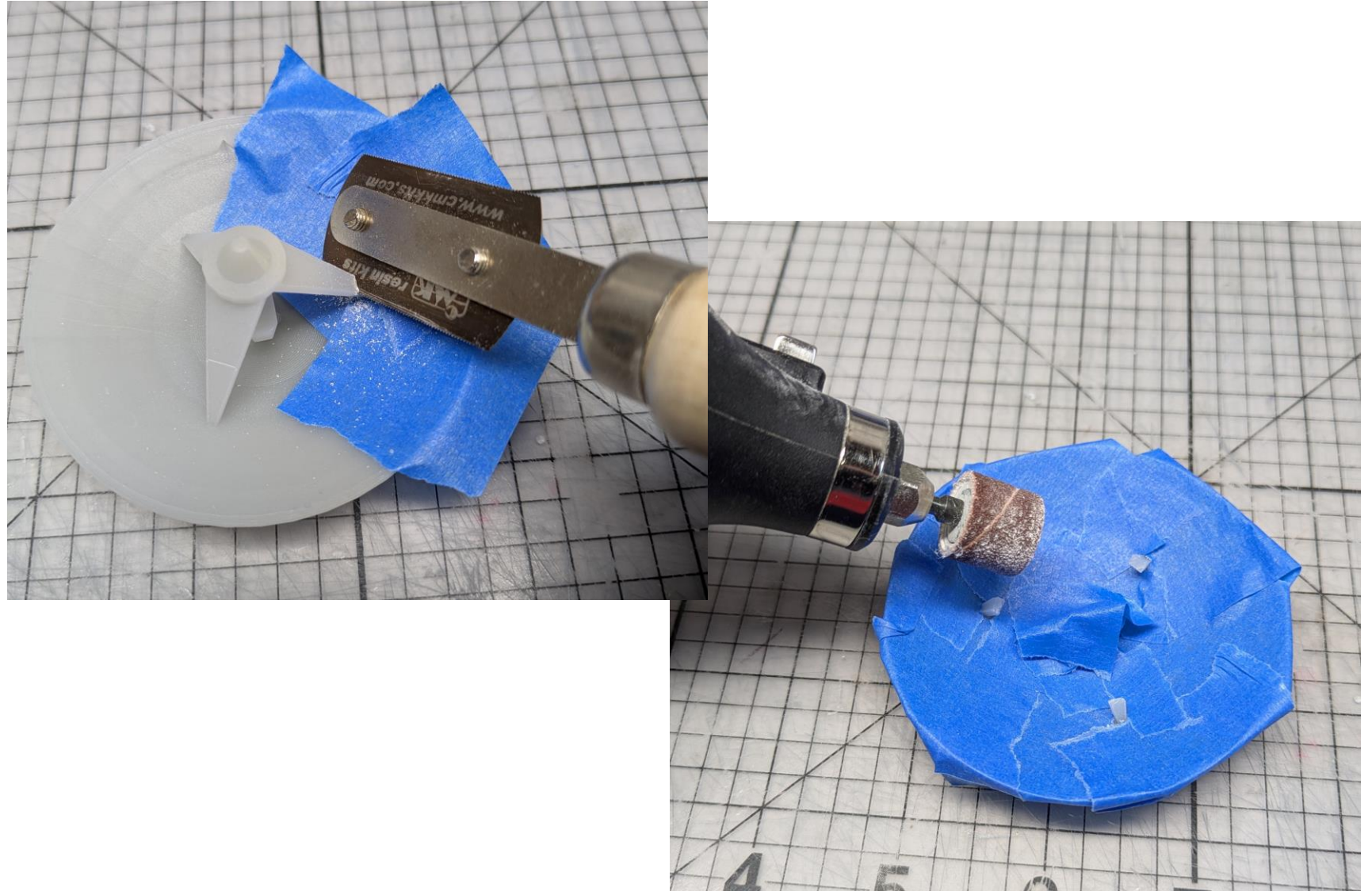
Like building an airplane in flight

- It was difficult to align the Huygens support ring and struts.
- I used 5-minute epoxy to cement the pieces together after in place.
- I added the 2 diagonal braces after foiling.



HGA mods

- Cut away the solid HGA reflector supports.
- Blue tape protected the dish surface.
- Carefully sanded away the stubs in the dish.
- Polished the dish smooth.



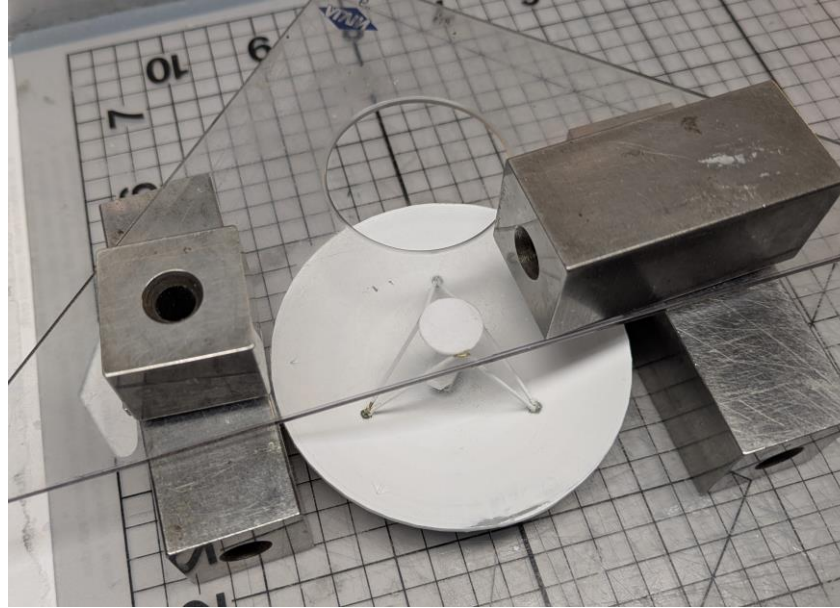
HGA sub reflector feed supports

- I used 0.032" brass wire for the bipods.
- Making them 'exactly' the same length and angles was difficult.
- I used Allene's Turbo Tacky Glue to hold them in oversized holes in the dish.



