

Tyler Liao

## BS Mechanical Engineering (Anticipated May 2026)

I want to make things and solve problems. My passions include machining, mechanical design, and fabrication. Currently, I am pursuing a BS in Mechanical Engineering at the University of Rochester. The best parts of my day are when I get the chance to put engineering theory into practice, such as with my time leading the Baja SAE car team. During my time at the University of Rochester, I was awarded membership in the Tau Beta Pi Engineering Honors Society, and Dean's List Scholarship. I also enjoy learning and teaching and have worked as a teaching assistant for a wide range of engineering and fabrication courses. In my spare time, I enjoy playing the trombone with the University of Rochester Symphony Orchestra, playing Ultimate Frisbee, and machining pens and small toys on my Taig micro lathe.

# Table of Contents

• <u>Baja SAE Chief Mechanic</u>	<u>1</u>
• <u>YJR-25 Baja Vehicle</u>	
• <u>Independent Study: Gears</u>	
• <u>Tritium Science Research</u>	<u>4</u>
• <u>Atomic Layer Deposition Process Development</u>	
• <u>Mini Projects</u>	<u>7</u>
• <u>Tube Welding Fixture</u>	
• <u>Machining Pens</u>	

# Baja SAE Chief Mechanic

## Role Description:

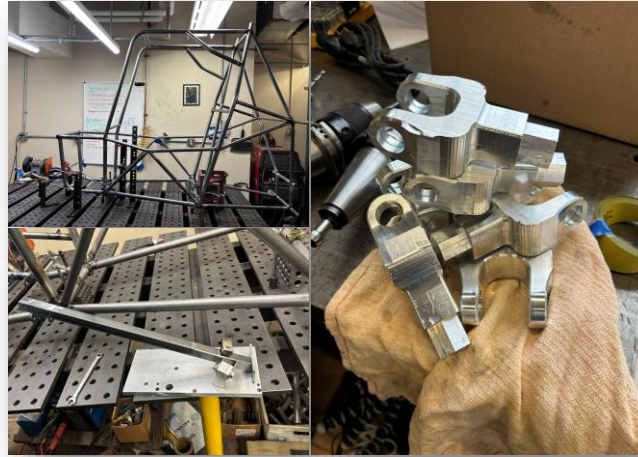
Chief Mechanic of the Yellowjacket Racing team is responsible for all aspects of manufacturing and shop operation.

## New Member Training/Onboarding:

- Devised new member training program
- Organized safety sessions for machining and welding

## Manufacturing:

- Maintain documentation and knowledge on advanced manufacturing capabilities
- Coordinate manufacturing and test schedule
- Manage car build budget of \$12,000



Weld fixturing and machining



YJR25 Model Unveiling



Baja team at competition



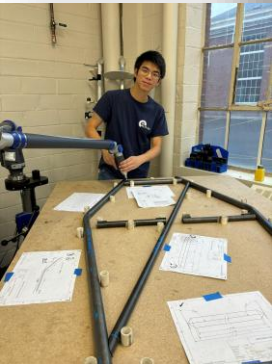
# YJR-25 Baja Vehicle

## Project Description:

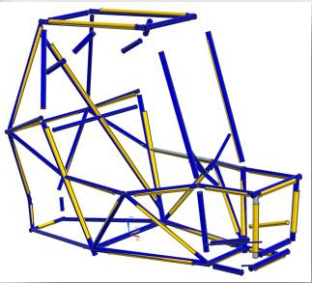
- Lead design, fabrication, and testing cycle of new Baja car
- Improve vehicle robustness and manufacturing accuracy

