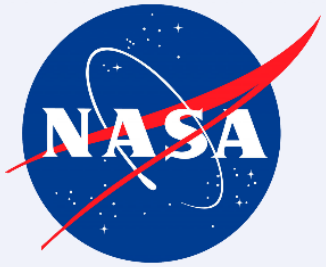

THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Astronomy
& Steward Observatory

Designing Assembly for MET

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Meissner Effect Transistor (MET)

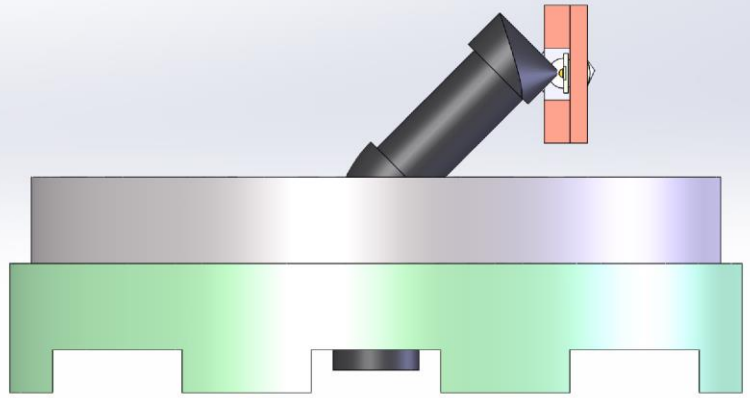
- The Meissner Effect uses superconductors and magnets to do essentially what Field Effect Transistors do.
- Transistors are building blocks for microchips. For a sense of scale, the A10 chip in the iPhone 7 has 3.3 billion transistors.
- The MET has the potential to be faster and be more densely packed than current transistors, because there will potentially no heat given off.
- I was tasked with designing an assembly for the proof of concept testing of the MET.

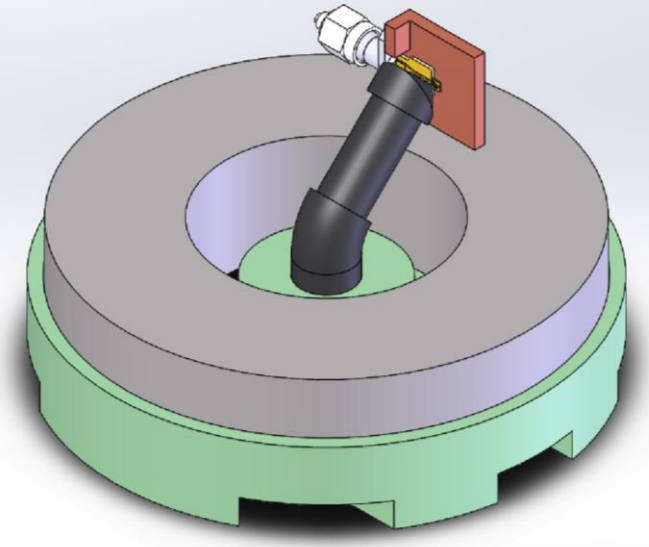
Given Requirements

- The spiral mixer is required to move between 1mm to 6mm away from the magnet pole.
- This is how the mixer detects change in the magnetic field.

- Fit in cylindrical volume of 8.34 inches in diameter and 3.25 inches tall.
- To cool down the assembly, it is placed in a cryostat, which has limited space.

