Fermilab | U.S. DEPARTMENT OF ENERGY | Office of Science

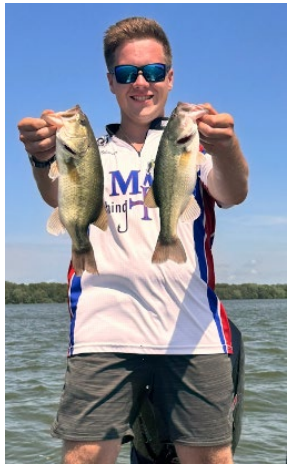
VALOR Internship Final Presentation – Target Systems Department & Accelerator Division

Vincent Hlavacek

Final Presentation

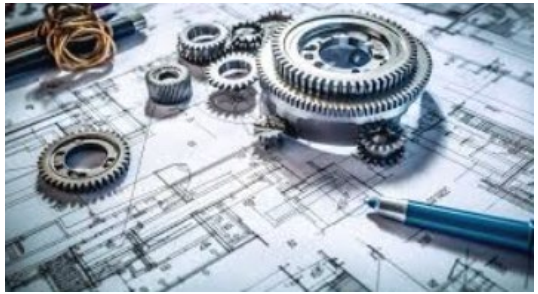
26 July 2024

ARMY JROTC



Marmion Academy
Class of 2025

Vincent Hlavacek



My Future

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Why Fermilab?

- Field-Specific Experience
  - I have been heavily considering Mechanical Engineering for my college major. However, I have only ever been able to experience Mechanical Engineering as an online application, in particular CAD software. I knew there was so much more to Mechanical Engineering though, and I wanted to experience it! Fermilab has brought that to my finger tips and it has been all the best!
- Deeper Understanding
  - I had basic knowledge of what Fermilab did and I had heard about particle accelerators in the past, but I was still curious. I wanted to experience the science first hand and be able to help make advances in this specific field.
- Influence on my college major
  - Before my internship at Fermilab, I had been deciding between the three different fields of engineering however, this experience has helped me decide upon which I would like to pursue. Working in MI-8 doing hands on engineering has helped me solidify my pursuit of a Mechanical Engineering degree.

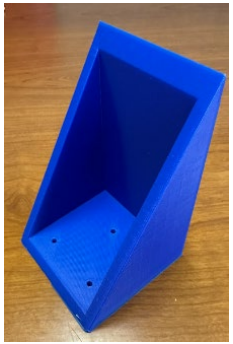
Stripline Shipping - Brackets

The stripline for the LBNF Horn A needed to be shipped to Germany. During shipping, the stripline needed to be held in place to prevent damage.

- Design
  - First, we developed a complex design and decided a simpler design for the scope of the project was needed.
  - Once we settled on a design, we brought the design to production.
- Production
  - In our initial design we set a goal to have each print take a maximum of 8 hours.
  - We chose PLA filament and used an Ultimaker S5 Printer.

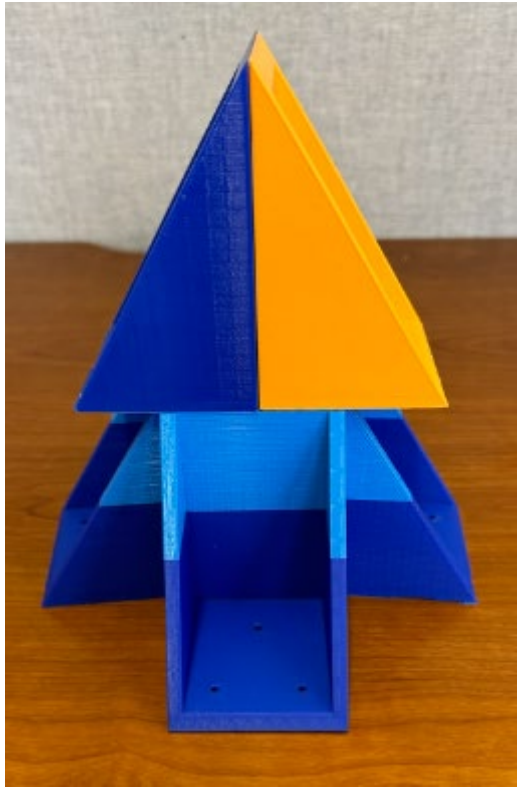
Initial Design (Left)