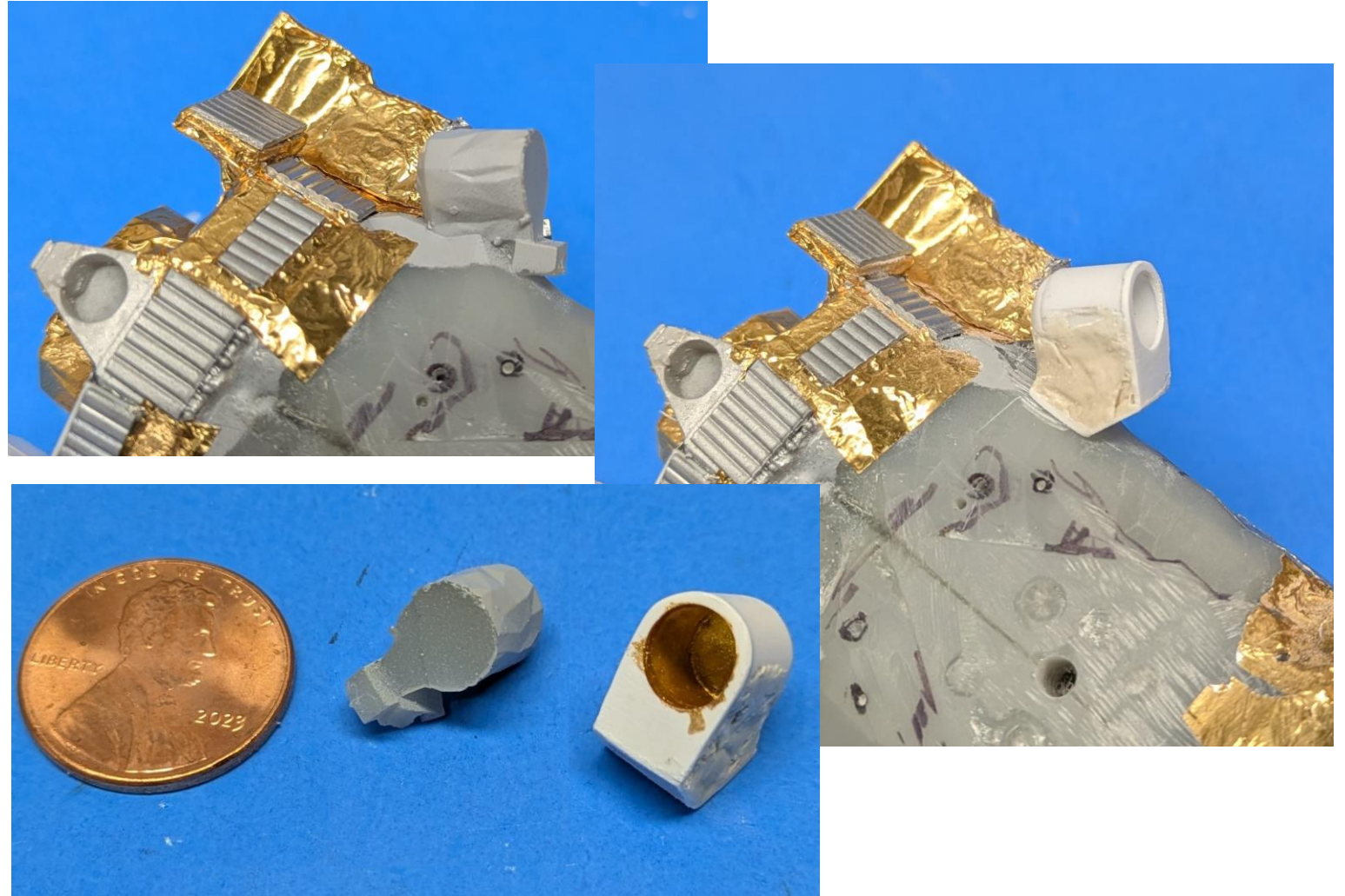
HGA

- Frustrating and difficult to get the parts to line up.
- Later used 5-minute epoxy to attach a round disc on top.
- Later glued the modified LGA on top.



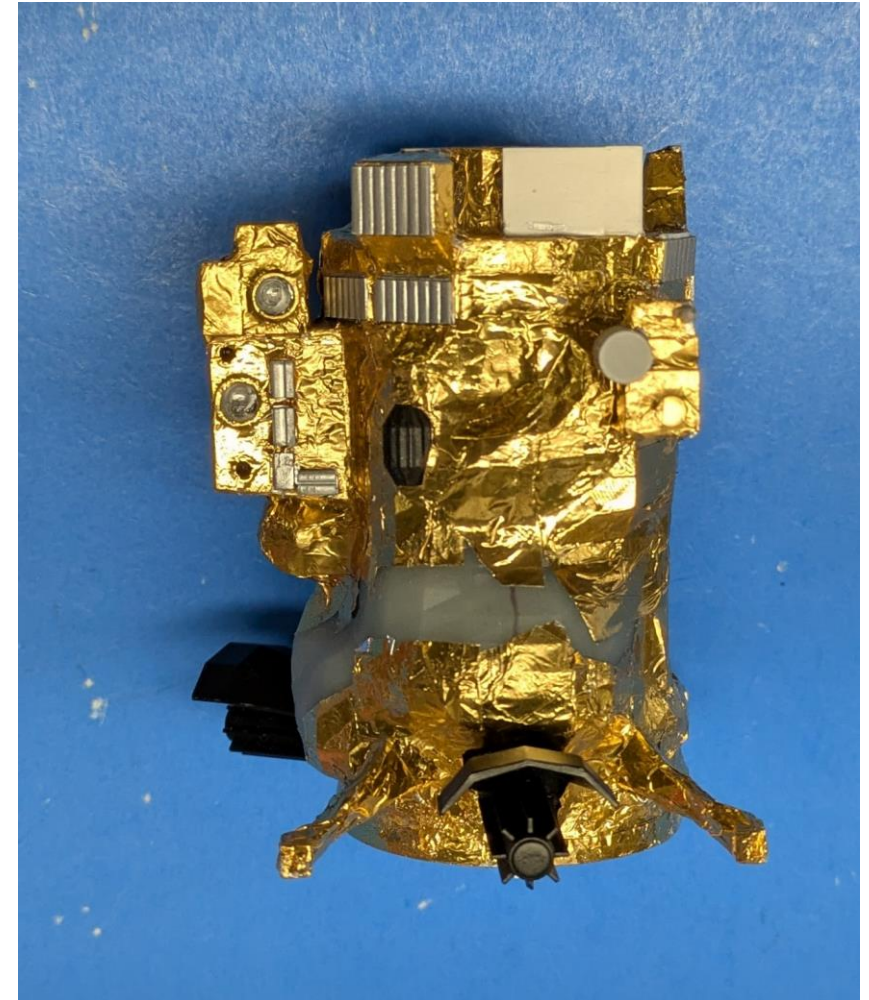
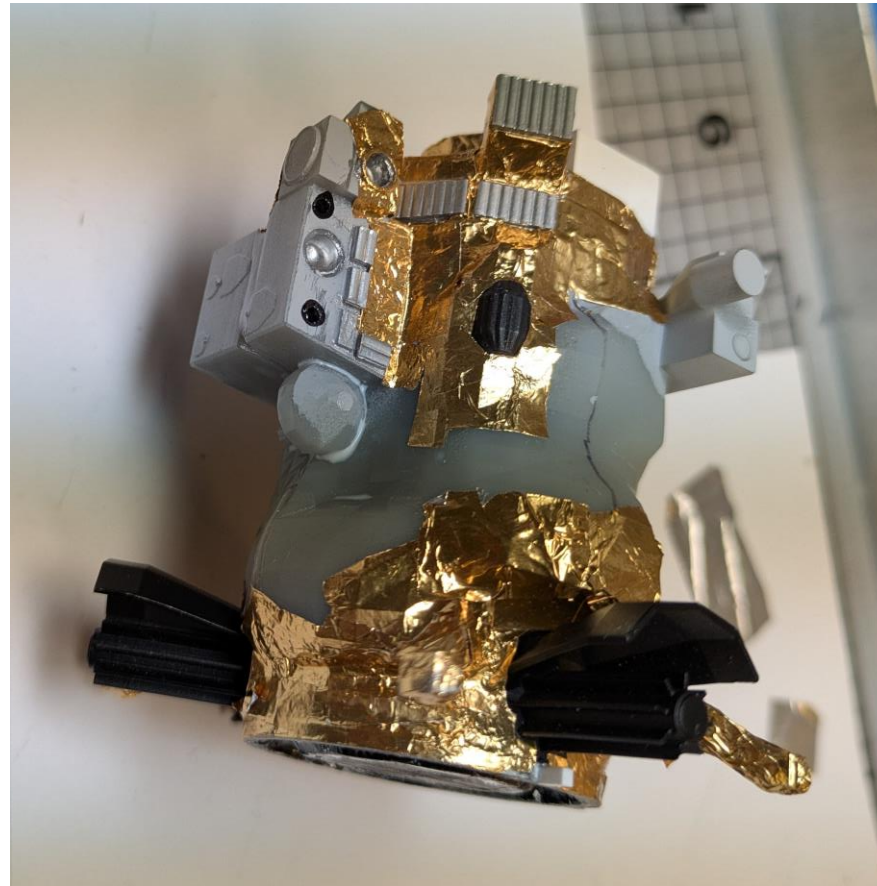
Cosmic Dust Analyzer (CDA)

- The printed CDA was a cylindrical solid blob but was an open 'bucket' to trap dust.
- I drilled/cut/broke it off and made a new one.
- I used 5/16" tube, a formed dish for the closed end and added a built up styrene mount.