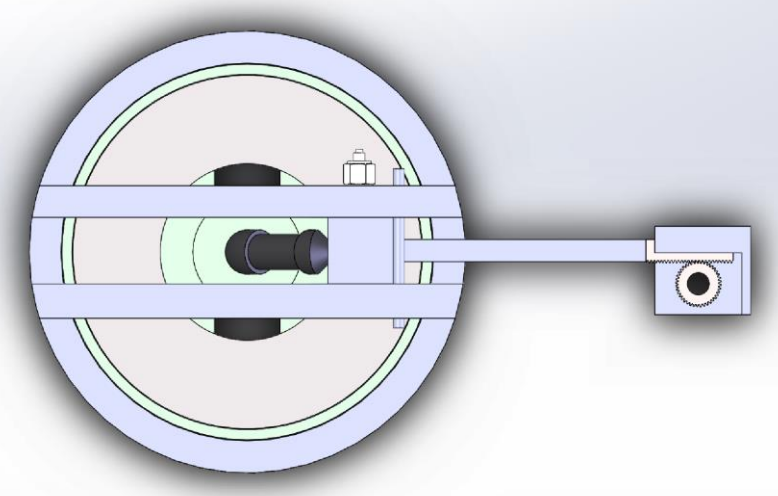
- All parts must meet correctly and move as needed when cooled to sub 20K temperatures.
- The only was to get a superconductor is to supercool it.

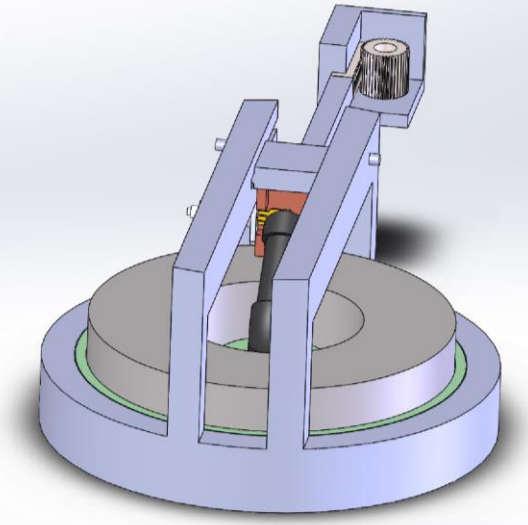


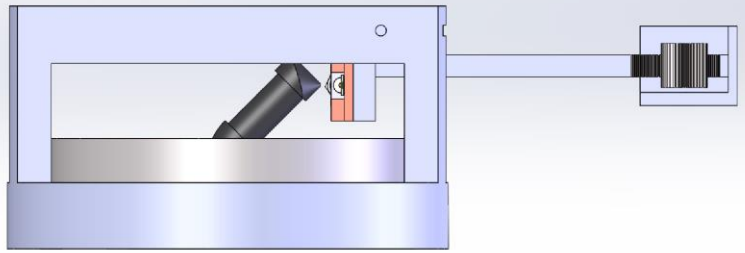


Movement

- I chose a rack and pinion for the assembly
- Transfers rotation 90° from the top to lateral motion of the spiral mixer.

