THE OHIO STATE UNIVERSITY

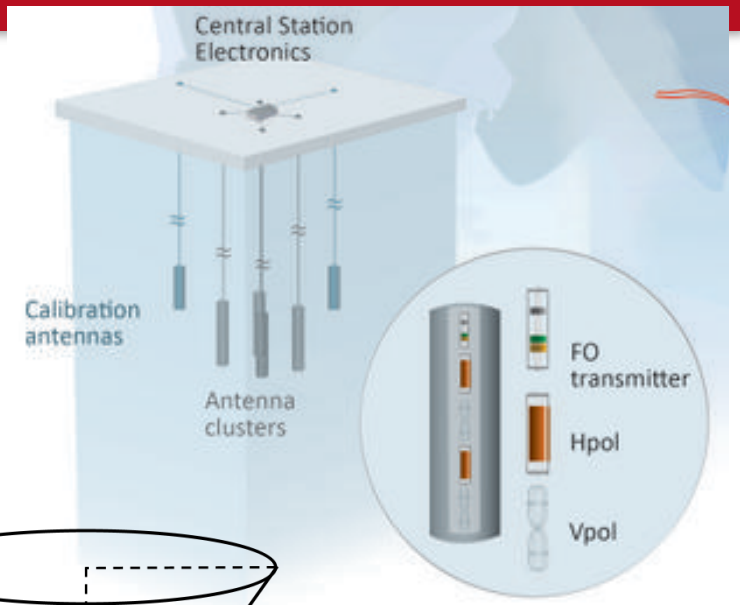
GENETIS
Experts meeting: Building

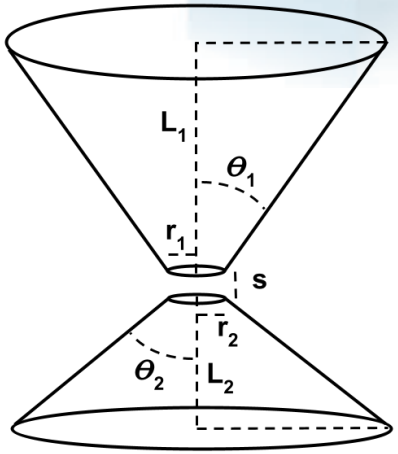
Amy

August 2, 2023

ARA neutrino detector

- First major project: design antennas optimized for detection of UHE neutrinos in the ice
- Begin with a bicone-like design
- Fitness score: number of neutrinos detected by ARA when using the evolved "individual"

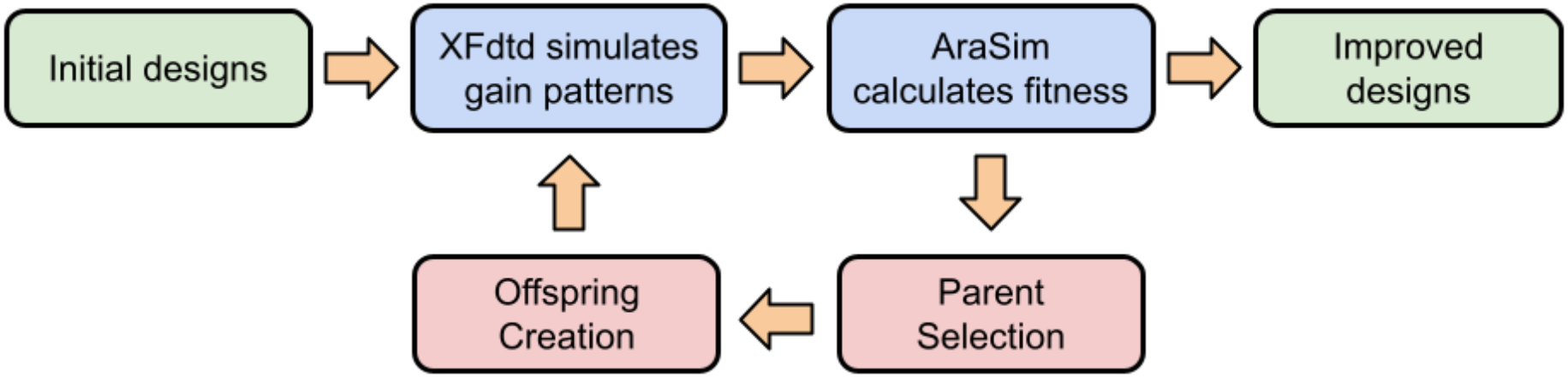




- Lengths, inner radii, opening angles are "genes"

GENETIS ARA loop

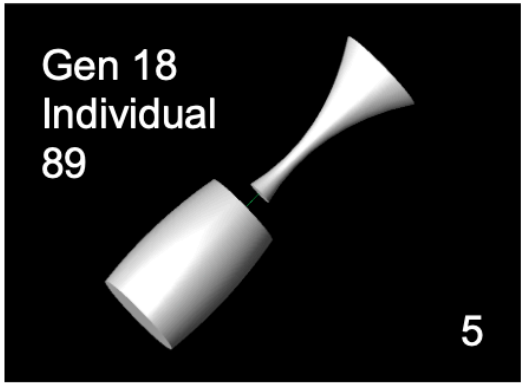
The Loop:

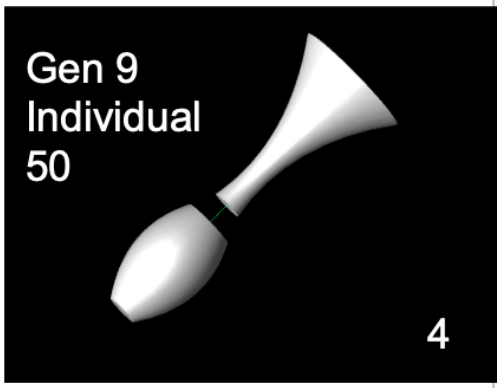


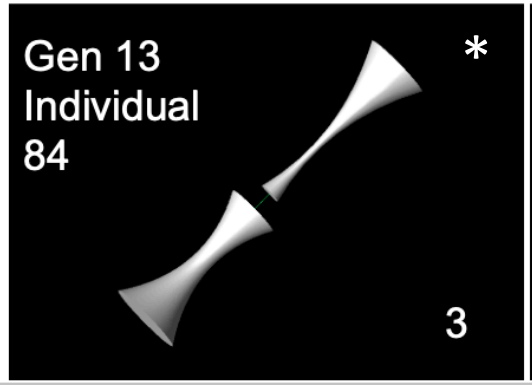
- 50 individuals/generation
- Computing time: 14 hours / generation
- ~35 generations to plateau

