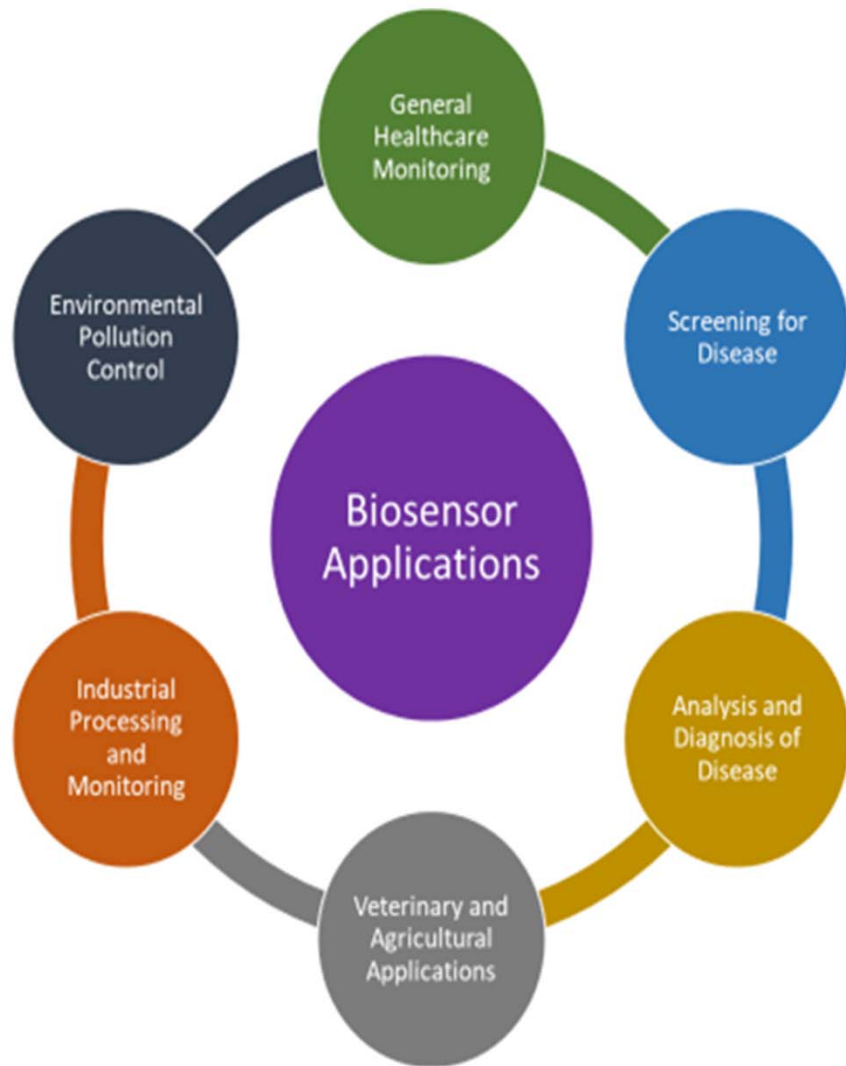


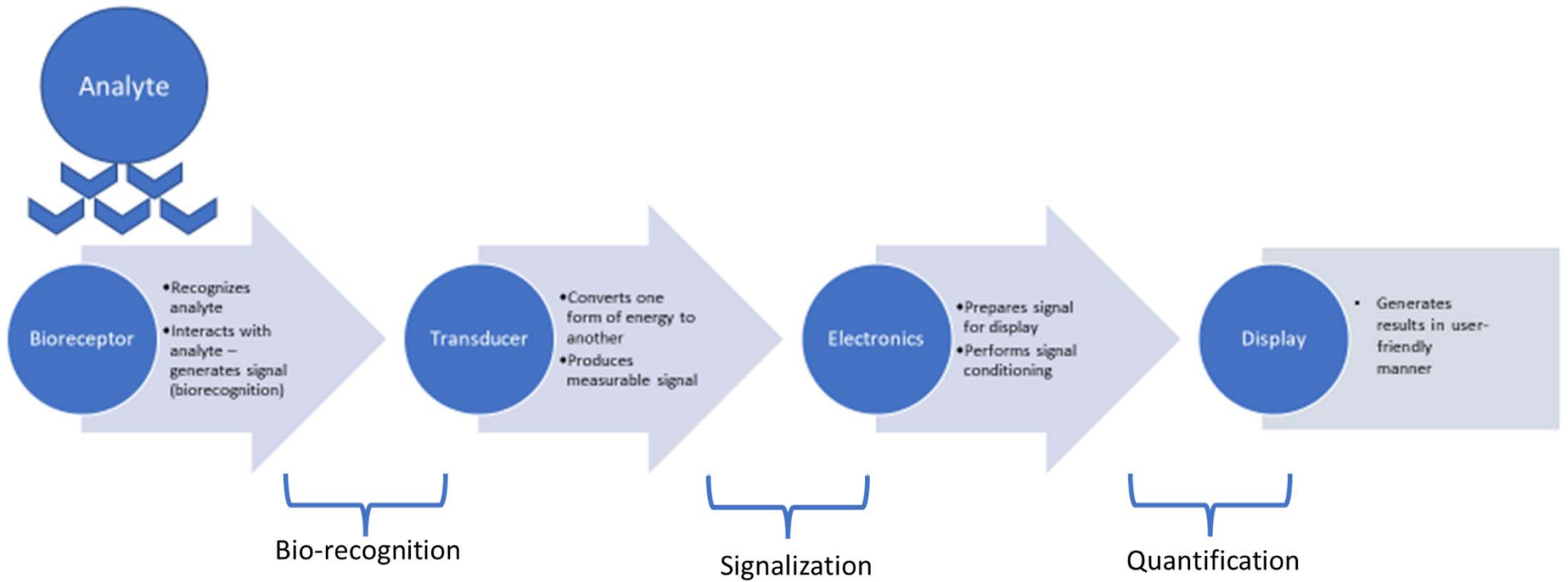
Optical Engineering of Photonic Circuits and Devices in structured media: Biosensor

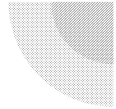
Advisor: Dr. Eric Seabron
Samuel Dowling, Jerome Halsell,
Rachel Hurst, David Masale





Our research is centered around biosensors and improving their applications. Biosensors are an upcoming technology that can be used for noninvasive detection and chemical sensing. In our research, the main objective is to develop resonators to enhance biosensor sensitivity. Its sensitivity is its ability to detect a specific analyte in a mixture. The sensitivity of a biosensor is arguably its most important feature.