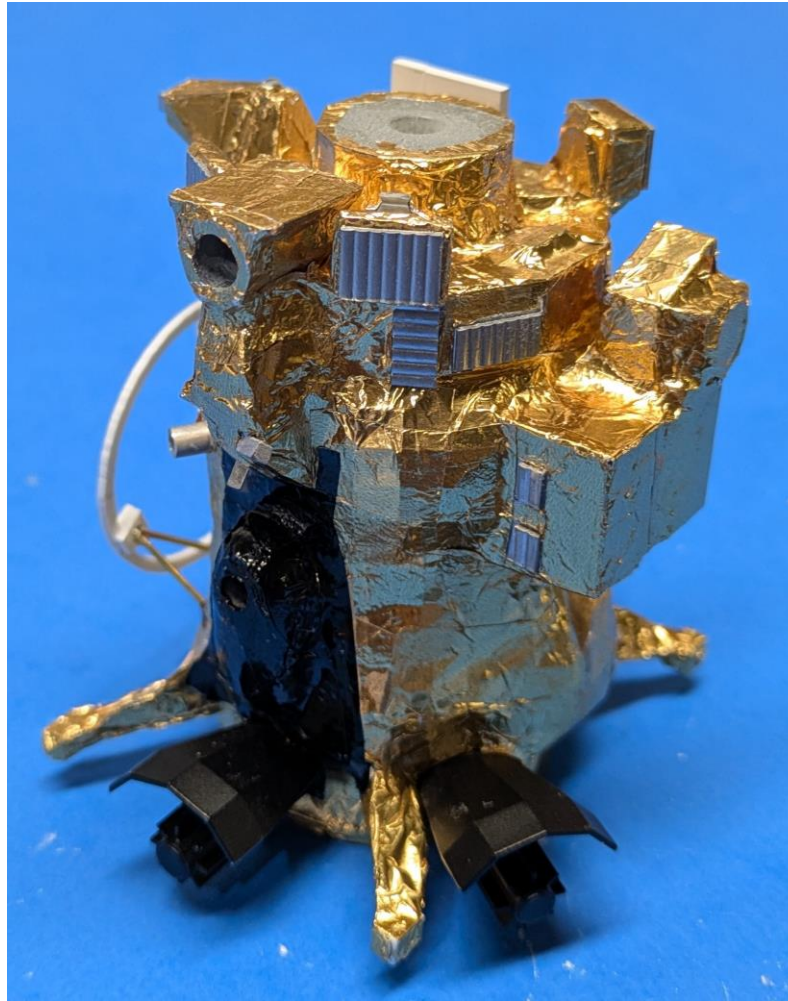
Imaging pallet

- I drilled out the various imagers, painted the insides, and then applied foil.



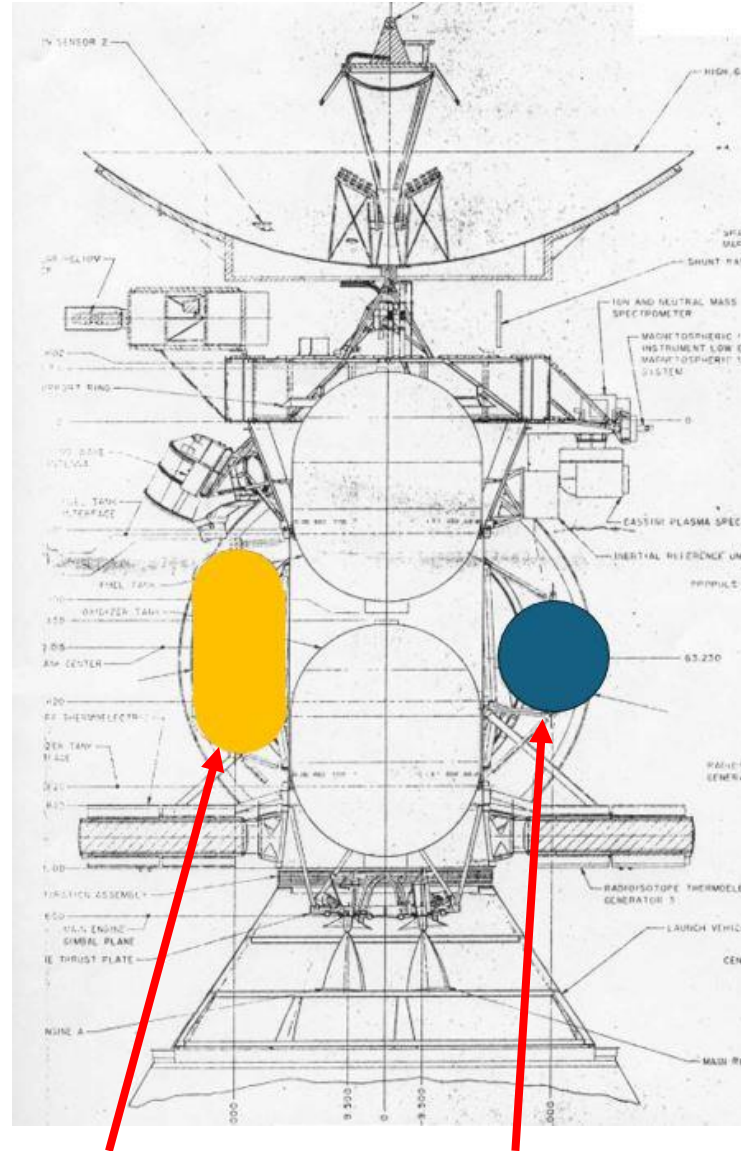
Foil work

- I used Candyland Crafts gold and black foil to represent the MLI.
- Some photos show the s/c MLI as 'orange' but it was primarily covered with 'yellow' Kapton film, which appears gold.
- Applied with Microscale Micro Metal Foil Adhesive.



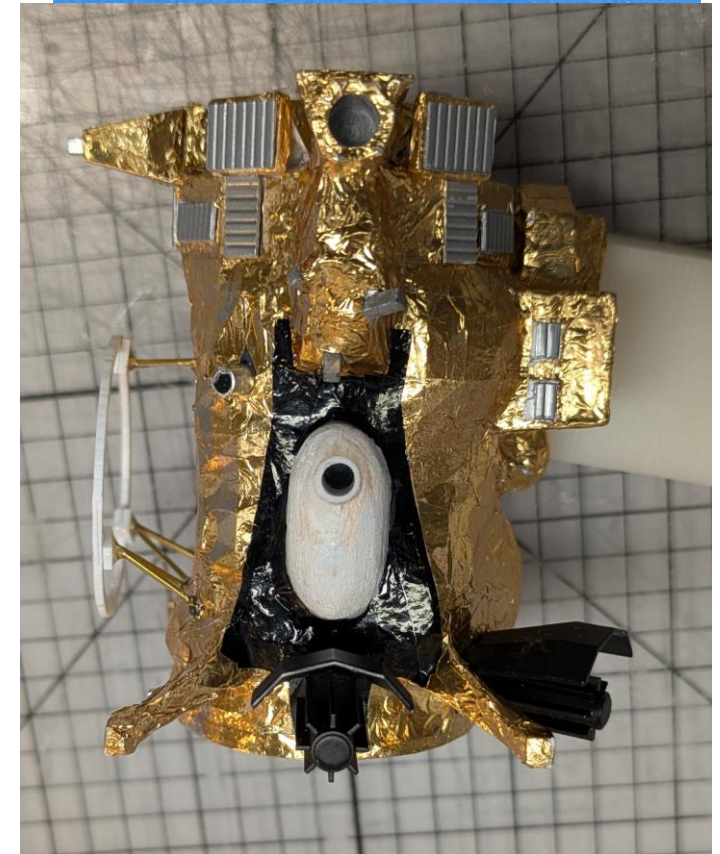
Missing He tank

- Late in the build I realized the 3D print omitted the helium tank. The hydrazine tank 'bulge' is on the other side.
- I sanded a basswood block to shape to be half of the tank (the rest is buried in the s/c side and MLI).
- The mounting hole for the stand was covered by the 'tank' so I put a 3/16" diameter tube thru it.