Dimensions
- 3” Tall
- 3” Wide
- 3” Deep



Final Design

Dimensions
- 5” Tall
- 3” Wide
- 3” Deep



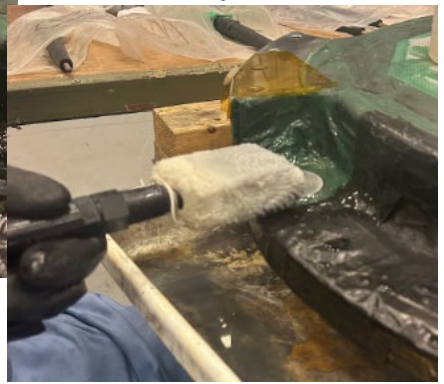
Silver Plating

Preparation

Step 1

Step 2

Step 3



Chemical Process

- 1st , we applied Cleaner 101. We applied this until the surface started releasing a slight amount of smoke. Test with water to see if the water breaks.
- 2nd , we applied Etching 1022. We apply this chemical until the surface turns to a charcoal/black color.
- 3rd , we apply Etching 1023 which helps take off the smut.

- Process
  - Preparation
    - First, we started by sanding the surface and spraying it with water.

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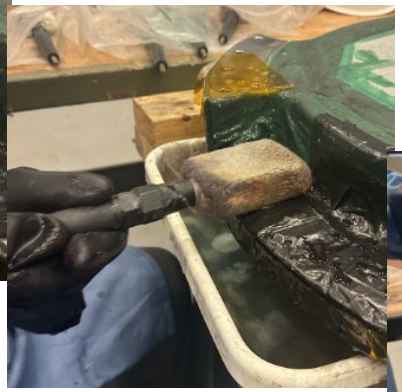
Silver Plating Continued…

Step 4

Step 5

- 5th, we apply Palladium 3040, this is generally the fastest step, forms a light grey matte deposit on the surface.
- 6th, we apply a coat of Silver 3084, this is the final step. in this step, you have to be extremely cautious of stopping motion, by doing so, you will burn the surface.



Step 6

4th , we apply Nickle 2080, this is a green fluid, that we apply after it is preheated to 50-60 degrees Celsius.

Rinsing

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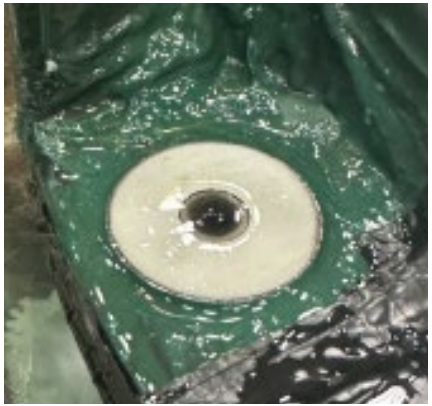
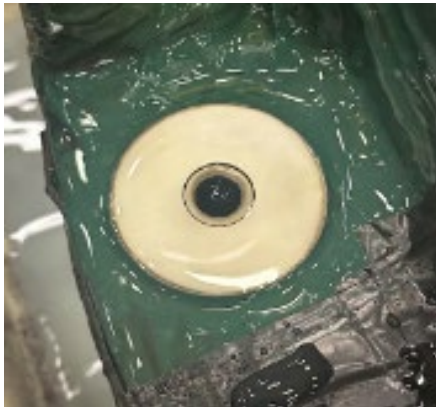
Other Pictures From Silver Plating



Before Cleaning



After Cleaning

After finishing the final silver layer, we ran water over it. Using a spray bottle, we are able to concentrate the spray of the water on the desired surface.

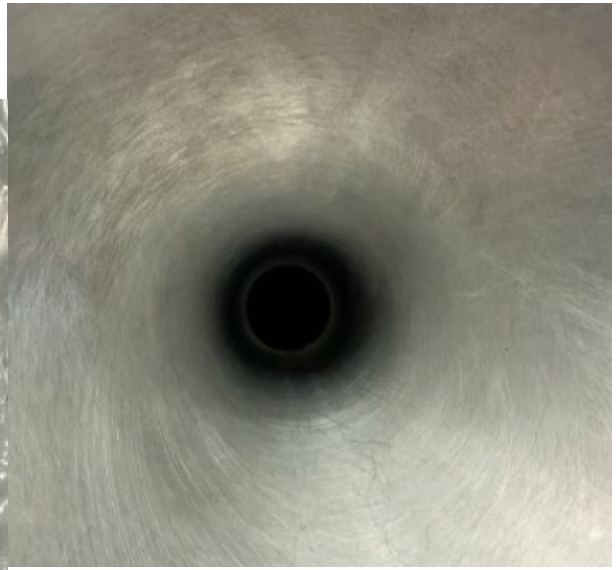
Post-Dry & Scoring

After drying the silver-plated surface using compressed air, we take a special tool that scores the surface of the plating at a set distance. Then we apply Elcometer Adhesive Tape. By peeling the tape off, it will remove the surface of the silver plating, leaving a gray surface behind. However, if you properly did the plating, it will not reveal any grey surface.