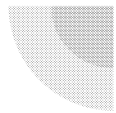




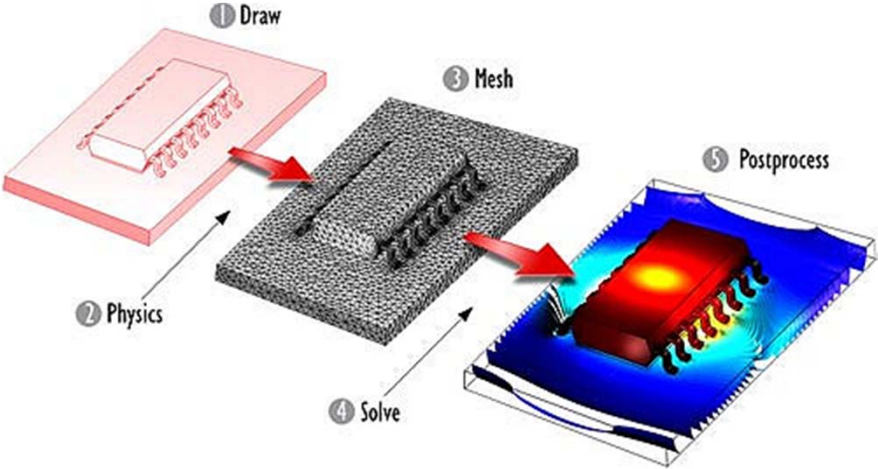
Background

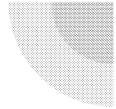
Specifically, Terahertz-based biosensors have the potential to lead the way for low-cost, non-invasive, and rapid virus detection. The frequency range of the THz wave correlates to the vibrational frequencies of numerous significant biomolecules (proteins, RNA, and DNA), allowing biomolecule vibration to be detected. THz technology is well known for its high penetration into most dielectrics with low photon energy

Recent progress in nanophotonic biosensors has been useful in combating the COVID-19 pandemic.