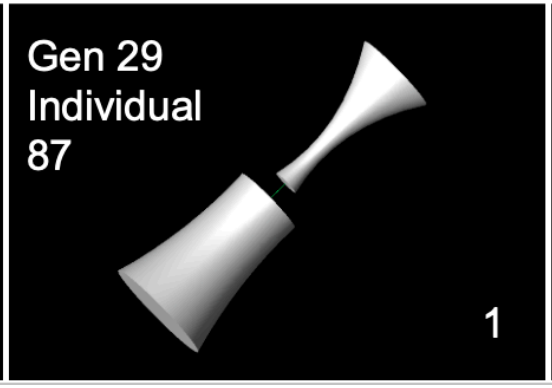
Bicone evolution - crazy sides: Best individuals

r_0	L	A	B
1.15986	18.7904 cm	0.0233761	-0.204119
0.0806527	15.0253 cm	-0.00721627	0.428999

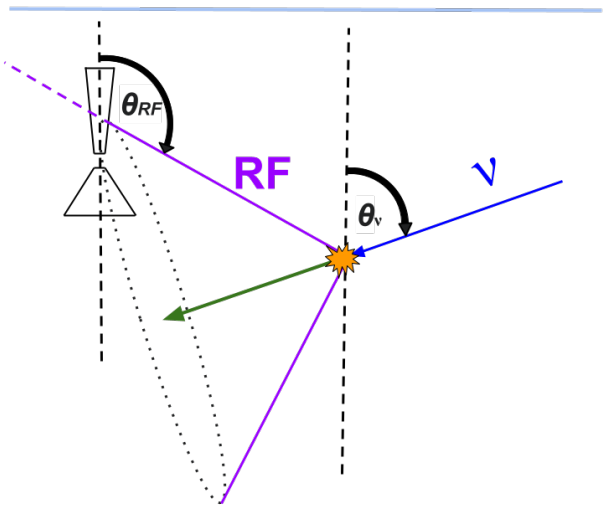


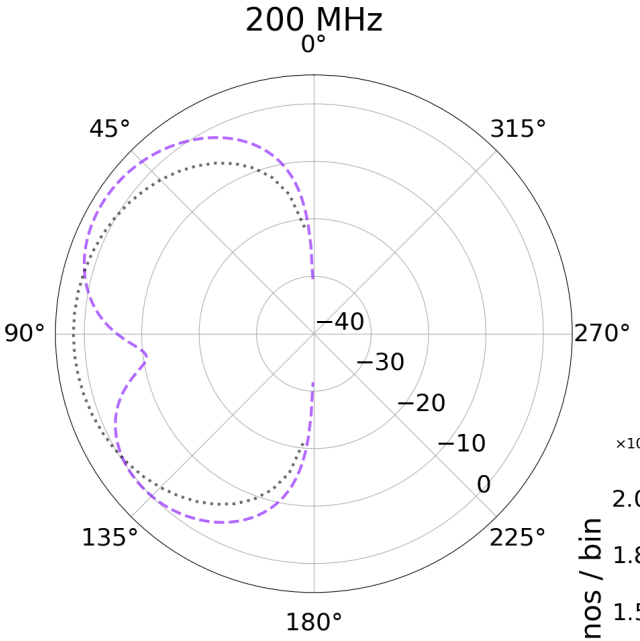


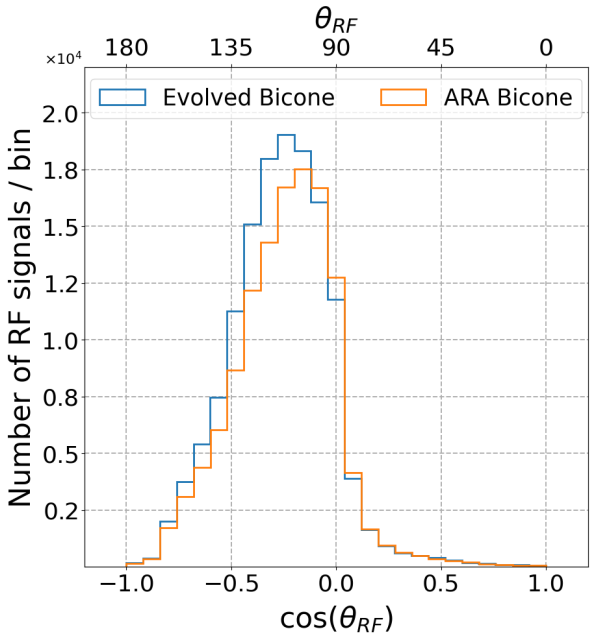


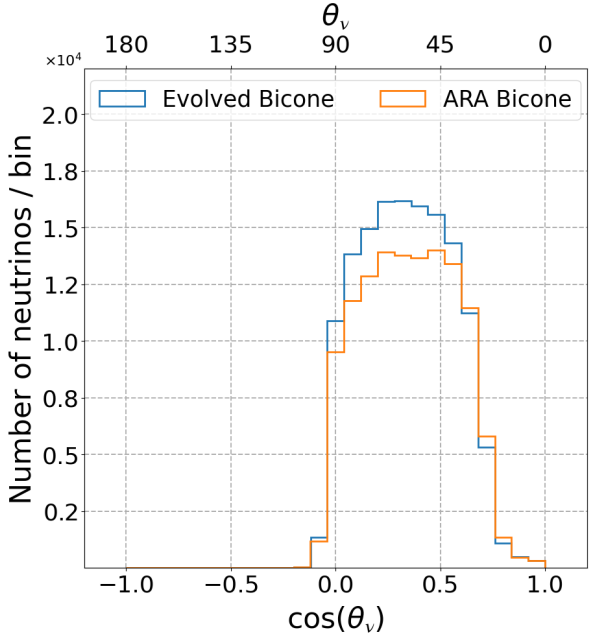


Physics benefit







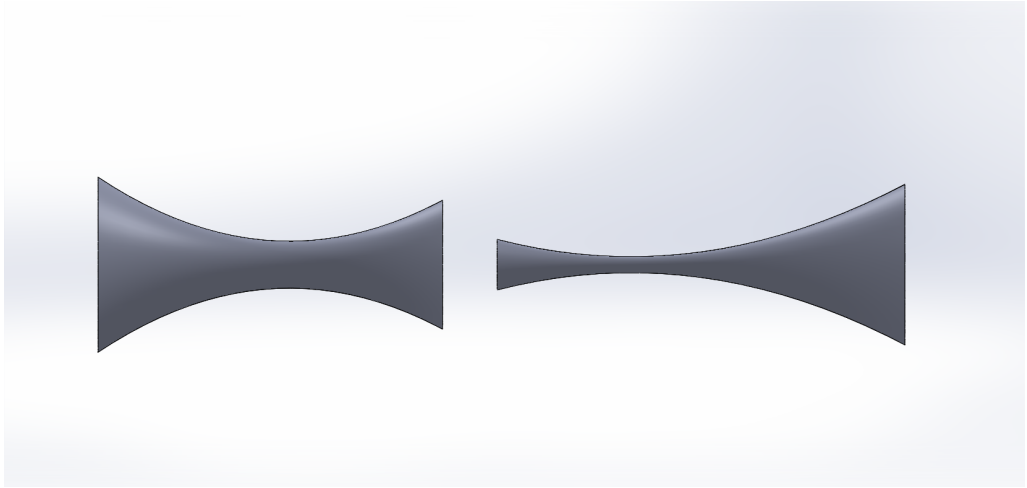