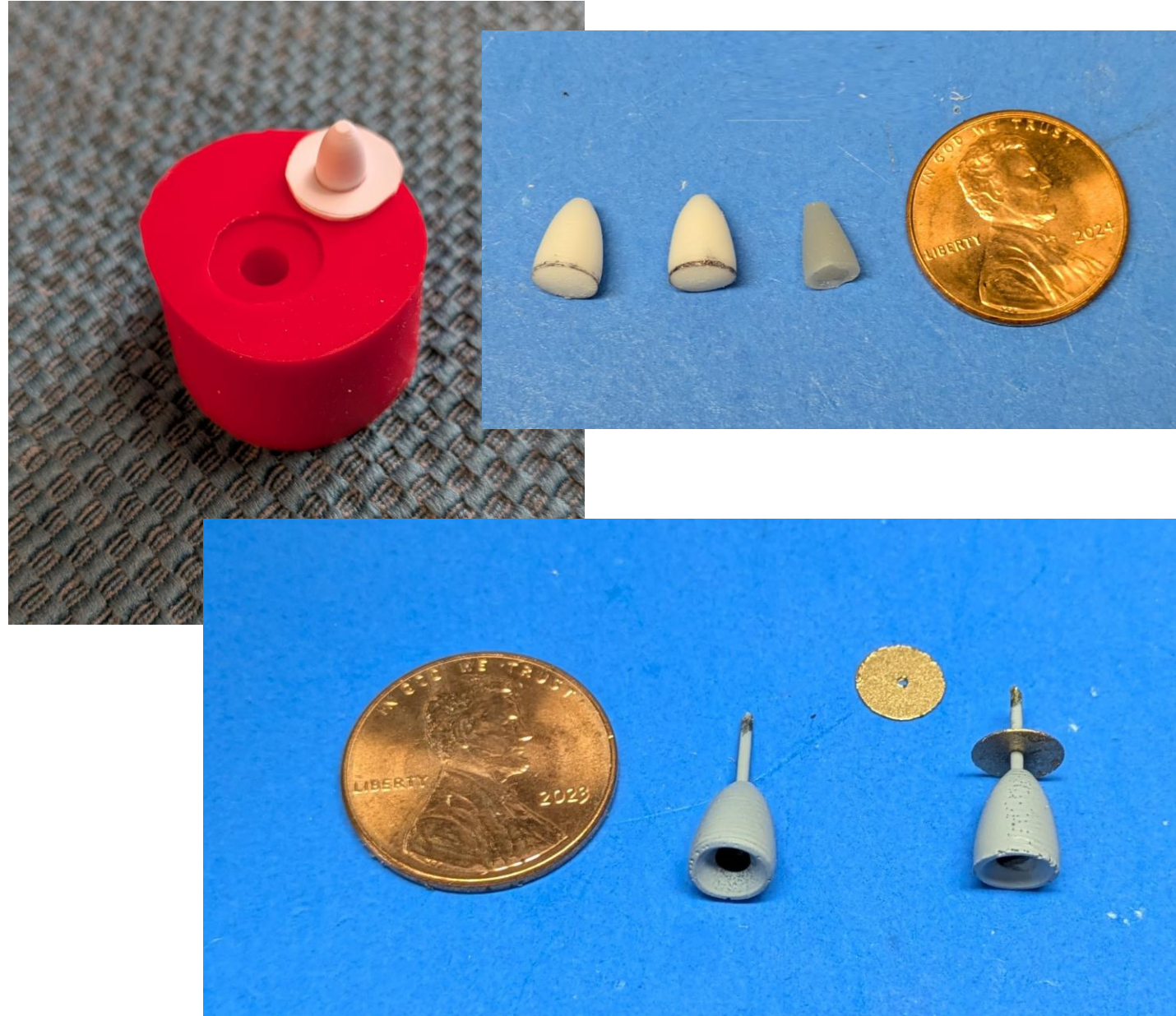
Helium tank

Hydrazine tank



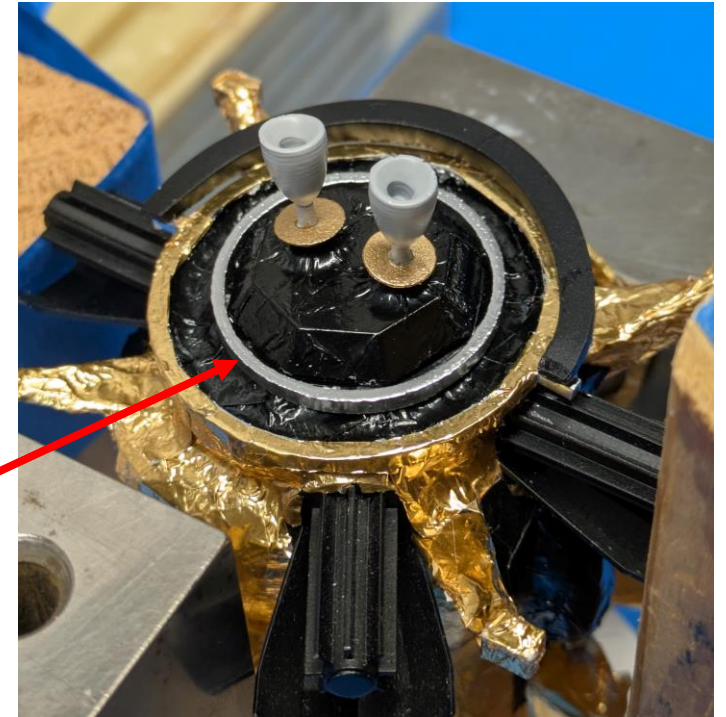
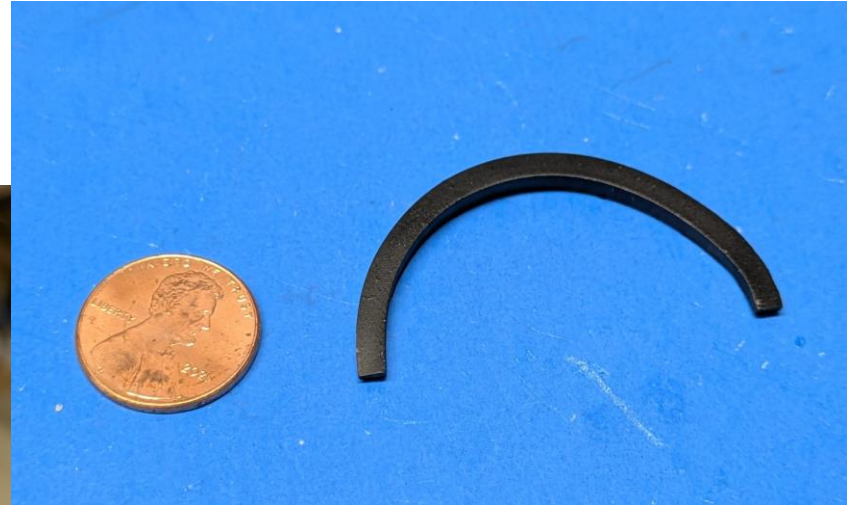
Engines

- The 3D printed engine nozzles were simple cones and solid.
- I turned a master part from styrene, then cast new ones.
- I partially drilled them out, adding a 0.032" brass rod inside a 1/16" tube.
- The thermal shields were a 0.020" thick styrene disc.