Software Specifications





Technical Constraints

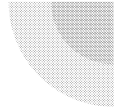
- Due to the finite element approach, convergence can oftentimes be challenging
- Troubleshooting a numerical model can be challenging
- Drawing tools are limited for 2D
- Our most significant technical constraint is our hardware, namely computer memory and RAM - recommended minimum configuration criteria is 1 GB of RAM per CPU core

Non-Technical Constraints

- We only have a single computer capable of running the software.
- Socio-cultural: This project isn't something immediately ready to be sold it requires further research and as of right now can only be understood by those in the industry.
- Environmental - Can't have constant simulations running, too much of a drain on home electricity.



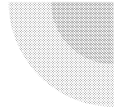
Solution Generation



Solution Generation: David

My solution was to upgrade the computer we were using as a means to avoid future potential issues in regards to overheating or crashing.

I suggested the purchase of a new graphics card and transitioning from a water cooling system to a traditional air cooling system.



Solution Generation: Samuel

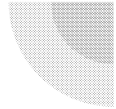
Acquire Personal Copies of COMSOL

My Solution is to acquire personal copies of comsol

In theory this would allow us to allocate memory space better and work at a faster pace

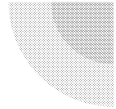
This solution is hard to implement. Each copy of COMSOL will cost the user approximately \$1,700 for a 12 month trial. Currently no student options or free trials exist

Another alternative could be to use a similar simulation software as a back up when COMSOL is ineffective.



Solution Generation: Jerome

Generating possible solution is to use a different software to run our simulations. ANSYS and ABAQUS are also viable simulation software products that would allow us to solve multiphysics phenomena. ANSYS is useful for creating general models and saving time, and ABAQUS is good for solving non-linear problems in solid mechanics. COMSOL is the main software to give the best results any other form is rejected for simulation test at this time.

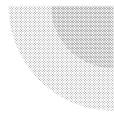


Solution Generation: Rachel

Create a rotating schedule for using Titan

Unfortunately, one of the downsides of using Titan is that only one individual can use it at a time. To mitigate the issues associated with that restriction, we can allocate time slots to give team members the opportunity to use Titan.

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
11:00	Open	Rachel	Sam	Desvaun	David	Jerome	Open
12:00							
13:00							
14:00		Open	Open	Open	Open	Open	
15:00							
16:00							
17:00		David	Jerome	Brandon	Rachel	Sam	
18:00							
19:00							
20:00							



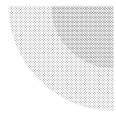
Top Solution Design

Rank factors on a scale from 1 - 5, with 5 being the most important factor.

Solutions	Cost - 5	Convenience - 1	Time to Complete - 3	System Knowledge - 4	Flexibility - 2	Total
<u>Solution 1</u> Individually purchasing COMSOL	4	3	1	4	3	48
<u>Solution 2</u> Create schedule between users	1	4	4	3	4	41
<u>Solution 3</u> Upgrading the computer	3	1	3	1	2	33
<u>Solution 4</u> Use different software package	2	2	2	2	1	28