Building prototype of evolved bicone

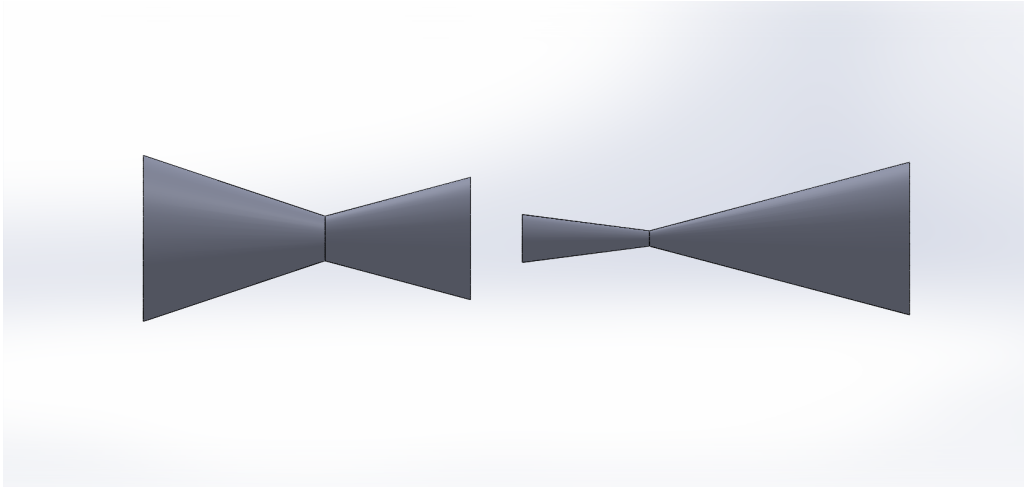
- Had call in Jan. with Chi-Chih, Edward Herderick (CDME) where we hashed out a plan
  - suggested making curved sides into two straight edges
  - 3d print plastic bicone
  - cover in copper foil
  - cable runs through middle attaches to
  - custom board with matching circuit fixed to one cone, use jumper wire to connect a microstrip on circuit to other cone