	Created: 6/8/24	Edited: 10/2/24	Summer + Fall Semester																											
	Current Date:	12/13	6/7	6/14	6/21	6/28	7/5	7/12	7/19	7/26	8/2	8/9	8/16	8/23	8/30	9/6	9/13	9/20	9/27	10/4	10/11	10/18	10/25	11/1	11/8	11/15	11/22	11/29	12/6	12/13
	Due Date:		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
First Projects + NX Learning	7/19/24	-147	X	X	X	X	X	X	X																					
Iteration 0	8/26/24	-109		X	X	X	X	X	X	X	X	X	X	X	X															
Activities Fair	8/30/24	-105												X	X															
Oltobajafest	9/27/24	-77												X	X	X	X	X	X	X										
Iteration 1/w/ Full Assembly and Analysis	10/25/24	-49												X	X	X	X	X	X	X	X	X	X							
Pumpkin launch	10/25/24	-49																	X	X	X	X	X							
Spooky Science Day	10/26/24	-48																	X	X	X	X	X							
Frame Manufacturing Start	10/25/24	-49													X	X	X	X	X	X	X	X	X	X						
PDR General Email	10/28/24	-46																			X	X	X							
PDR Subsystem Emails	11/1/24	-42																			X	X	X	X						
Arc and Flame Weld Training	11/3/24	-40																			X	X	X	X						
Makers Faire	11/15/24	-28																				X	X	X	X					
Design Hard Deadline	11/27/24	-16														X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Virtual Business RFP	12/13/24	0																												
Cockpit Manufacturing	12/15/24	2																												
Manufacturing	3/14/25	91																												
Crowd Funding	2/15/25	64																												
Team Bonding																														
Shop Cleaning														X																
Newsletter																														

Gantt Chart Master Schedule



Faro Arm CMM measuring as built vehicle



CNC Prototyping



Official Competition Placing

24

109

Univ of  
Rochester

Yellowjacket  
Racing

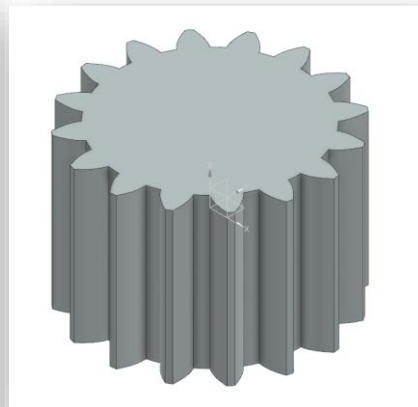
# Independent Study: Gears

## Project Description:

- Develop procedures to cut, simulate, and heat treat custom gears in-house for the Baja Team
- 4 Credit Independent study project under Dr. Christopher Muir



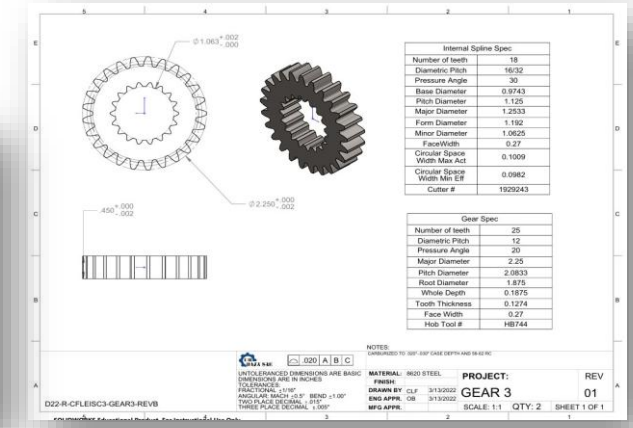
Torque testing rig



NX involute gear model  
from first principles

## Future Work:

- Build testing fixture to measure gear loading
- Correlate Faro Scanner data to model geometry
- Simulate and measure dynamic and fatigue lifetime of in-house gears