Target Alignment in Miniboon Horn

Below is the Miniboon horn with the target staged inside. The job of the horn is to refocus the beam and direct the beam to other experiments.

Large spacers that we had to use in order to align the target.



Above is a picture of the target aligned in Miniboon. During the alignment process, I worked closely with John. In the process, I learned how to use a pair of micrometers, I also learned how little additions, have big impacts.

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FARO Arm & Polyworks

FARO Arm

Using the FARO Arm, I was able to take actual data points and compare them with the nominal point that were desired. This also allowed us to check to see if the part was within tolerances.

Polyworks

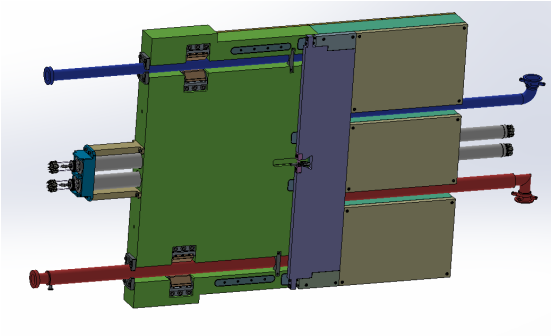
Polyworks was a big learning curve. From figuring out what plane corresponded to the model, to properly orienting the part, there were challenges to overcome. Multiple times, I oriented the part into an up-side-down position.

Packing & Shipping The Outer Conductor

Since I am an intern, I cannot help in the radiation areas, with that in mind, I had to do projects that didn't involve those areas. I worked alongside other techs to clean out the anode tube which had recently been drilled and had aluminum shavings inside. To cleaning out the tube, we connected a hose and ran water through the tube once we had plugged the holes. We then transported it back to MI-8. At MI-8, we worked on putting the anode tube into the outer conductor.

Once we had put the anode tube into the outer conductor, we secured it to the tube, and then we added plastic wrap to protect it during shipping, after the components were put together, we rachet strapped the outer conductor to the shipping container. After all parts were ready and secured, we closed the shipping crate and loaded it onto a truck using a crane.

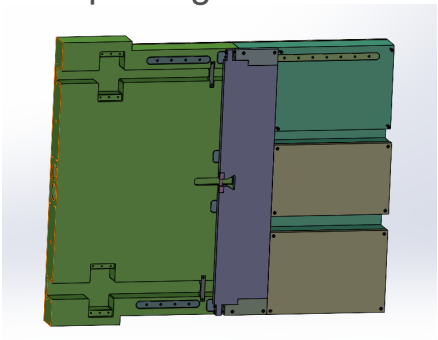
Ongoing Projects



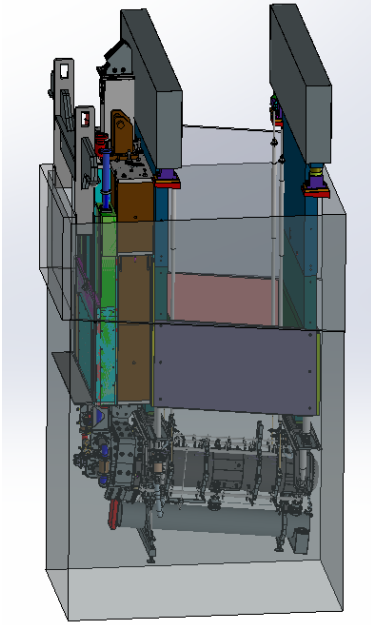
One project that I have been running in the background during my internship experience has been working on developing a 3D model for the LBNF HORN-A module. While working on this project, we have encountered a few hurdles, however we were able to overcome those.

Above, we have the part before it was defeatured, this part was 247 parts before we worked with it and prepared it for printing.

To the right, we have a defeatured model, in this model, we cut out nearly 100 parts allowing for less print time and a more basic design.



For this project, I have been working with the CAD files for the module and working on defeaturing those models, this will allow us to capture the model in a 3D print, while also keeping it simple enough to print the files. By defeaturing the model, we save time in printing, as well as still being able to grasp the design intent of the print.



LBNF HORN-A Module

The full model we are trying to print is just over 11,000 pieces before defeaturing.