Building prototype of evolved bicone

- Jack, Dylan checking we get same physics benefit with sides straightened

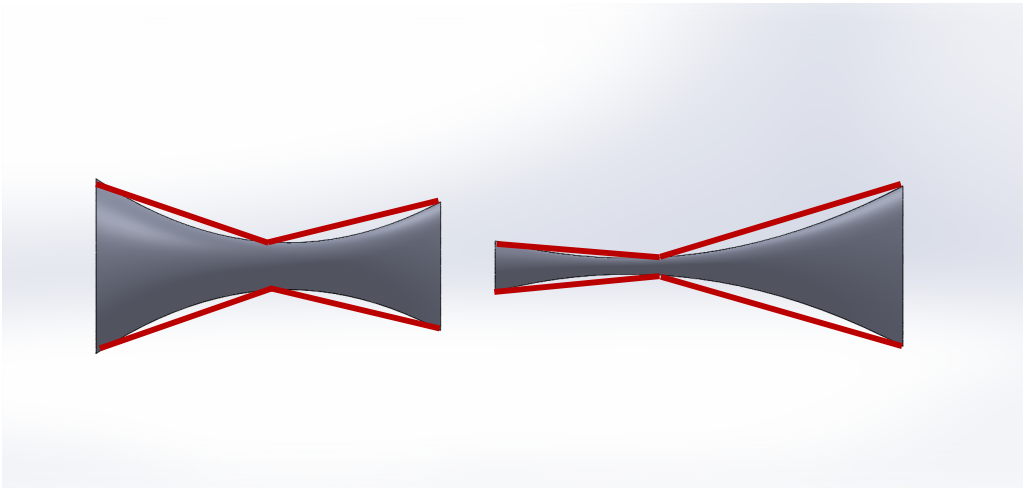


Curved sides

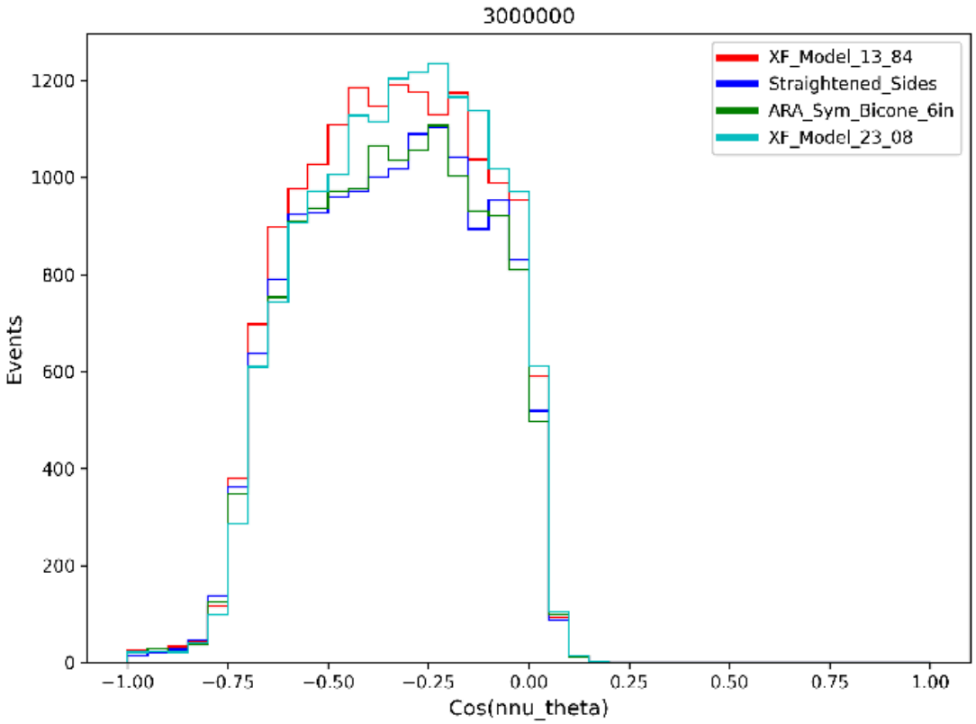


Straightened sides

First attempt at straightening sides

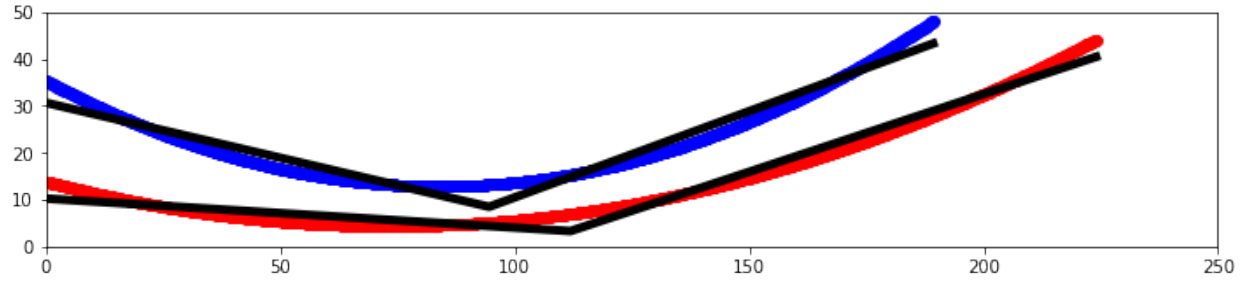


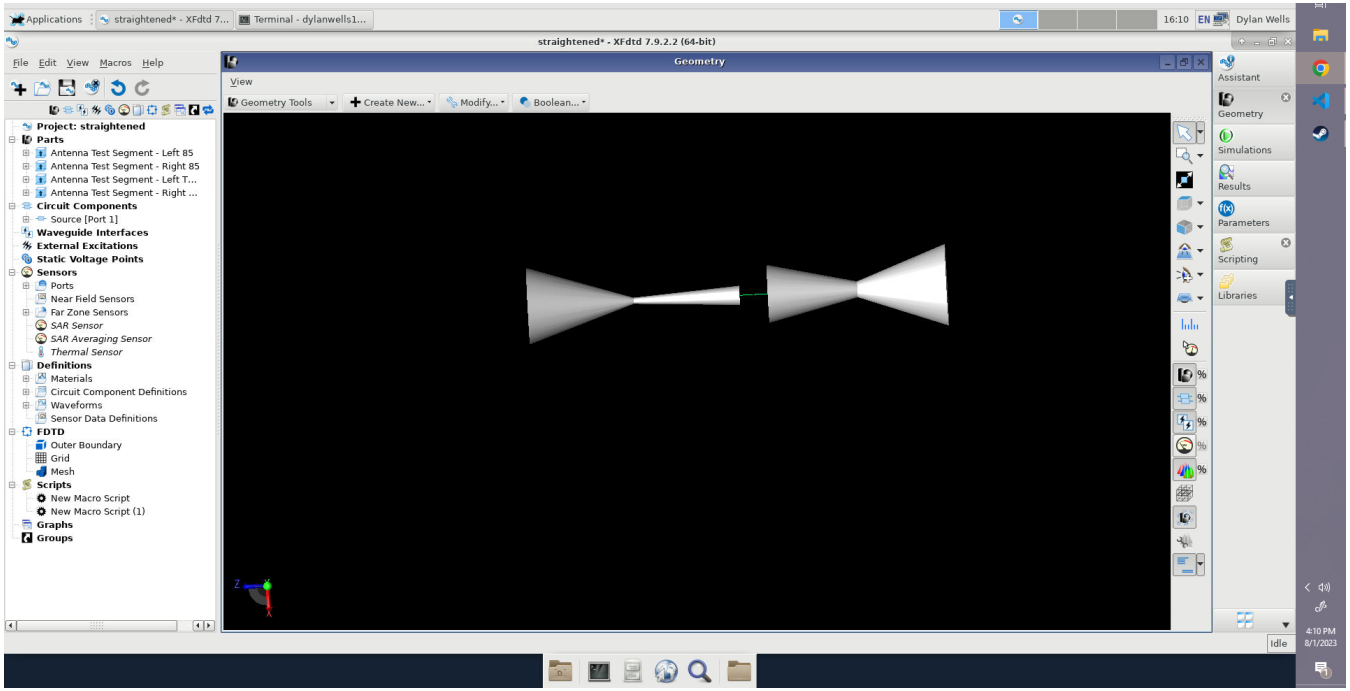
Curved sides



- Lost benefit from the evolved antenna
- Need to see beam patterns