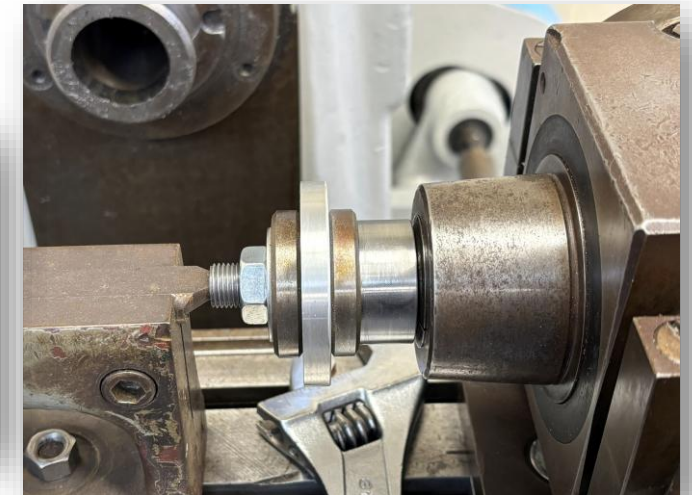
Example gears from Baja car

## Solution Methods:

- Generate involute profile from first principles in NX
- Machine gear cutting mandrel and arbor

	Imperial		Metric
# Teeth	25		25
Diametral Pitch	12.000		12.250
Pitch Diameter (in)	2.083		2.0408163265306100000
Pitch Radius (in)	1.042		1.020
Module (mm)	2.042		2.000
Circular Pitch (mm)	6.414		6.283
Base Radius (in)	0.979		0.959
Base Diameter (in)	1.958		1.918
Pressure Angle (°)	20		20
Addendum (in)	0.083		0.082
Dedendum (in)	0.104		0.102

Excel Calculations of gear  
parameters from AGMA standards



Gear Mandrel



# Tritium Science Research

## Role Description:

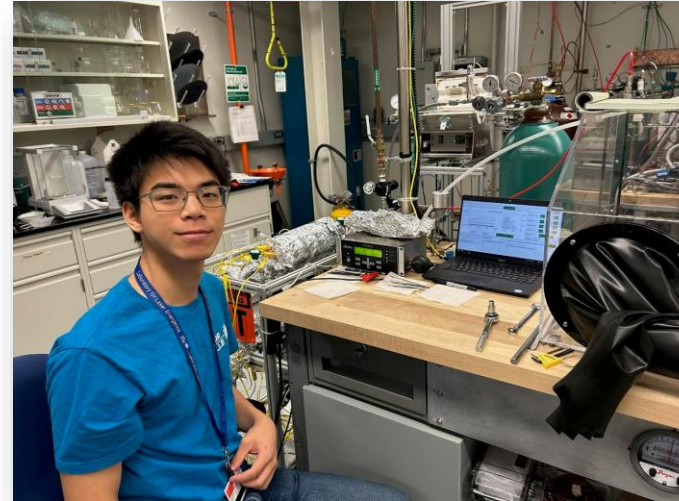
Perform work as research assistant under Dr. Zachary Robinson in Tritium Science group. Work performed at the University of Rochester's Laboratory for Laser Energetics.

## Atomic Layer Deposition (ALD):

- Specialized Chemical Vapor Deposition technique
- Self limiting chemical reaction
- Deposit conformal, pinhole free nanometer thin films

## ALD Research Goals:

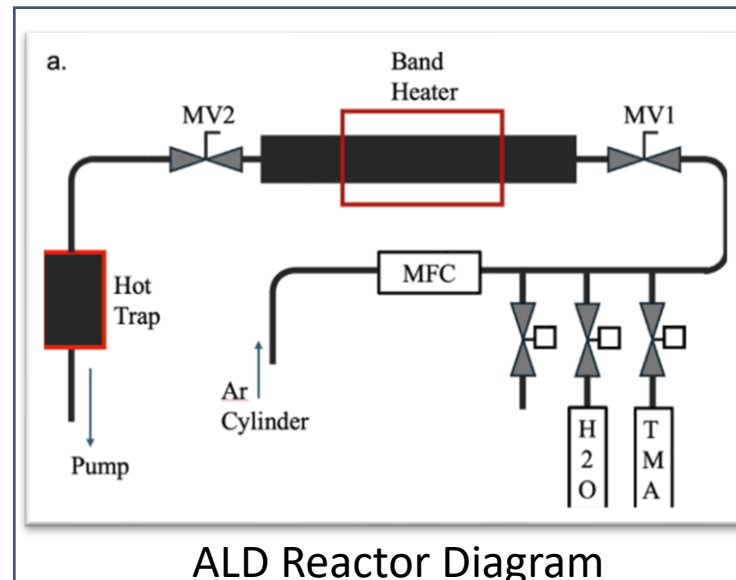
- Study Tritium permeation behavior for nuclear fuel containment applications
- Develop new ALD process conditions for uniform coating of large internal surfaces



