



My Research Experience in PURSUE

Undergraduate US CMS Summer Internship at Fermilab

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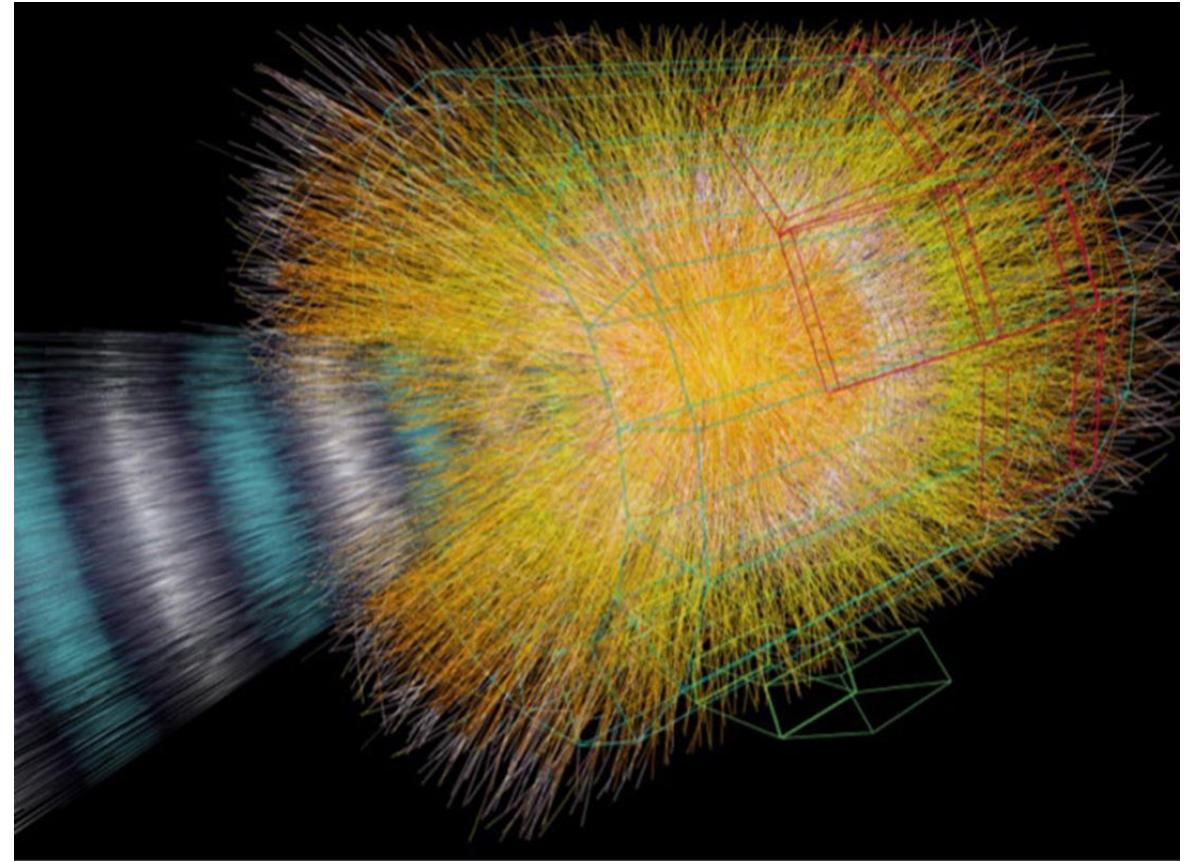
Overview

1. Introduction
2. CMS (Compact Muon Solenoid)
- 3.
- 4.
- 5.
6. Challenge of CMS
7. Fermilab
8. ECON Project
9. Conclusion