Second attempt at straightening sides

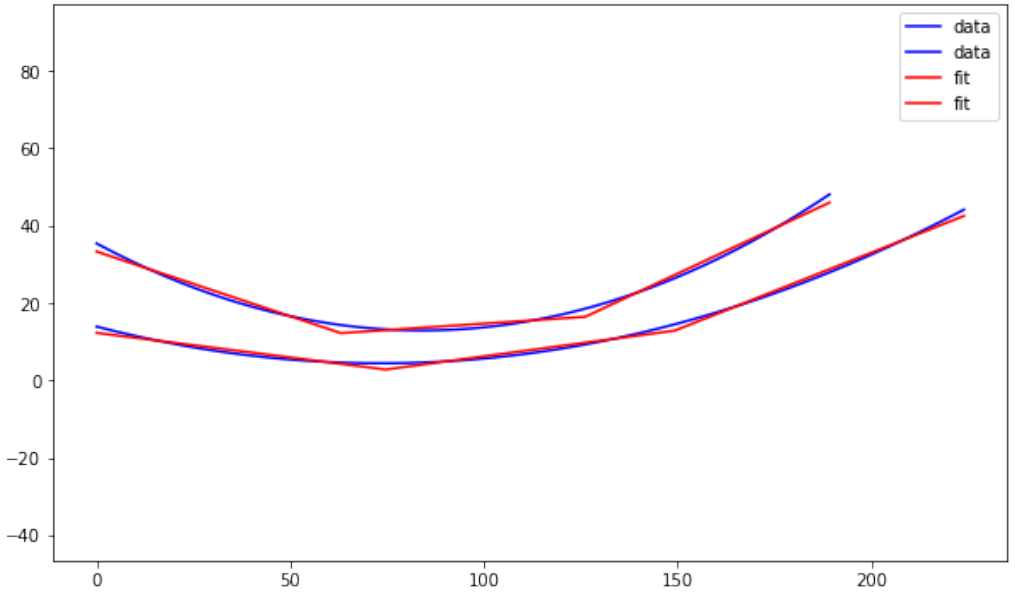




- Did worse
- Fitness score: 3.7 vs. 5.7 (evolved) and 5.1 (first attempt)
- Errors ~0.1
- Need beam patterns, physics plots

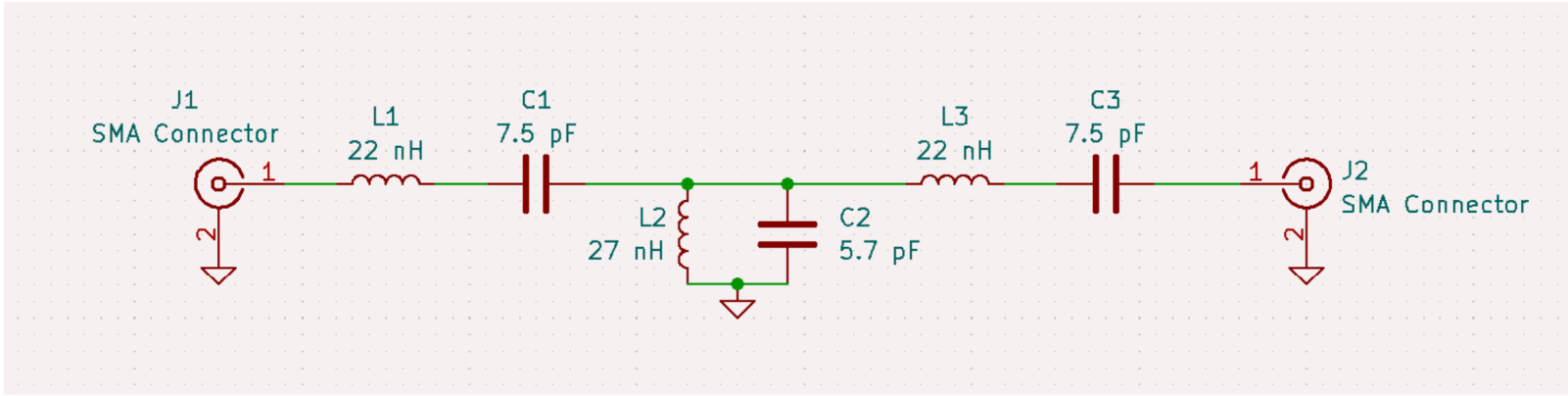
Next steps at straightening sides

- Investigate gains and physics plots from first attempts
- Anything different to try with 2 segments?
- Try 3 straight segments