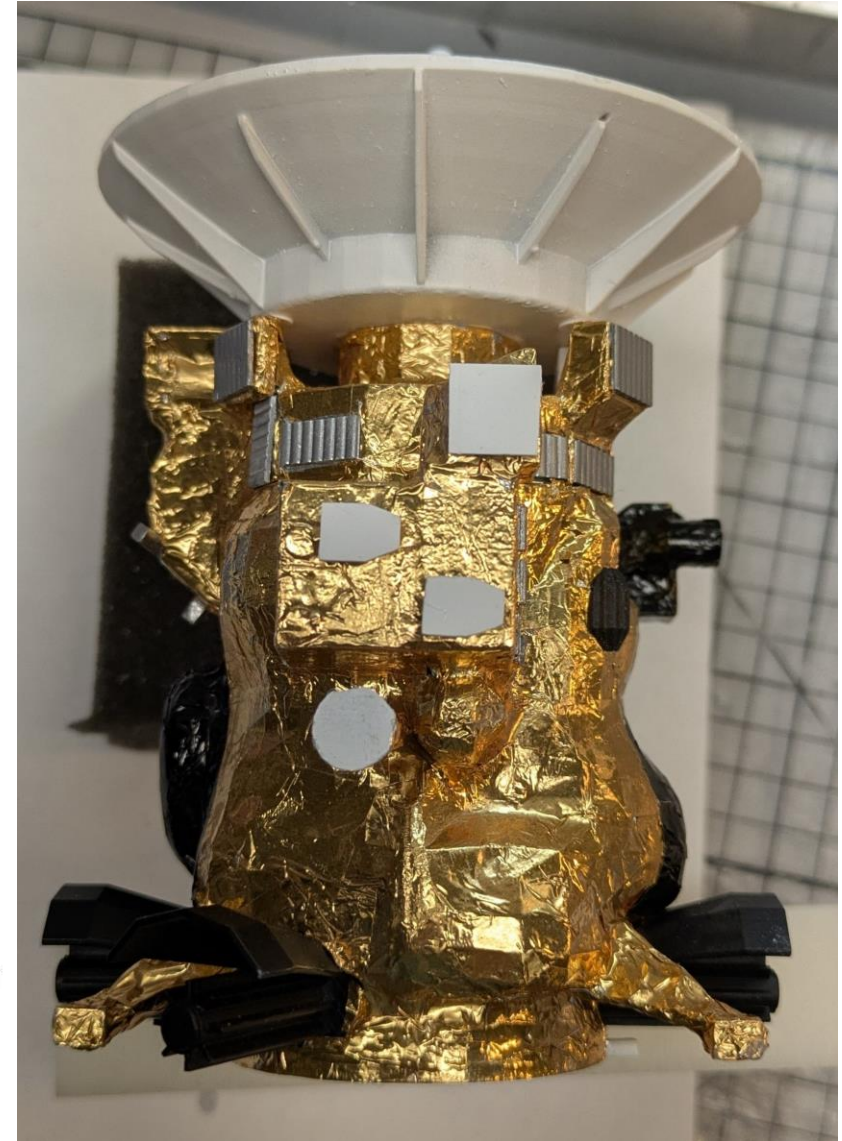
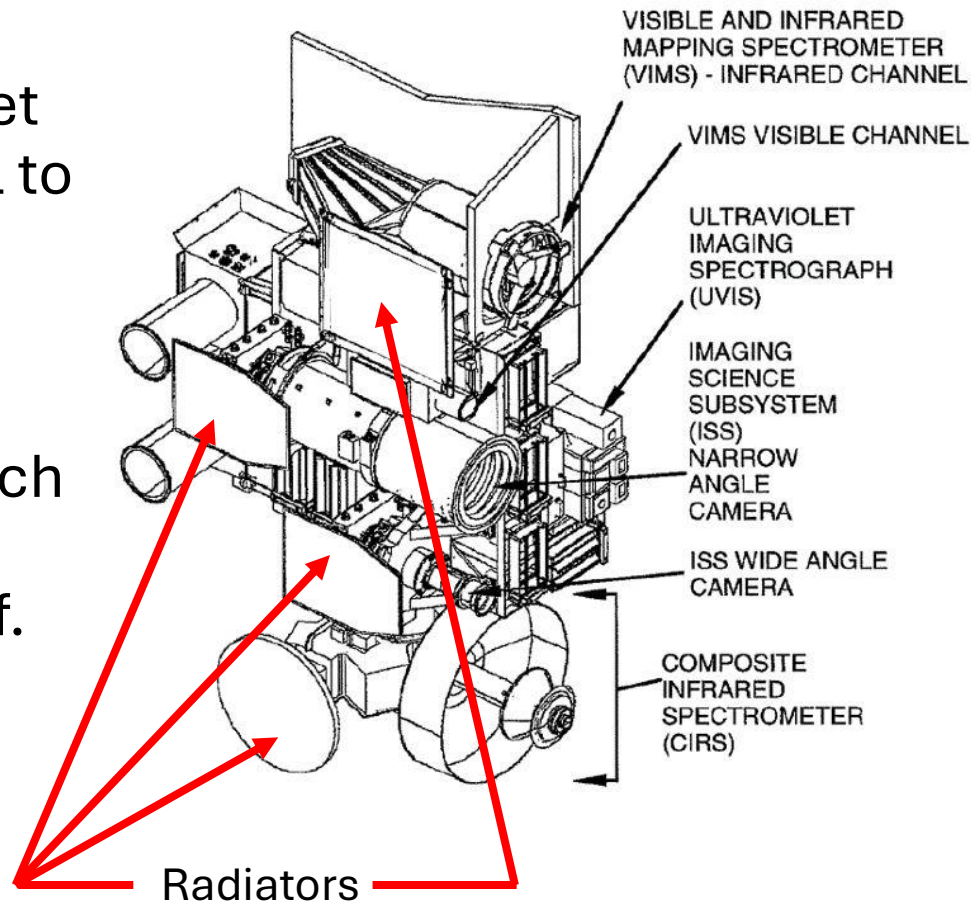
MEA cover

- I made the stowed engine cover from an $\frac{1}{4}$ " square styrene rod, heated and bent around a dowel.
- Cut and sanded to shape.
- Attached to 3 tabs on the aft ring.
- Added semicircular end covers.
- Added payload adapter ring (another routed out ring).



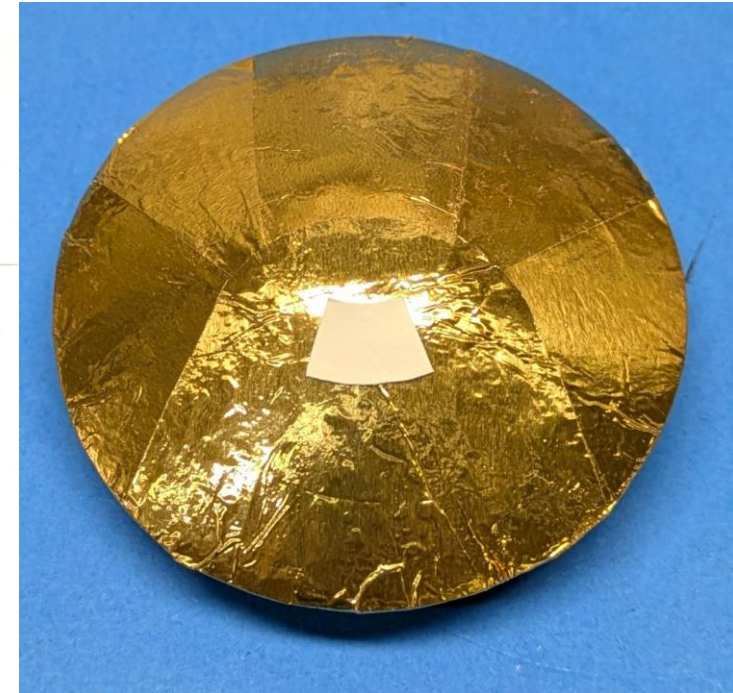
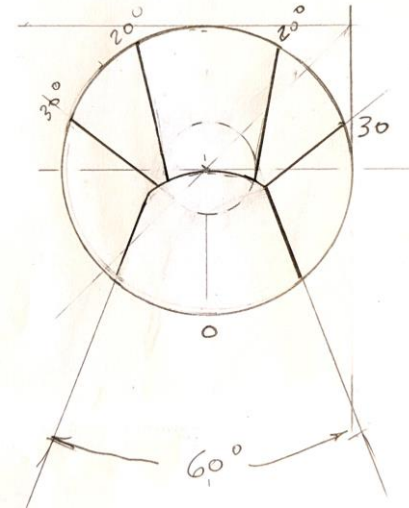
Thermal radiators

- The printed ones on the imaging pallet looked small to me.
- I made new thermal radiators, each on a styrene disc standoff.