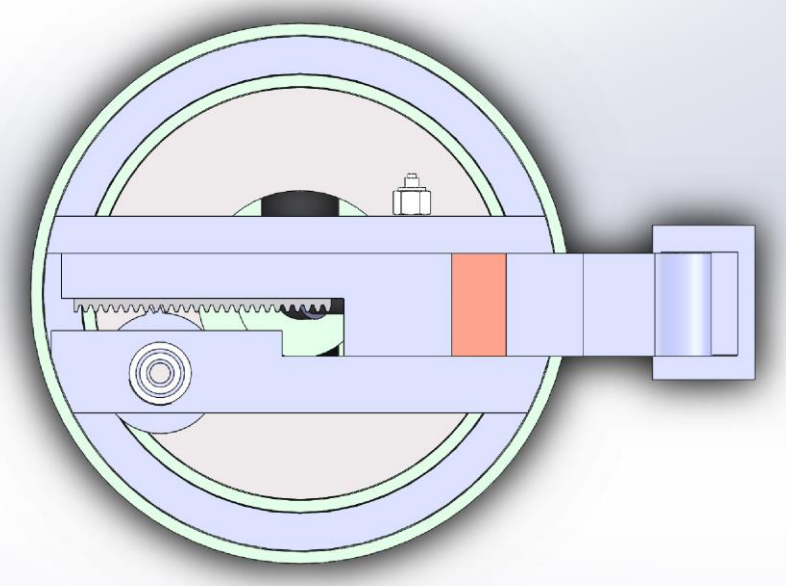


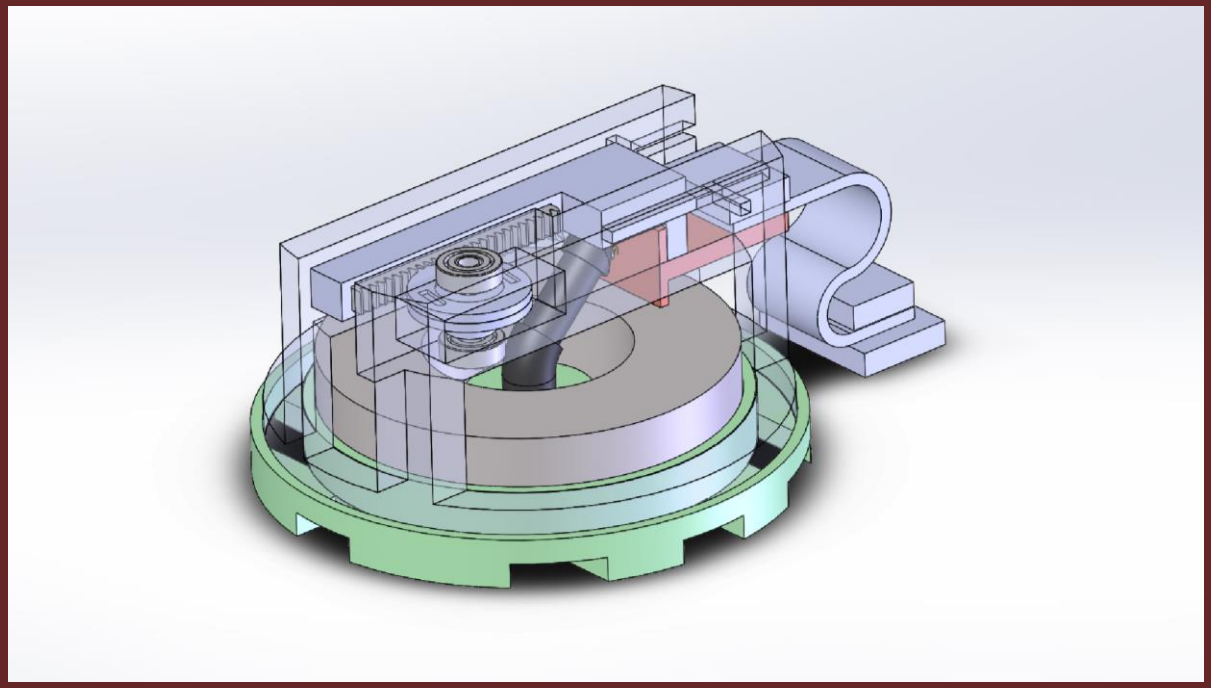


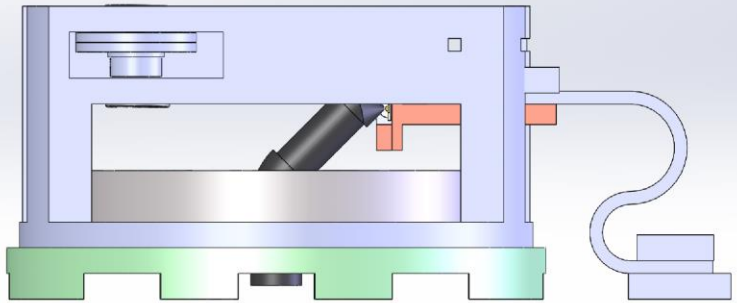


Condensing

- I moved the rack and pinion to the center to condense everything.
- This allowed me to add a thermal strap to the back of the spiral mixer.
- The thermal strap draws heat away from the electrical components down to the 4K plate.