Challenge of CMS

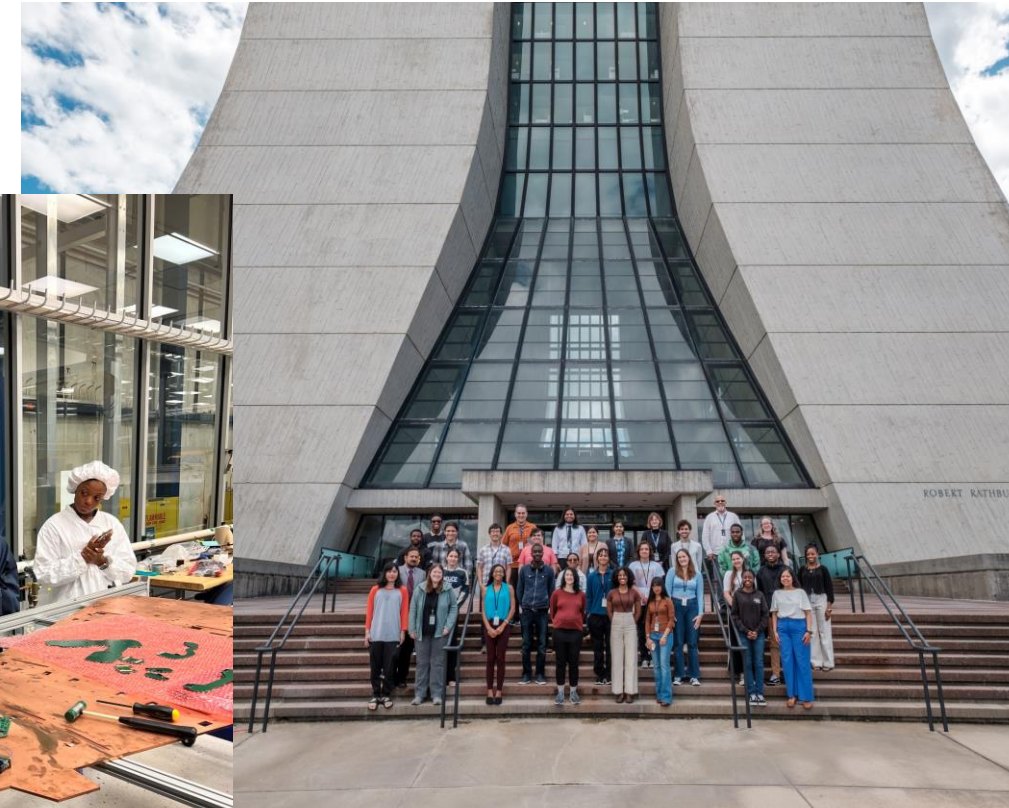
- Some of the hottest reactions in the galaxy: temperatures get so high it can cause radiation damage and make it hard to detect the collisions.
- It is so fast that there are billions and billions of collisions happening...now that's a lot of data to collect