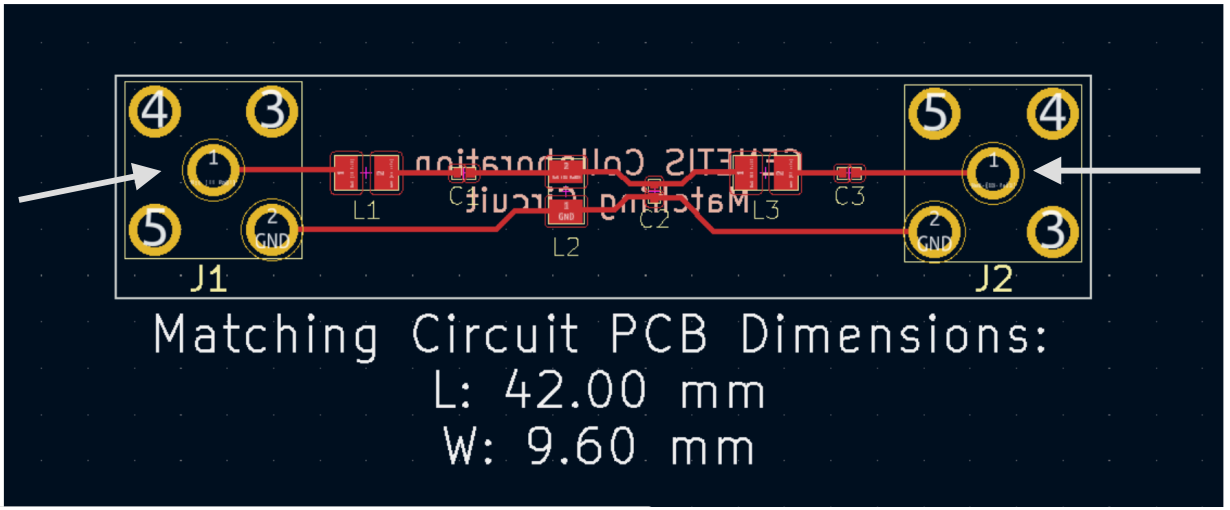
Matching circuit

- Been refining matching circuit to fit in tight space



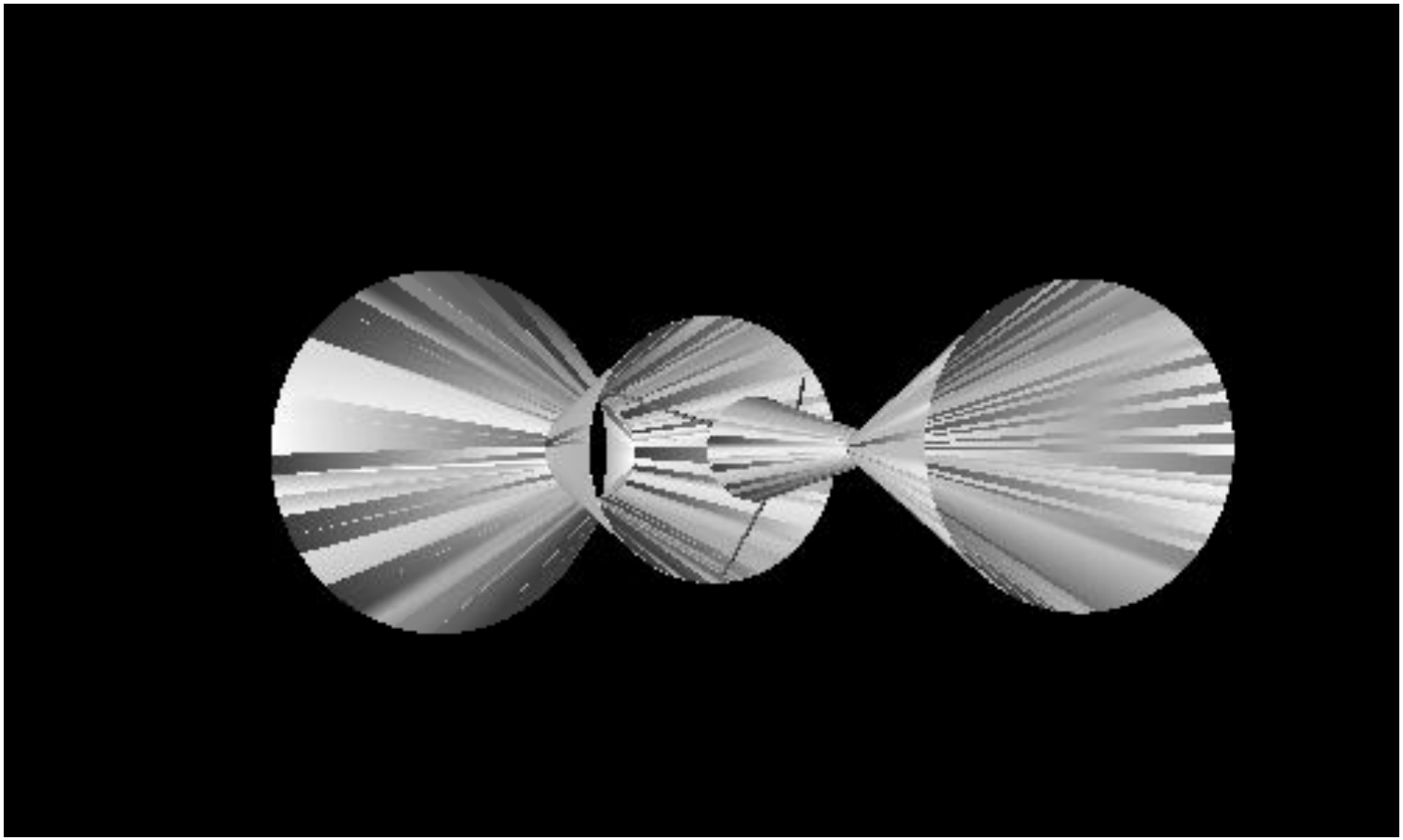
Attachment 2: Matching_Circuit_PCB.png 28 kB Uploaded Thu Jul 6 16:02:14 2023 | Hide | Hide all

Should be elbow connector so it fits?



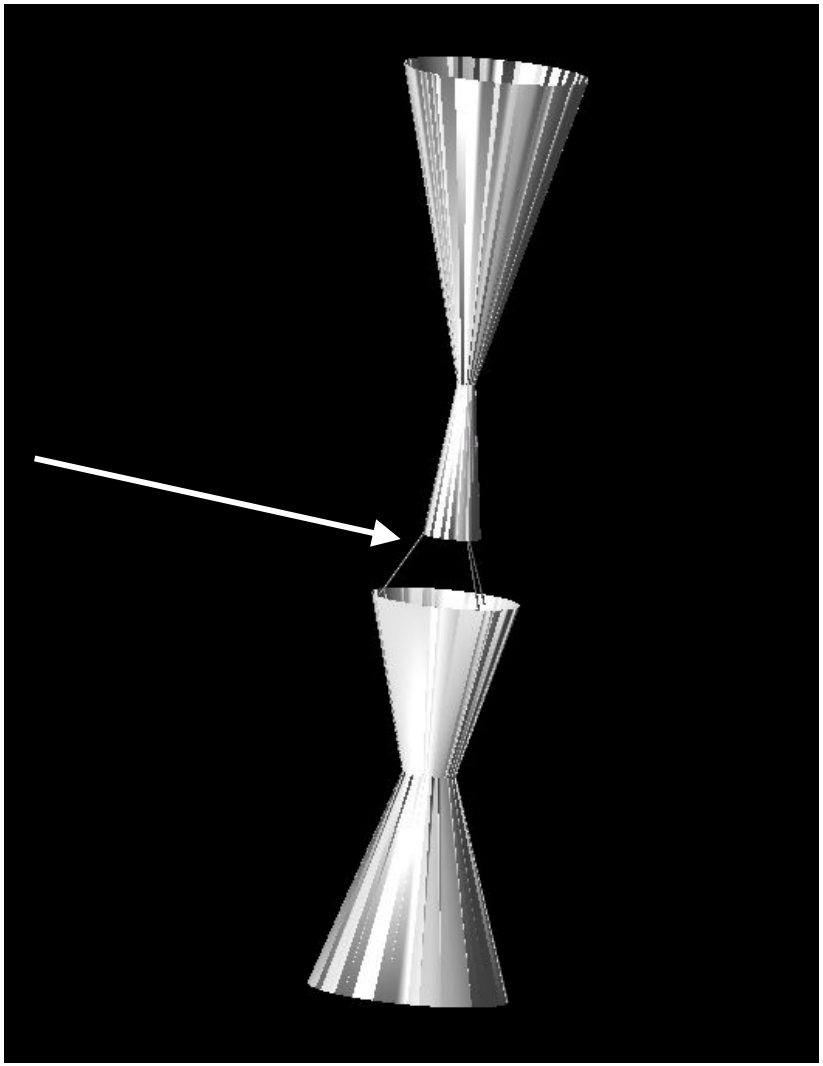
Signal end of J2 should also be connected with a trace? bolted? instead of an SMA connector