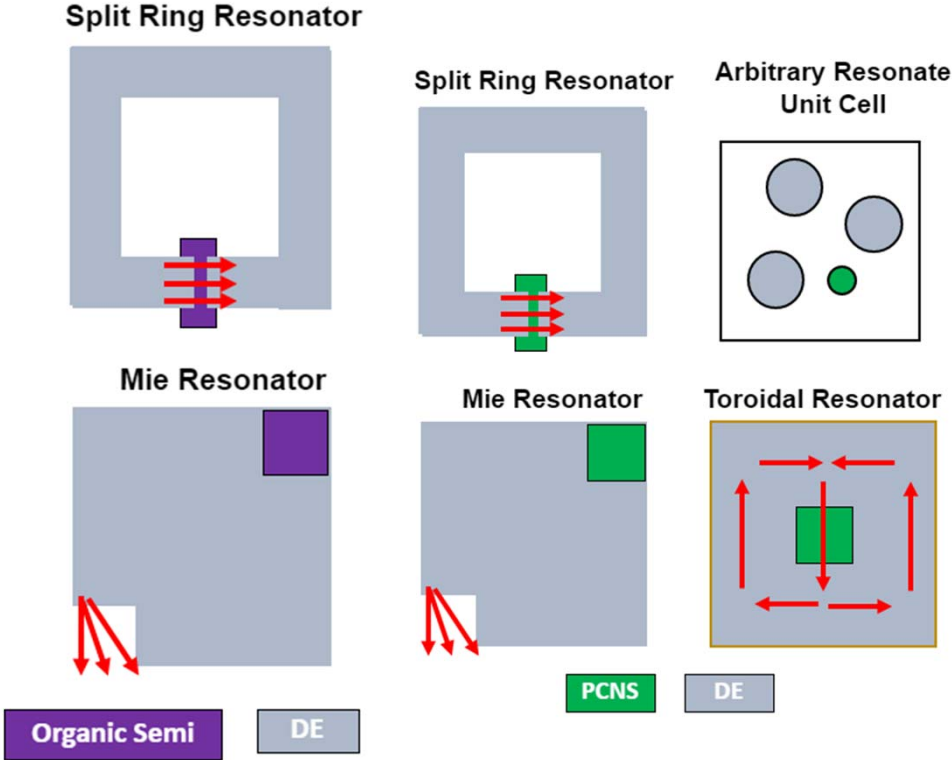
Rank solutions on a scale from 1-4 in terms of the above corresponding factor, with 4 being the most.

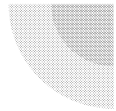
Multiply the corresponding rank factors and solutions. Add the totals.



Work as of: November 23rd, 2022

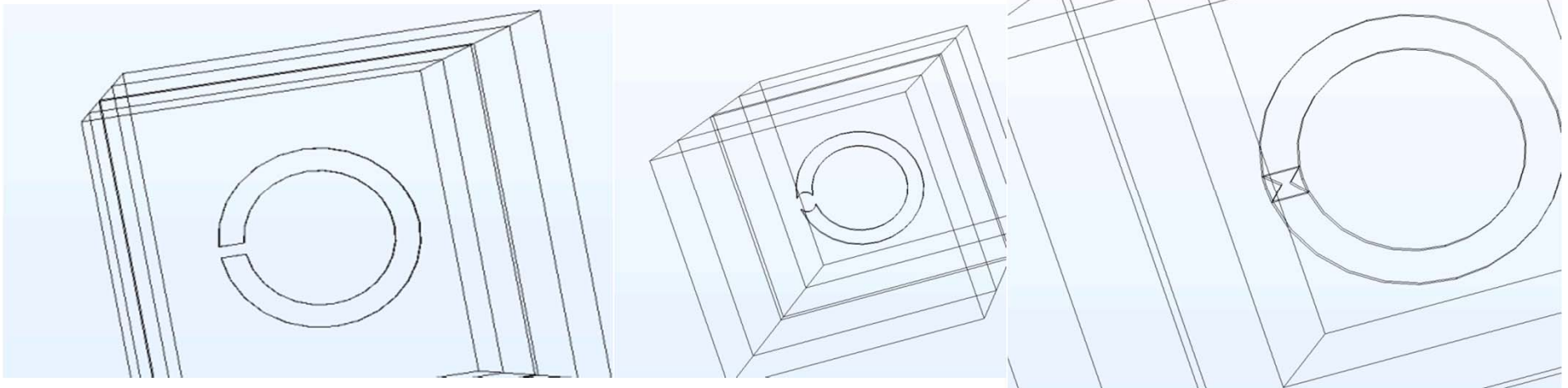
Some examples of simulation data and screenshots of data.