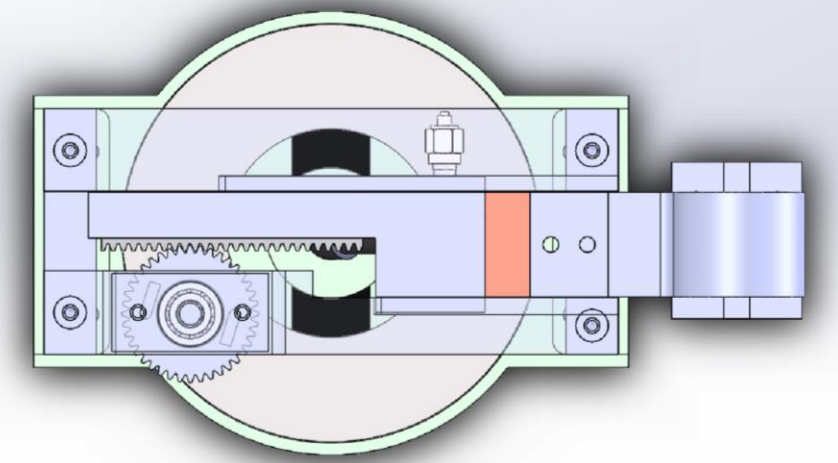


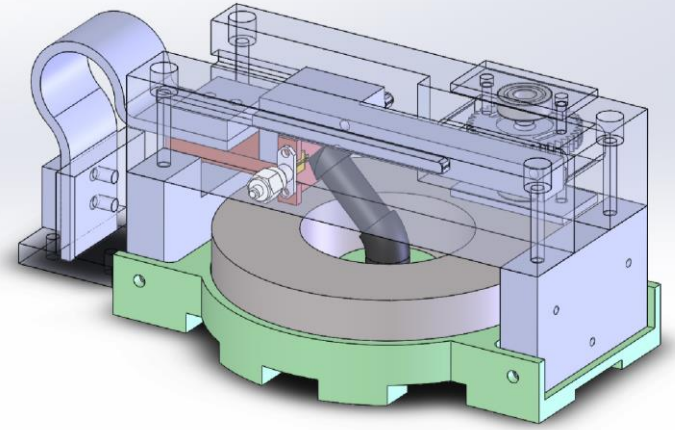


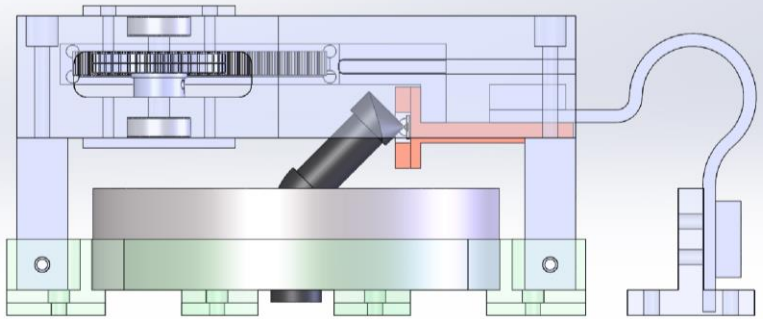


Ease of Assembly

- Making it easy to assembly was important
- I simplified the main scaffold into four rectangular pieces.