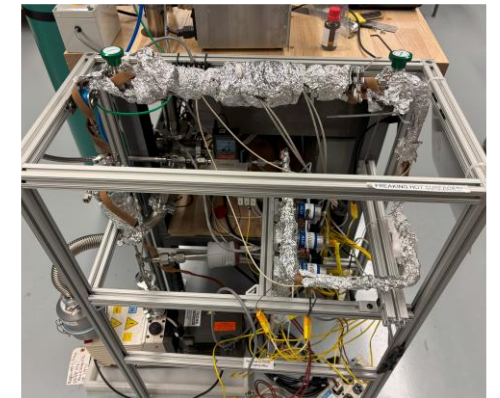
Lab Workstation



Supervisor: Dr. Zachary Robinson  
LLE Tritium Science Group



ALD Reactor Diagram



ALD Reactor

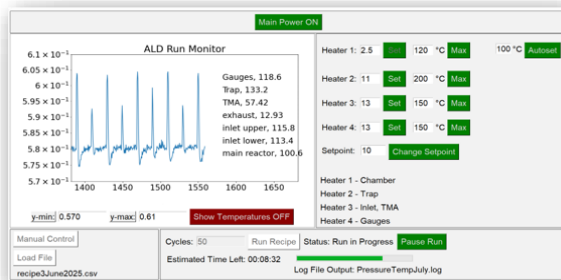
# Process Development

## Project Description:

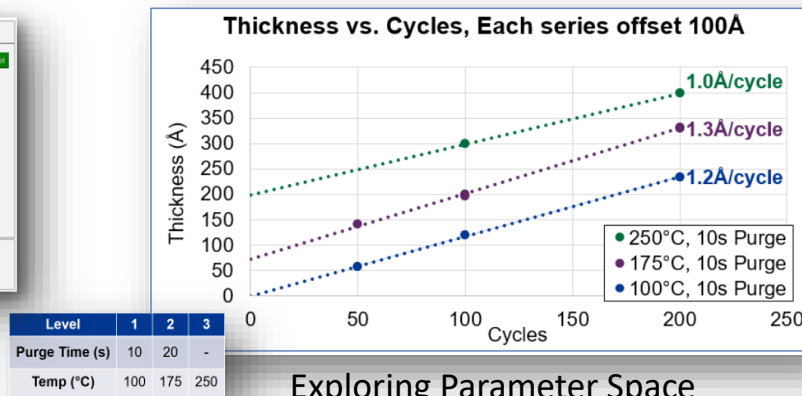
- Perform process development on atomic layer deposition for different reactor geometries
- New control software GUI



Horizontal Chamber Configuration



Python GUI



Exploring Parameter Space

## Solution Methods:

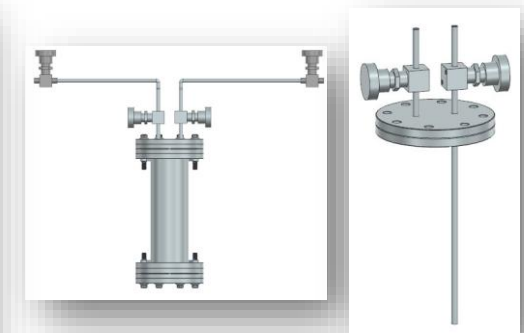
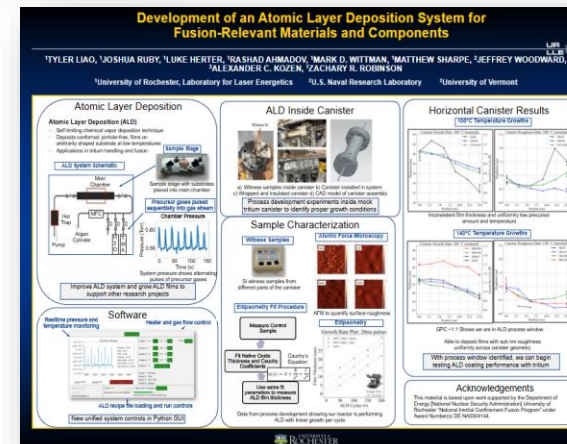
- Developed new control software in Python
  - Full factorial design of experiments
- Process development on silicon wafers in 1" Tube Reactor
- Designed new large horizontal chamber reactor
- Worked with Ebara to source custom heater jacket