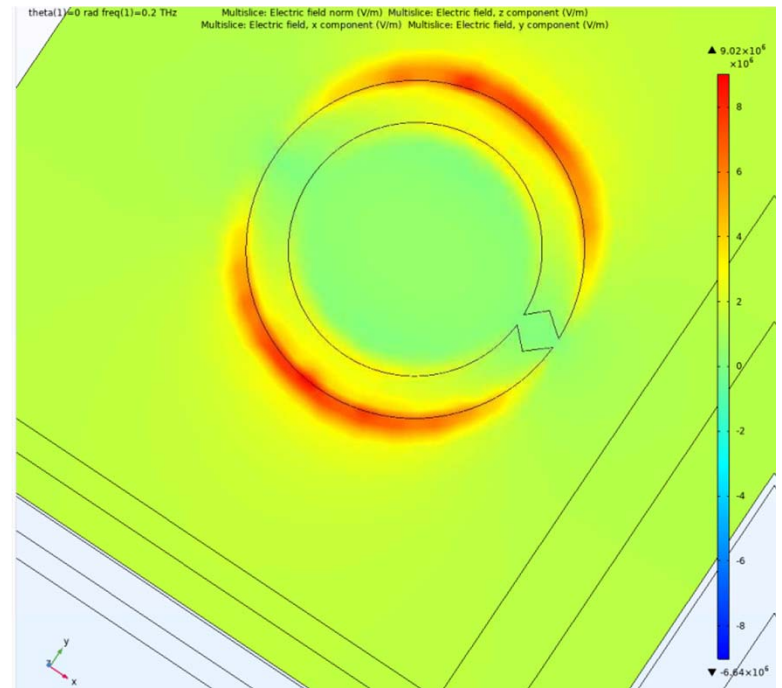
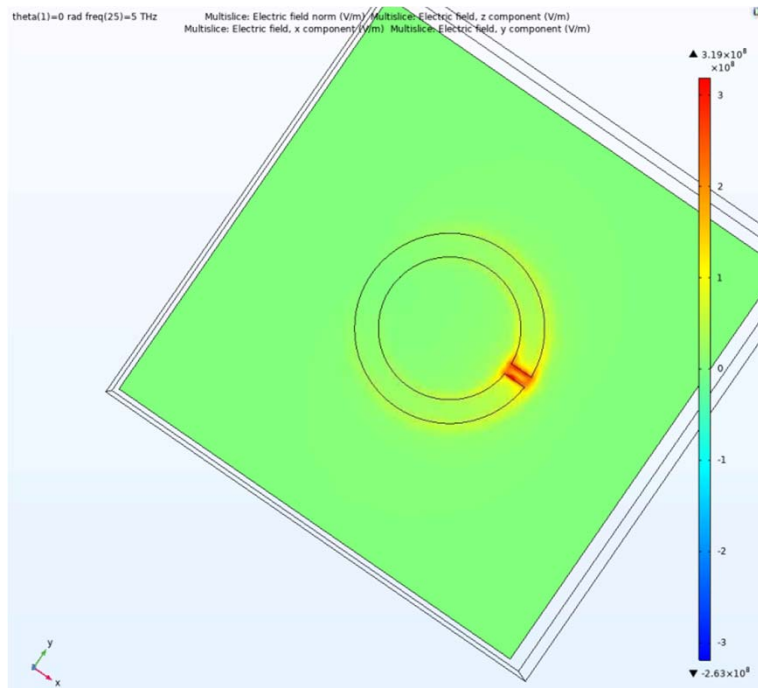