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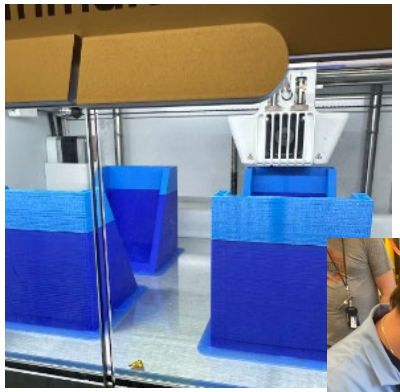
Favorite Workshops

My favorite workshop that we had during out internship was the Conservation at Fermilab Workshop. During this workshop, we went out to Prairie 15 with Wally. Wally provided us with a ton of information about prairies not just on the Fermilab campus, but in the State of Illinois as well.

In addition to learning about the prairies, we got physical application as well. During the workshop, we went into the prairies to help with seed collections. Before starting, we learned from Wally that these seeds will have a lasting impact. At Fermilab, the seeds from the prairies are used to plant specific blends of seeds into new areas. Fermilab has over 40 different blends of seeds for planting their prairies.

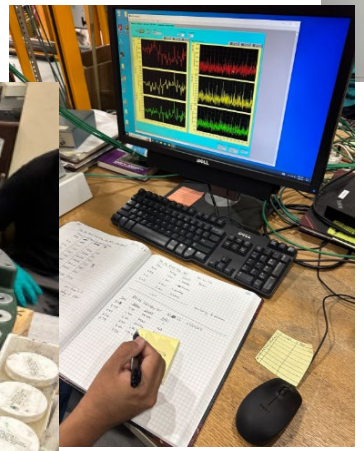
Pictures From My Experience



Above, we have the brackets for shipping the strip line in the printing process.

Above, I am learning how to silver plate. This was my first time silver plating.

Centered below, I was helping to silver plate 16 bosses on the cap plate. After finishing the plating, we applied a non-adhesive tape to the surface to prevent other chemicals from contacting the bosses.



Above, we were collecting data while running a test of 200,000 amps on the NuMI horn.

Above was the initial design for the shipping brackets, however, we determine this bracket to be too complex for the goal we were looking to achieve.

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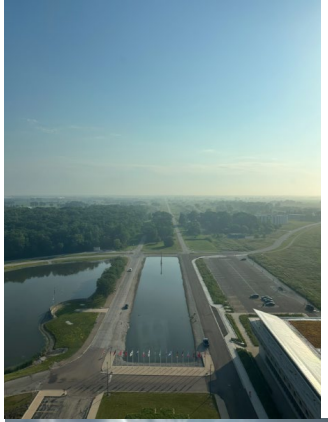
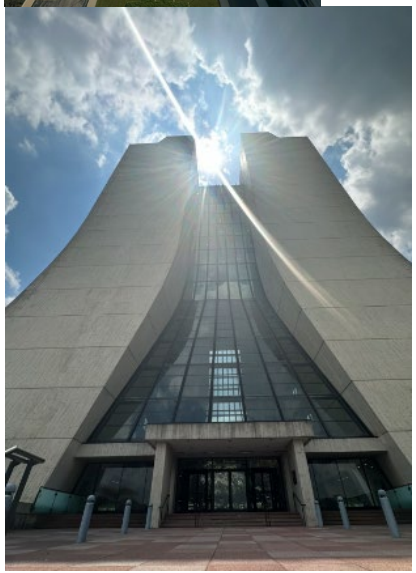
Key Takeaways

- Job site experience
  - By having the opportunity to gain hands on experience at the lab, I have come to conclusion that Mechanical Engineering is the field I would like to study going forward. Before Fermilab, I was deciding between Mechanical, Civil, and Aerospace Engineering.
- Never be afraid to ask!
  - There were multiple instances within my internship that were challenging to me. I had never used some of the software we had available to us. However, even though I had no experience with these applications, many other staff did. All I had to do was ask for help and they were more than happy to teach me!
- Don’t be afraid to challenge yourself!
  - Almost everything I did at Fermilab was something I hadn’t done previously. However, although there was a learning curve and lots of frustration, by working through those struggles, I now have a broader understanding of multiple topics.

Thank You

I would like to extend a big thank you to everyone in MI-8. Every morning, I was greeted with a warm welcome from John, a head nod from Anthony, and a smile from many others of the staff. Over the course of my internship, I have made many new connections, as well as created many memories with everyone I have worked with. I would also like to thank Cortez Watkins and Anahi Ruiz Beltran as well as all of the other staff that have helped me throughout this opportunity.





My experience at the lab could not have been made possible without the help of all these wonderful people. There were many challenges I came across during my time at the lab, however, everyone was there to support me as well as help me understand how to improve even if there wasn't an issue that arose. I would also like to thank all of the workshop leaders who helped all of us have action-packed afternoons. Every single day of my internship brought joy and the feeling of accomplishment which wouldn't have been possible without all the great staff at the lab.

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