## Results:

- Poster presentation award winner at New York State Section American Physical Society conference

## Future Work:

- Working with Mechanical Engineering department to manufacture new vertical reactor configuration



New Vertical Chamber Assembly

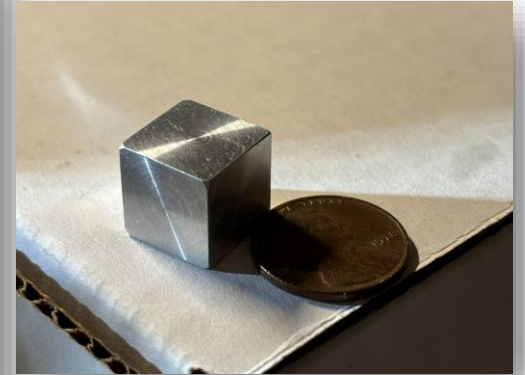
# Mini Projects

## Mini Projects:

The following are a selection of smaller engineering projects done over the course of my engineering education at the University of Rochester, as well as in my free time

## Creative Manufacturing:

- With these small projects I get to experiment and exercise my creativity in machining
- I own a Taig Micro lathe that I machine on in my spare time

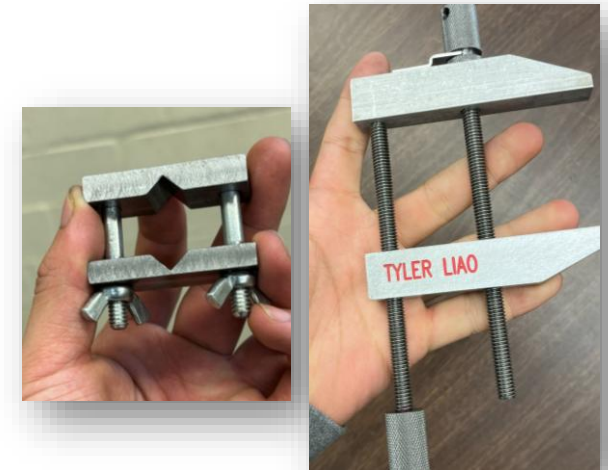


Lathe cube!

Taig Micro Lathe machining small parts



Bolt action pen



Small clamps and other shop tools



# Tube Welding Fixture

## Project Description:

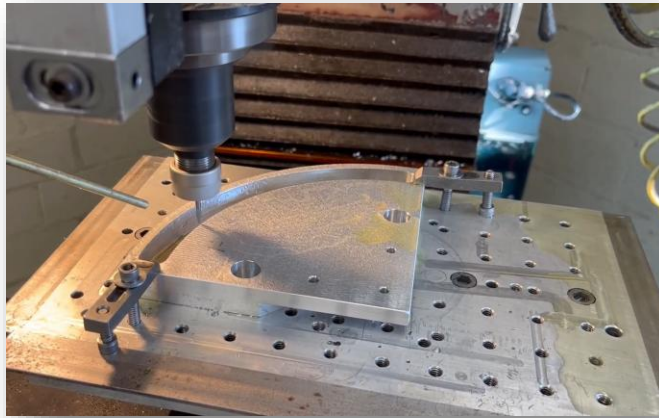
- Tube coping and welding for the Baja team is done inefficiently
- Design fixture to speed up and increase accuracy of tube coping and welding process