Putting it all together

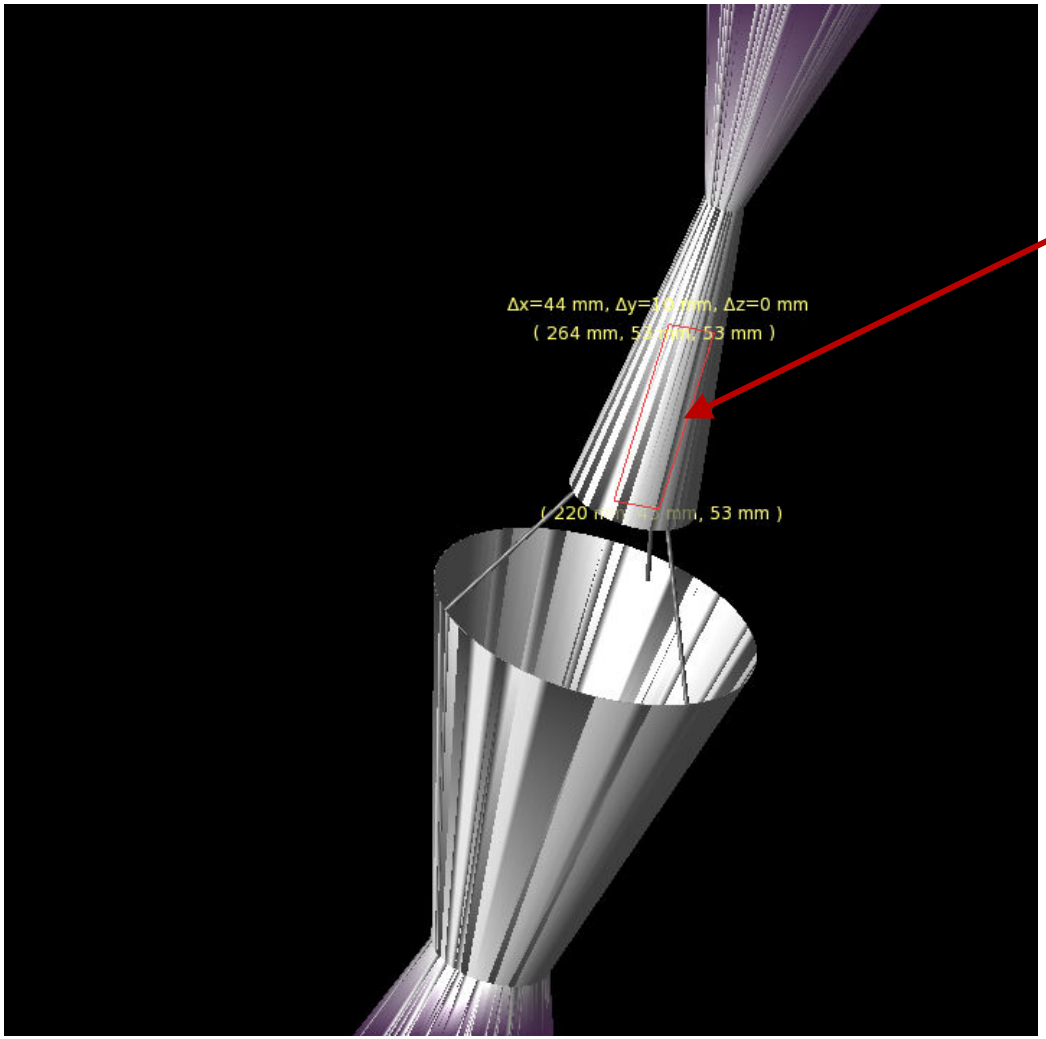


Putting it all together

Three of these (plastic) to hold the cones in position relative to each other



Putting it all together

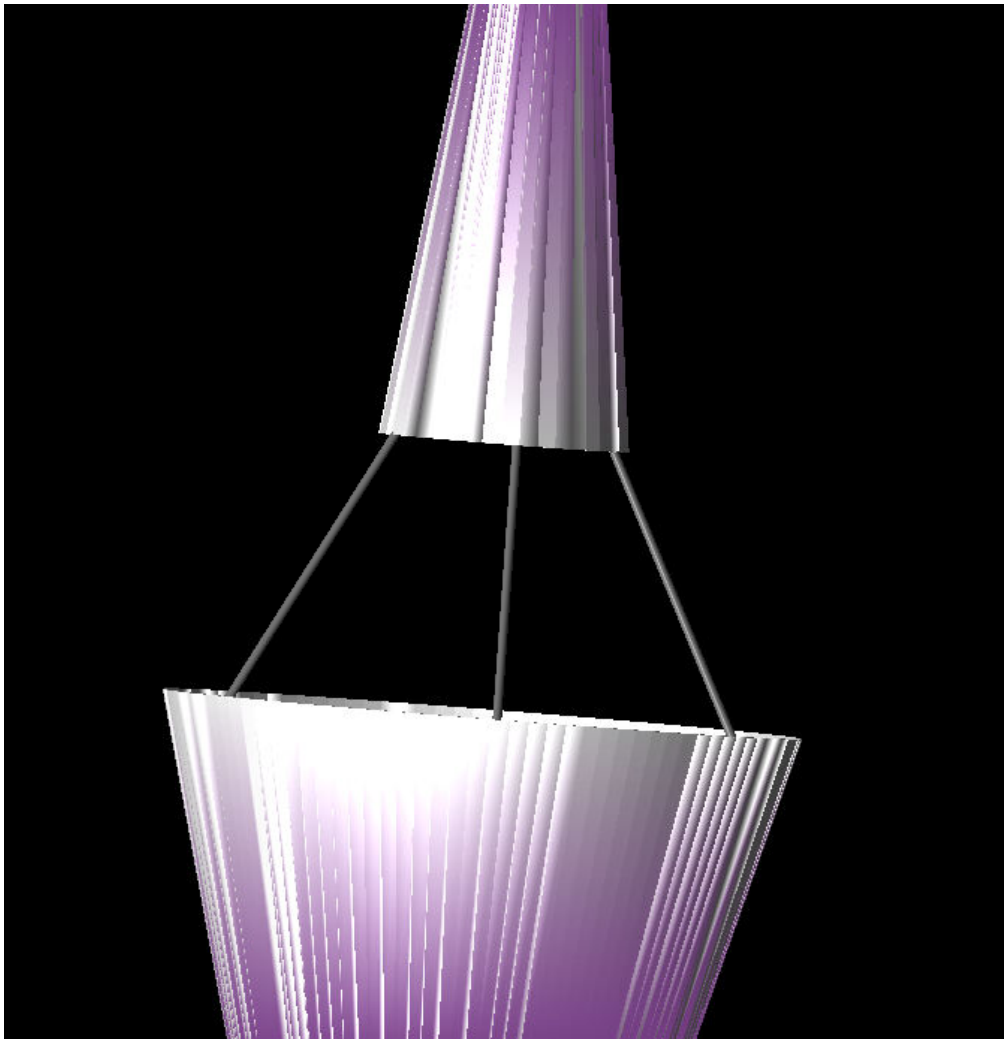


Matching circuit board

Solder lead (bolt?) on one end to top cone

Solder lead on other end to bottom cone via jumper

Putting it all together



Plastic for cones

- Email from Ryan Brune:

Thanks for the additional information. I would think we might end up using ABS if there isn't a preference, simply because our ABS-ready printer (Stratasys F370) is the one that prints with dissolvable supports and would likely print the most consistent-looking cone shape, when compared with our PLA printers (Ultimaker S5). We would want enough wall thickness at least for it to keep its shape…something close to 1/8" wall thickness would likely work I would think, but we can look into that.

Copper foil to cover cones

- Any advice welcome
- Skin depth for Cu @ 500 MHz looks like it's 2.95 μ or 0.116 mils
- How important are crinkles in foil or regions of overlap
- What adhesive?

Budget

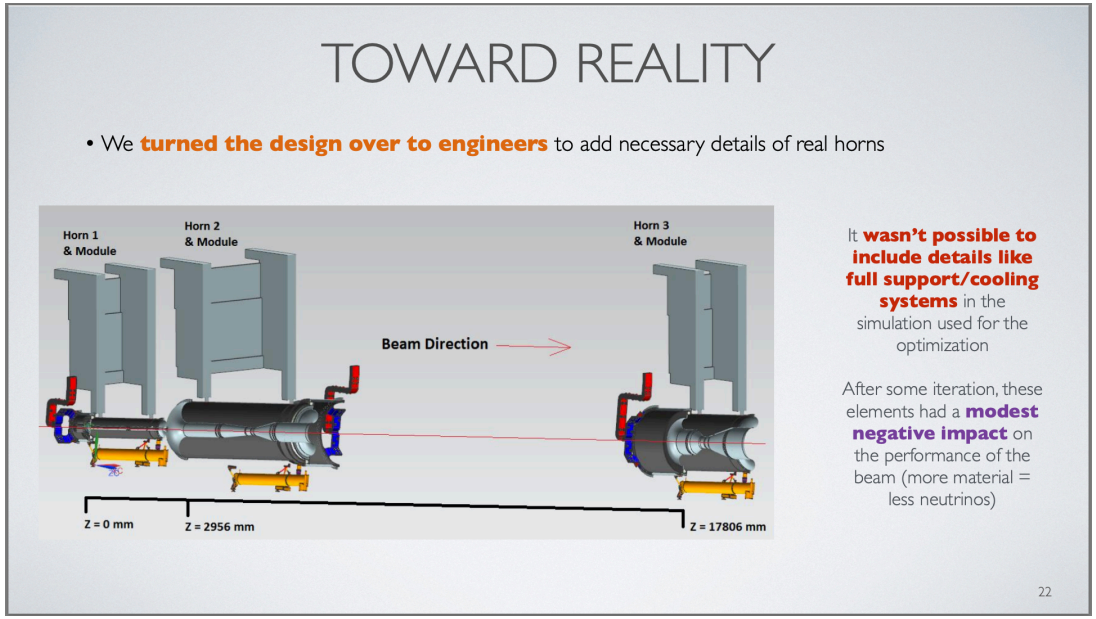
- We have about $10k to build this prototype
- Will send detailed budget to CDME for back and forth

Things to do before building

- Do we have endcaps??
- Make modifications to matching circuit board design, order any components
- Find straightened sides configuration that keeps science benefit (not too important)
- Get copper foil, adhesive? (Simple)
- Simulate in XF with everything in there
- Send CAD drawing to CDME
- Iterate with CDME on budget