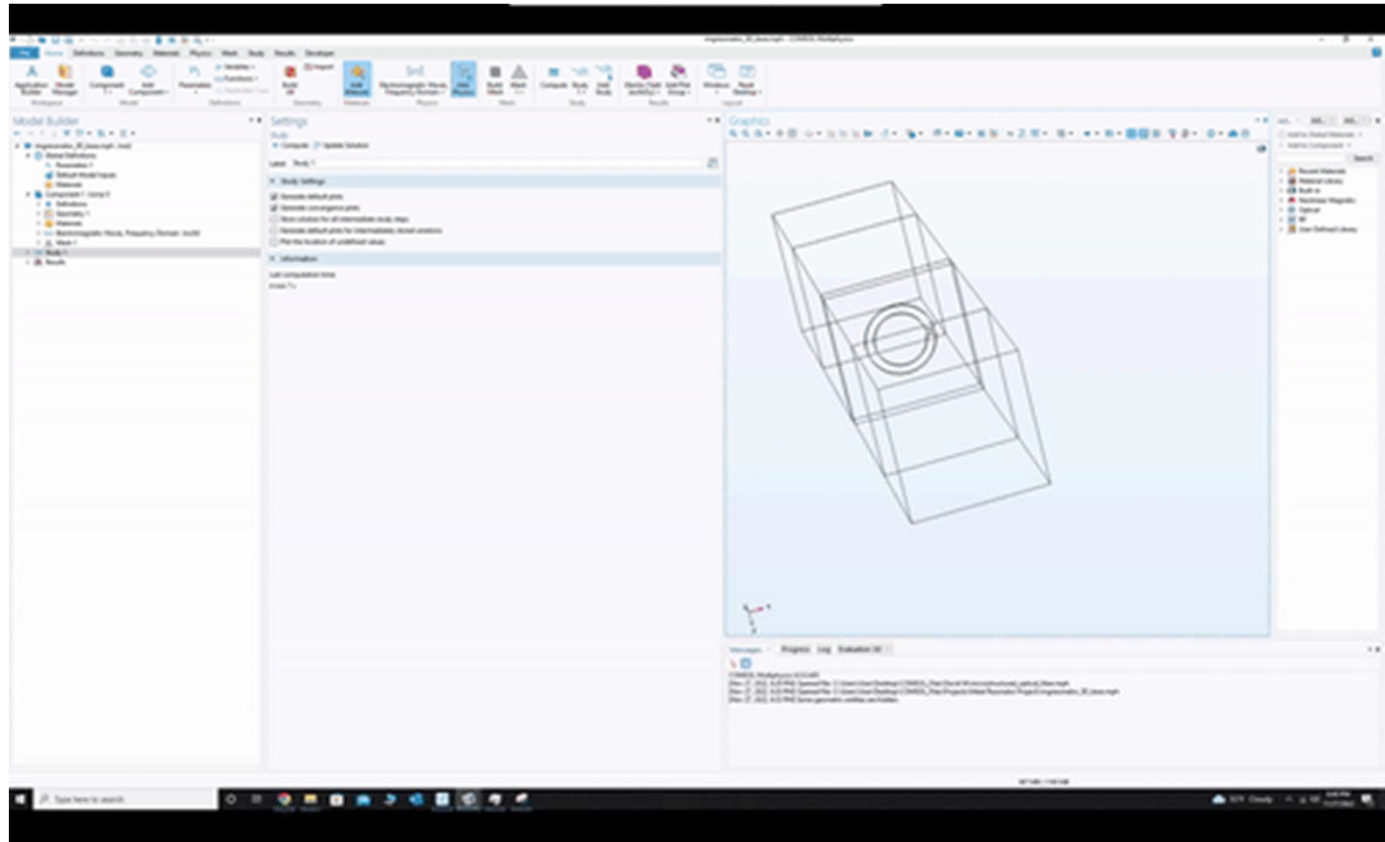
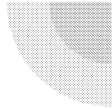
Work. Cont.

As of right now, we are currently experimenting with different shapes and extrusion heights on the split ring resonator to see which would be the most effective. Our next step would be testing a variety of different phase change chalcogenides and organic semiconductors and running those simulations to collect data.



Work. Cont.





The top right corner of the slide features three decorative circles of varying sizes, each with a fine grid or dot pattern. The largest circle is positioned highest and furthest to the right, with two smaller circles below it, one to the left and one to the right.

**Thank you for your
time!**

Any questions?