Routed Fixture



DIY fixturing at competition



Main baseplate milling with Prototrak 3 Axis



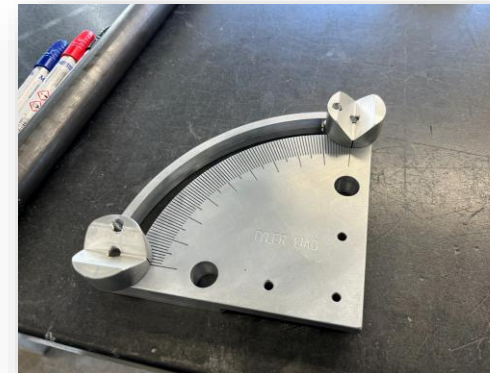
Pucks machined on lathe then processed in milling machine

## Results:

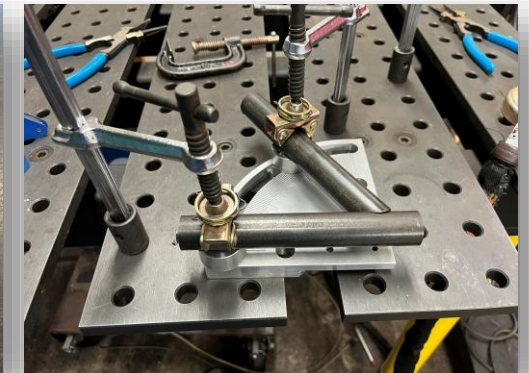
- Fabricated and assembled parts for use in tube welding
- Removed need for dedicated fixtures in certain cases

## Solution Methods:

- Custom angle fixture plate with angle graduations
- Worked with experienced toolmaker to design and fabricate parts using Prototrak 3 Axis milling machine



Assembled Part



Set up for welding

# Machining Pens

## Project Description:

- Personal project to make interesting metal pens
- Experiment with small part machining and custom fixture design



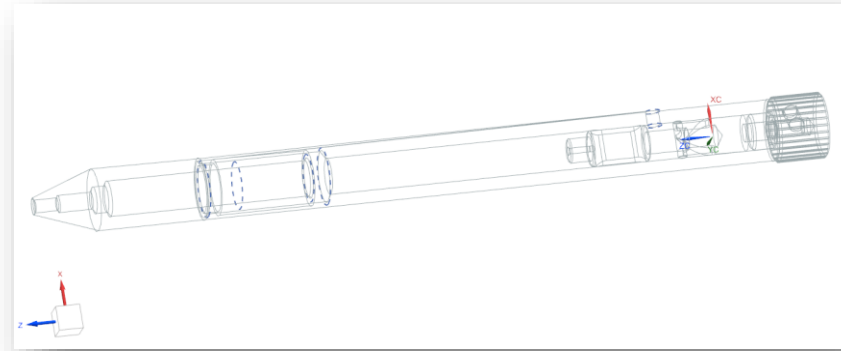
45° Indexing fixture



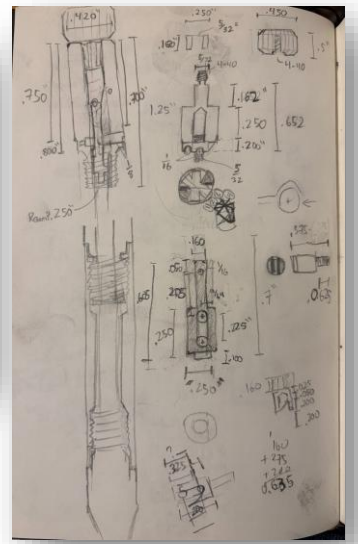
Ratchet Mechanism

## Results:

- Assortment of bolt action mechanism pens
- Custom ratcheting twist pen with pressed bronze bearing machined entirely on micro lathe machine



Planning ratcheting pen mechanism



## Solution Methods:

- Experiment creatively with fun machining techniques
- Machine custom pens out of brass, aluminum
- Prototype and design mechanisms



Bolt Action Pens



Ratcheting Mechanism Pen