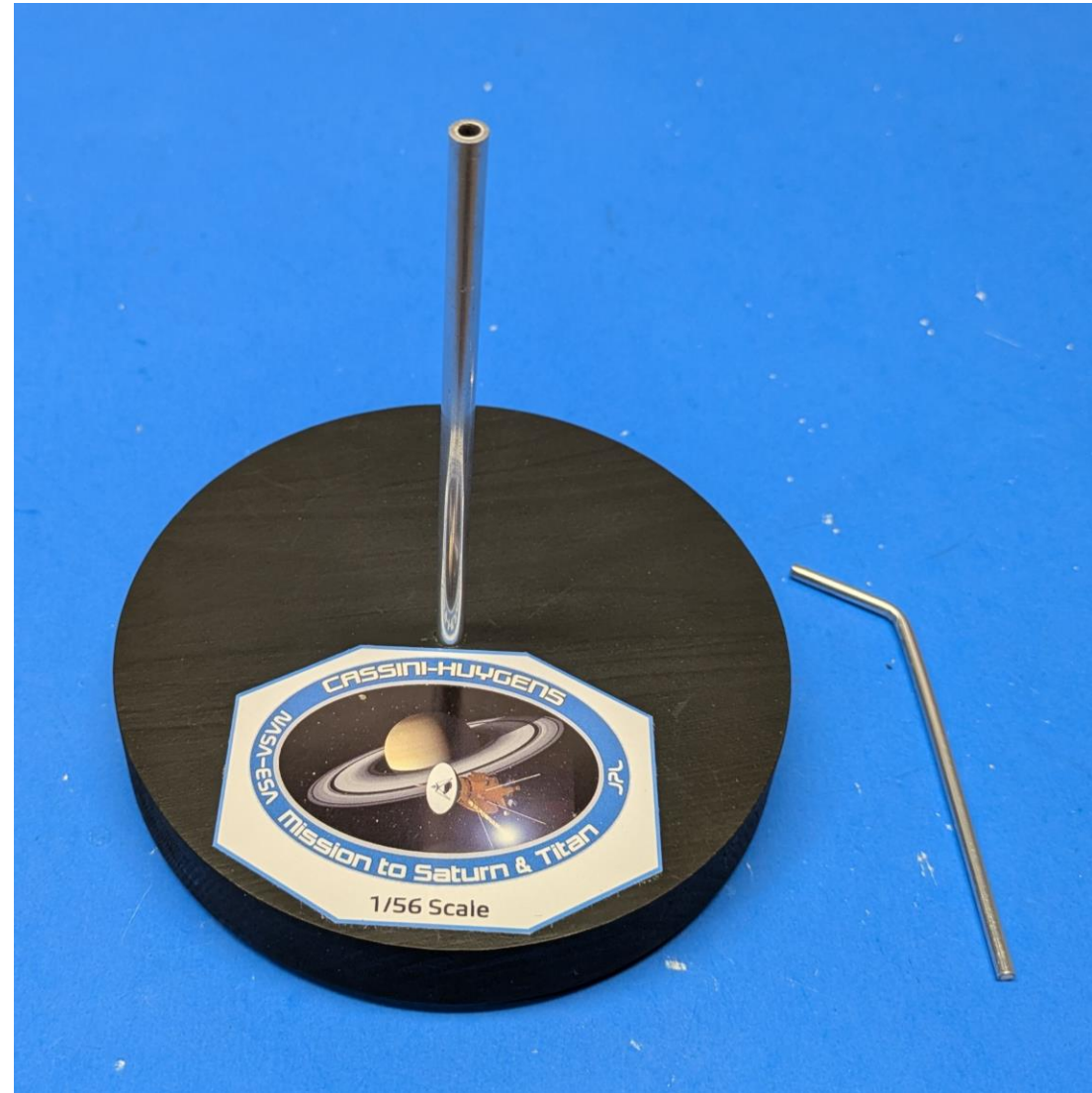
Huygens

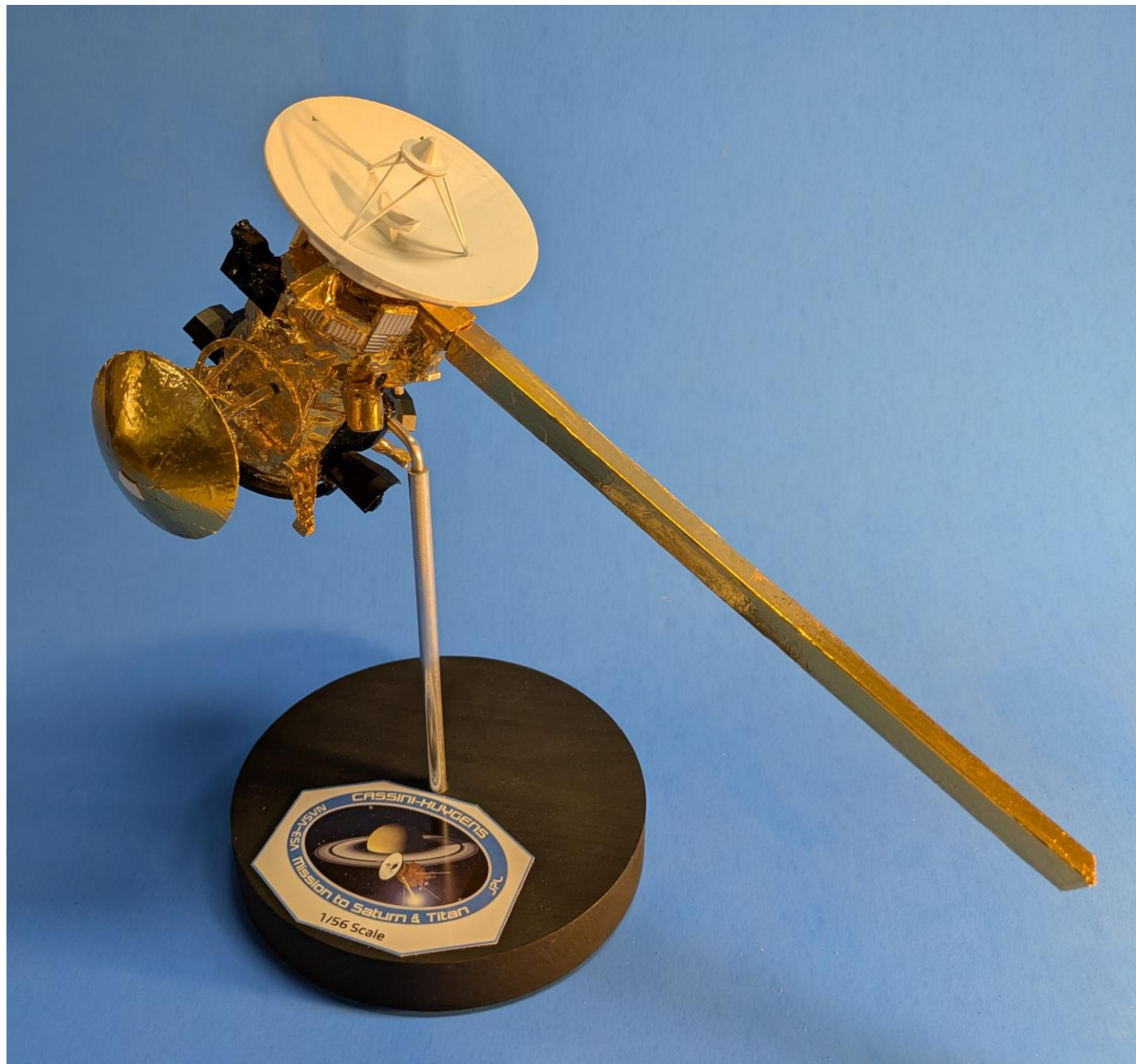
- I applied foil all to the backshell and the inside of the aeroshell.
- I added foil to the aeroshell front to simulate the MLI seams.
- I used 5-minute epoxy to put the two together.
- White thermal patch was cut from 0.005" styrene.