- Evolve with realized gain
- Future - put it in ice

Something of interest

- Saw this talk at MODE workshop last week:
  - https://indico.cern.ch/event/1242538/contributions/5453210/attachments/2691006/4669754/MODE_2023_Fields_LBNFDUNEOptimization.pdf
- Optimized neutrino beam for science outcome
- May invite her to one of our Monday calls



Plan for getting funding for GENETIS

- OSU agreed to help to strengthen our Keck one-pager, next internal due date mid-December
- NSF CSSI proposal:
  - https://new.nsf.gov/funding/opportunities/cyberinfrastructure-sustained-scientific

The CSSI program anticipates three classes of awards:

- **Elements:** These awards target small groups that will create and deploy robust services for which there is a demonstrated need, and that will advance one or more significant areas of science and engineering.
- **Framework Implementations:** These awards target larger, interdisciplinary teams organized around the development and application of services aimed at solving common research problems faced by NSF researchers in one or more areas of science and engineering, and resulting in a sustainable community framework providing CI services to a diverse community or communities.
- **Transition to Sustainability:** These awards target groups who would like to execute a well-defined sustainability plan for existing CI with demonstrated impact in one or more areas of science and engineering supported by NSF. The sustainability plan should enable new avenues of support for the long-term sustained impact of the CI.

- Also will check out NSF unsolicited interdisciplinary