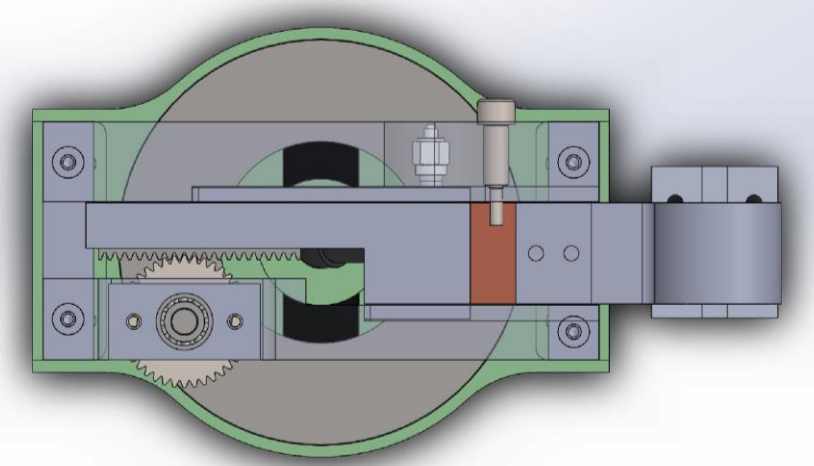


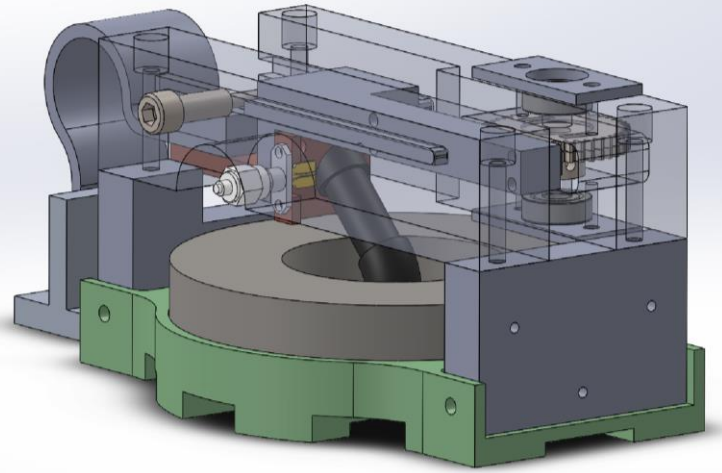


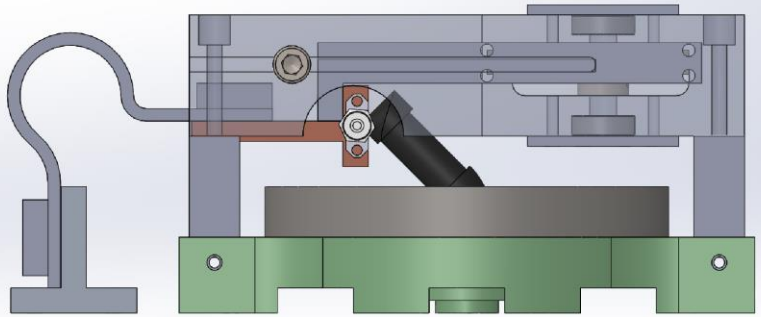


Thermal Contraction

- Thermal contraction is the amount a material shrinks when cooled to low temperatures.
- All parts have to be analyzed with relation to the others.
- The main structure is aluminum, with some steel, copper, and G10.
- Some of the measurements needed hundredths of an inch adjustment.