Display stand

- The stand is a wood disc, painted flat black.
- Nested aluminum tubes hold the model above the stand.
- The mission logo was printed on glossy photo paper.
- I attached the Huygens model to an 1/8" clear acrylic rod, showing it deployed from Cassini.

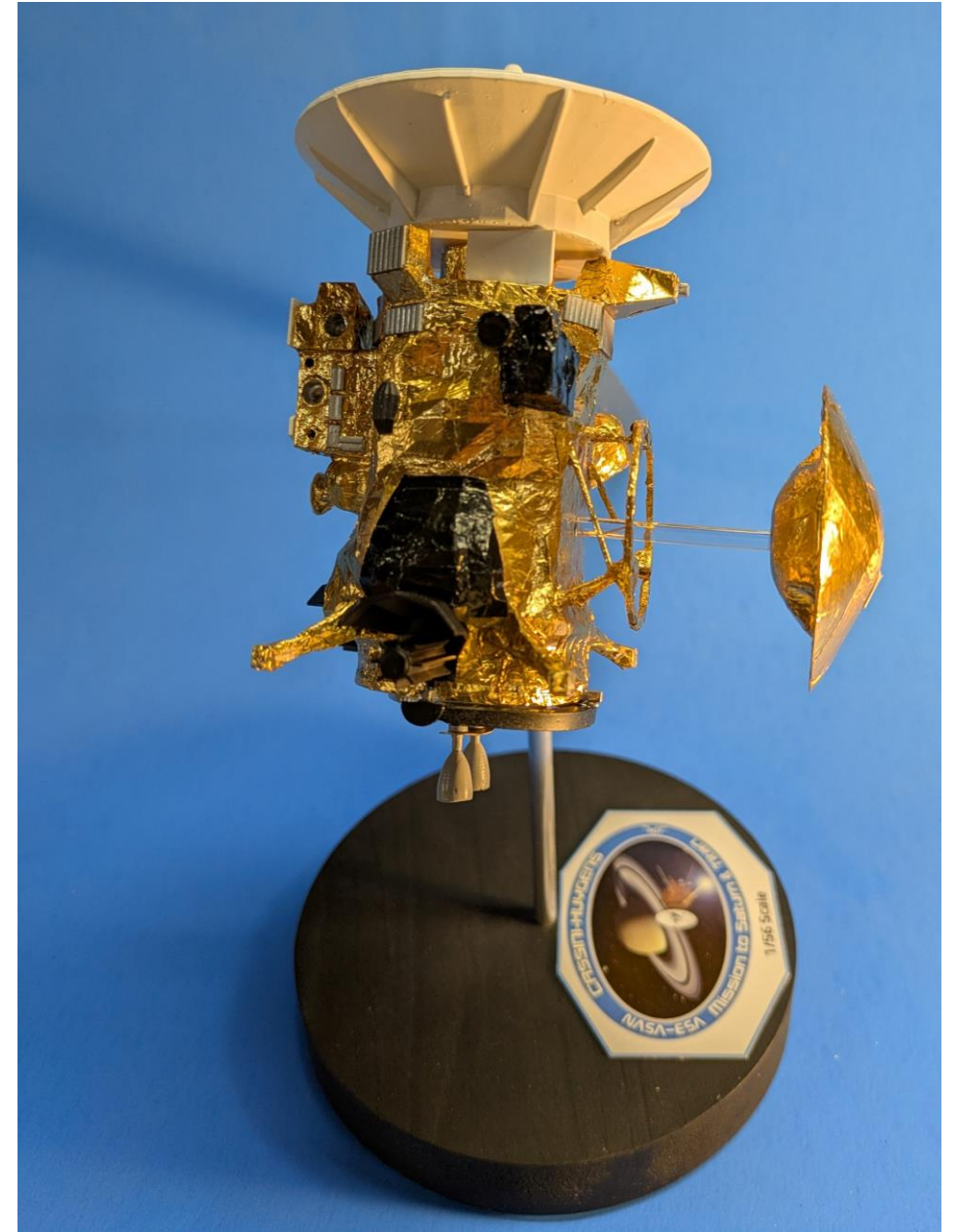


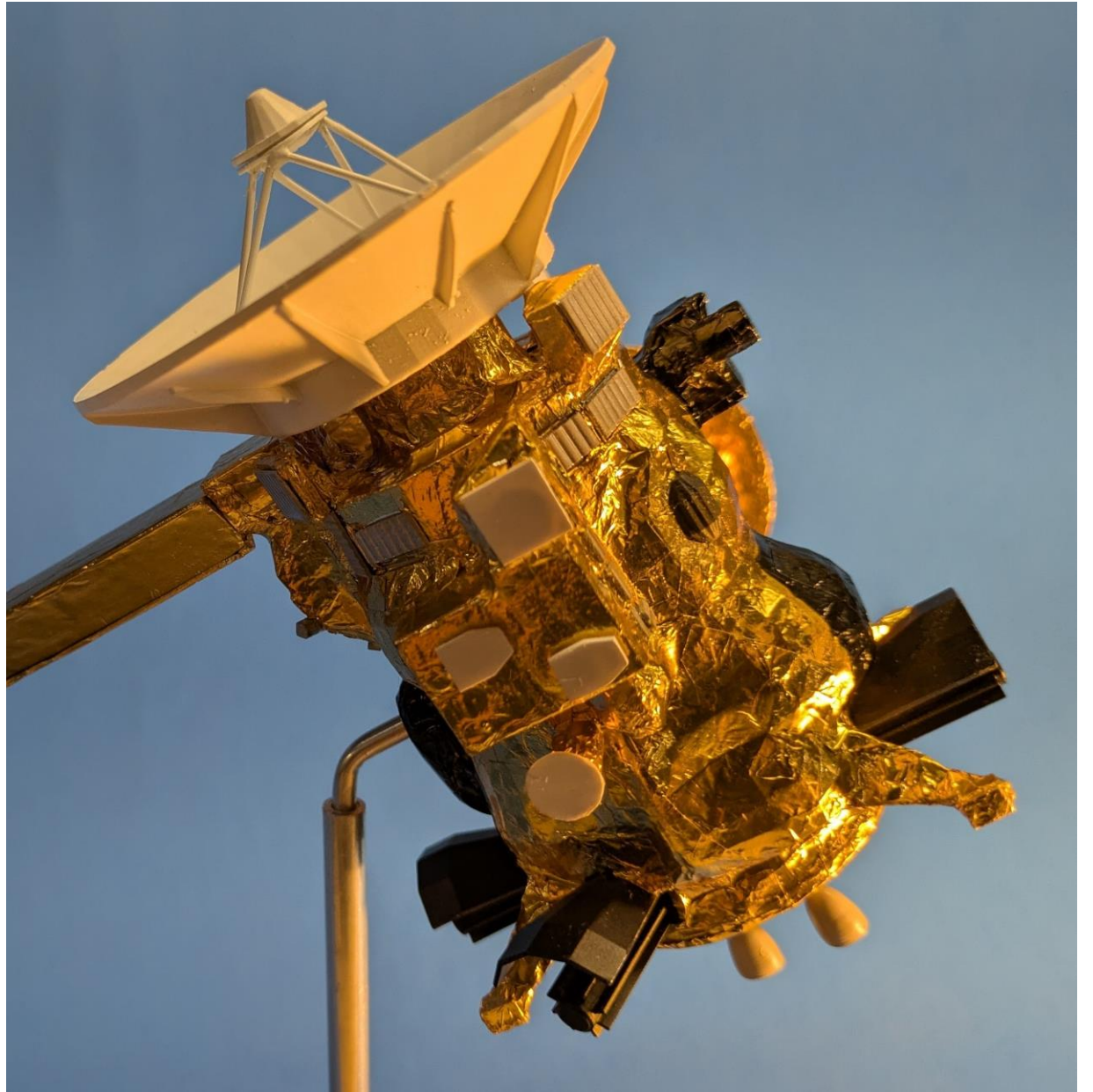


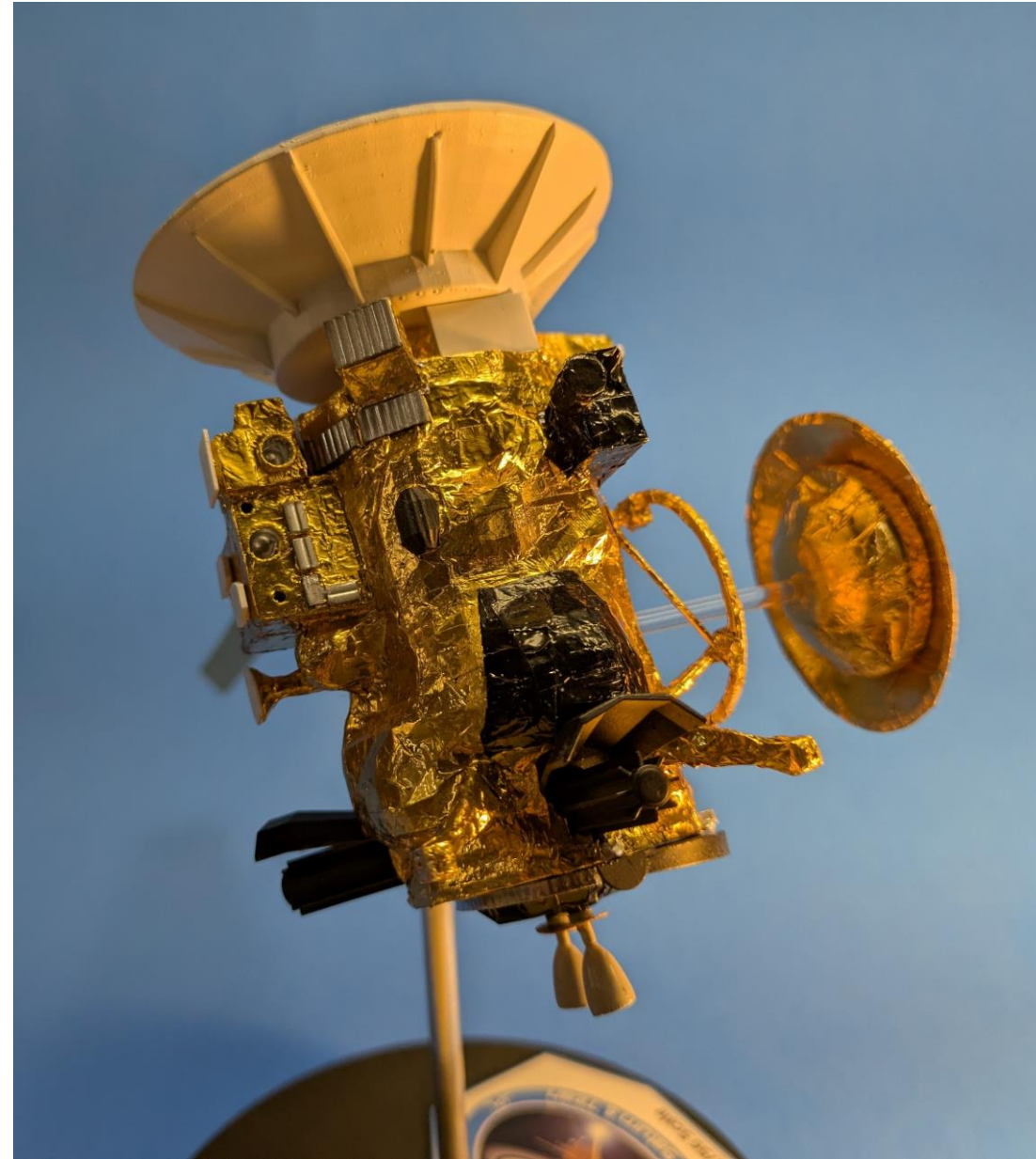
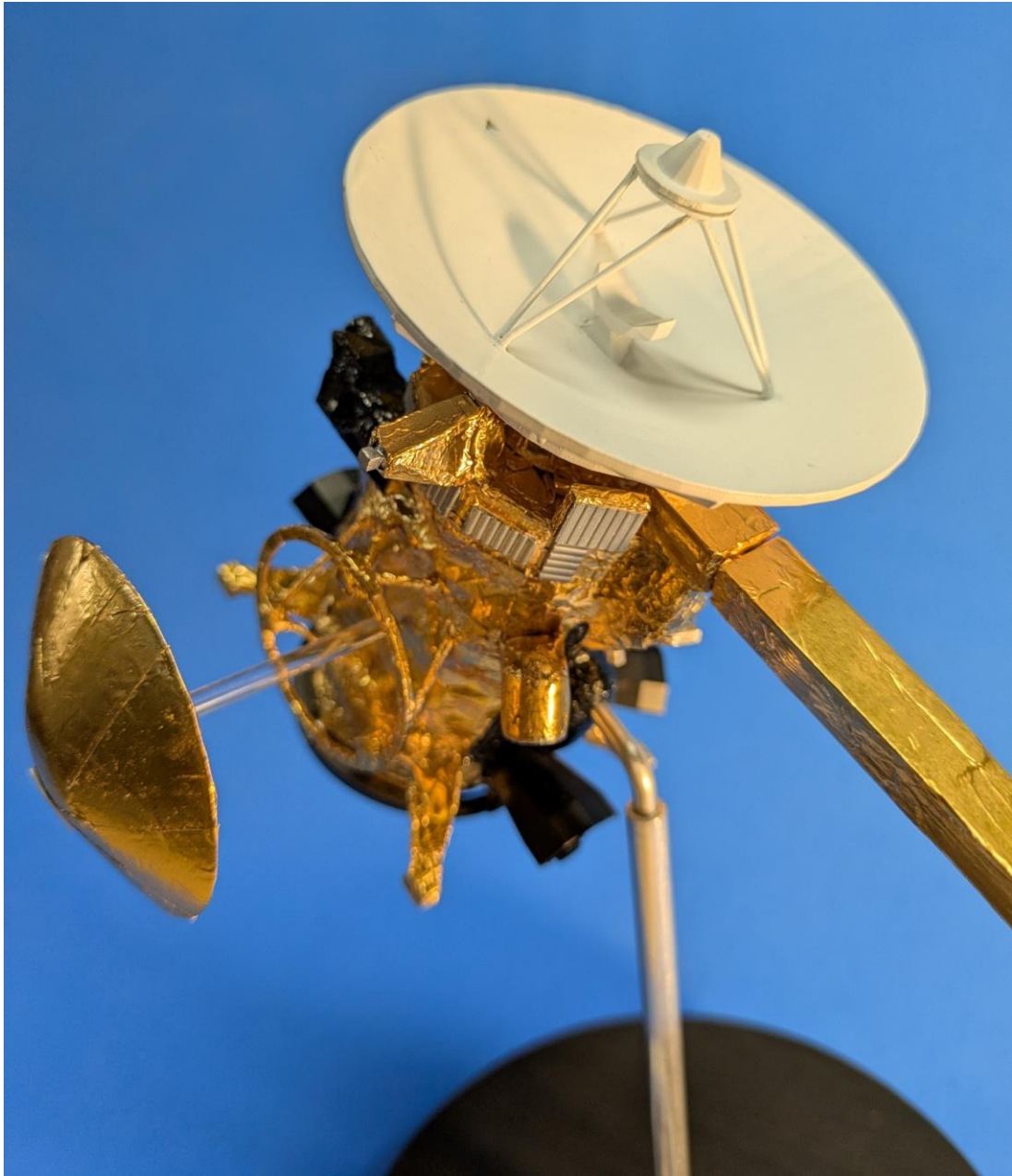
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