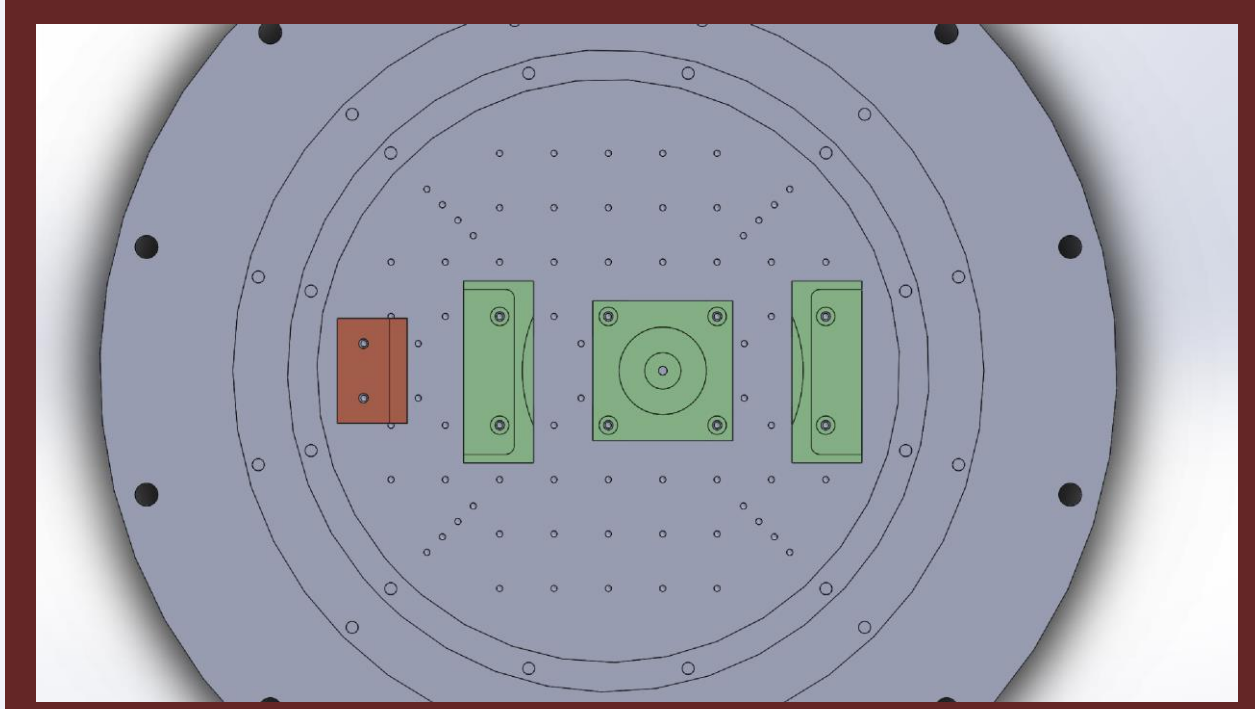


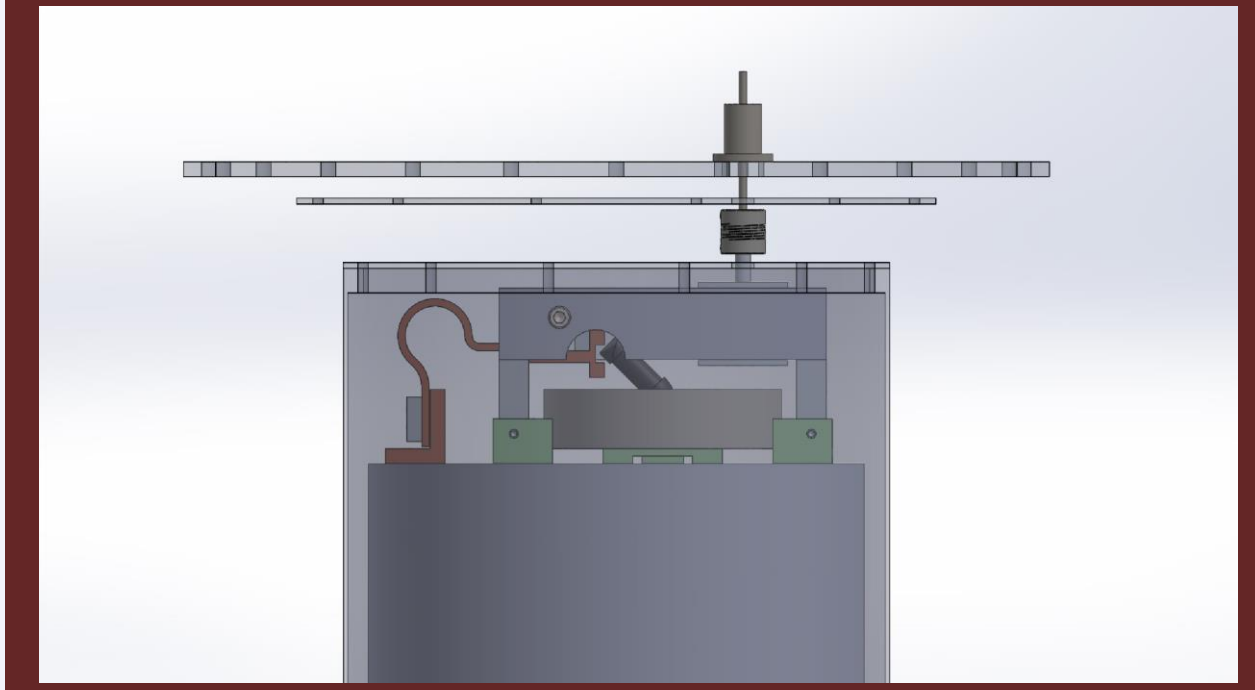




Bolting Down

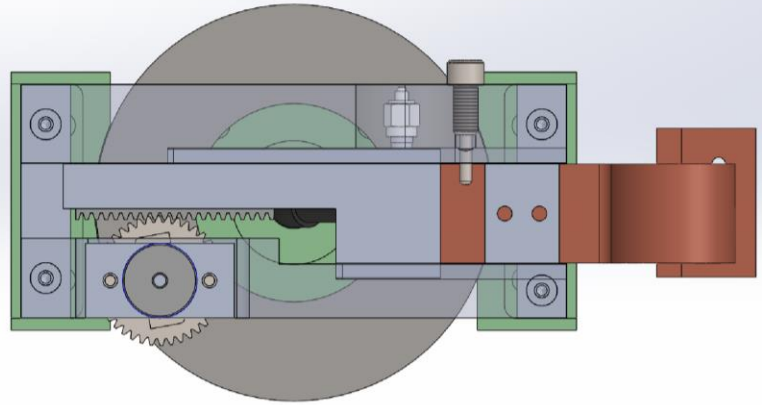
- I also made a simple model of the cryostat that the MET assembly will be going into.
- This helped to find where to make holes in the base and thermal strap plate so they can be attached to the 4K plate.
- This also helped find where to make holes in the radiation shield covers for the shaft coupling

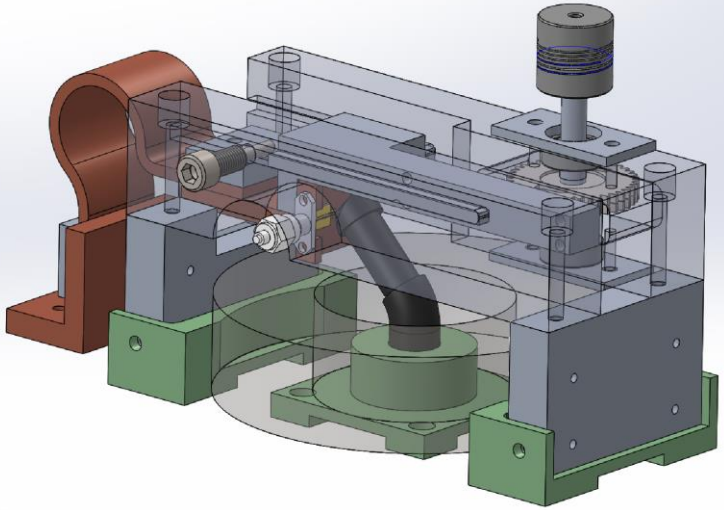


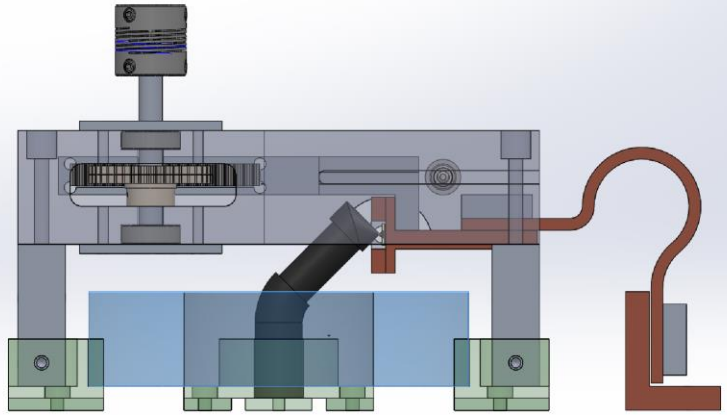


Finalizing

- Once finalized, I had to estimate the cost of all the parts. From the made parts and the parts that need to be manufactured.
- I made drawings to send out for machining the parts
- After some discussion, the G10 base was changed to simplify the part and bring down the cost of machining.
- I did thermal analysis to account for the change and made new drawings for the affected parts.







Thank you