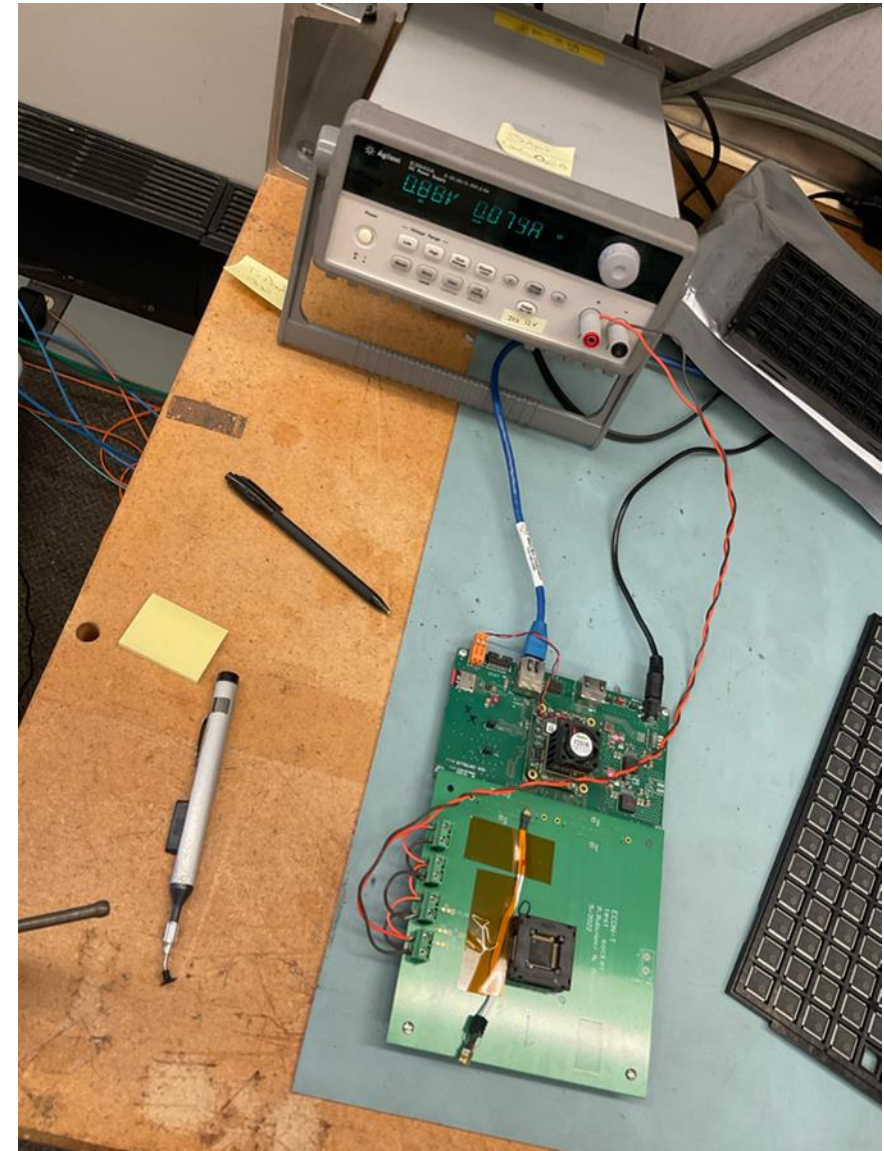
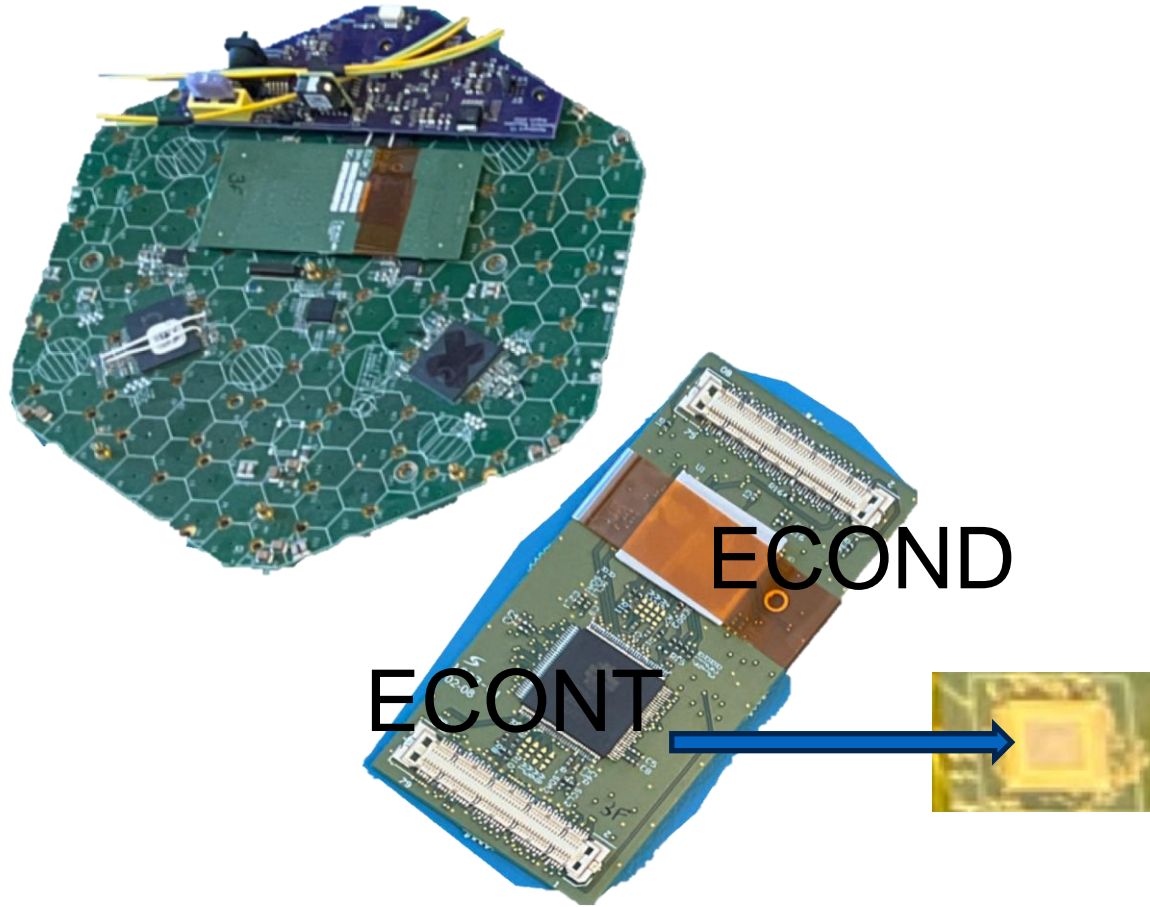


Fermilab

- I worked at Fermilab on the CMS HGCAL ECON project.



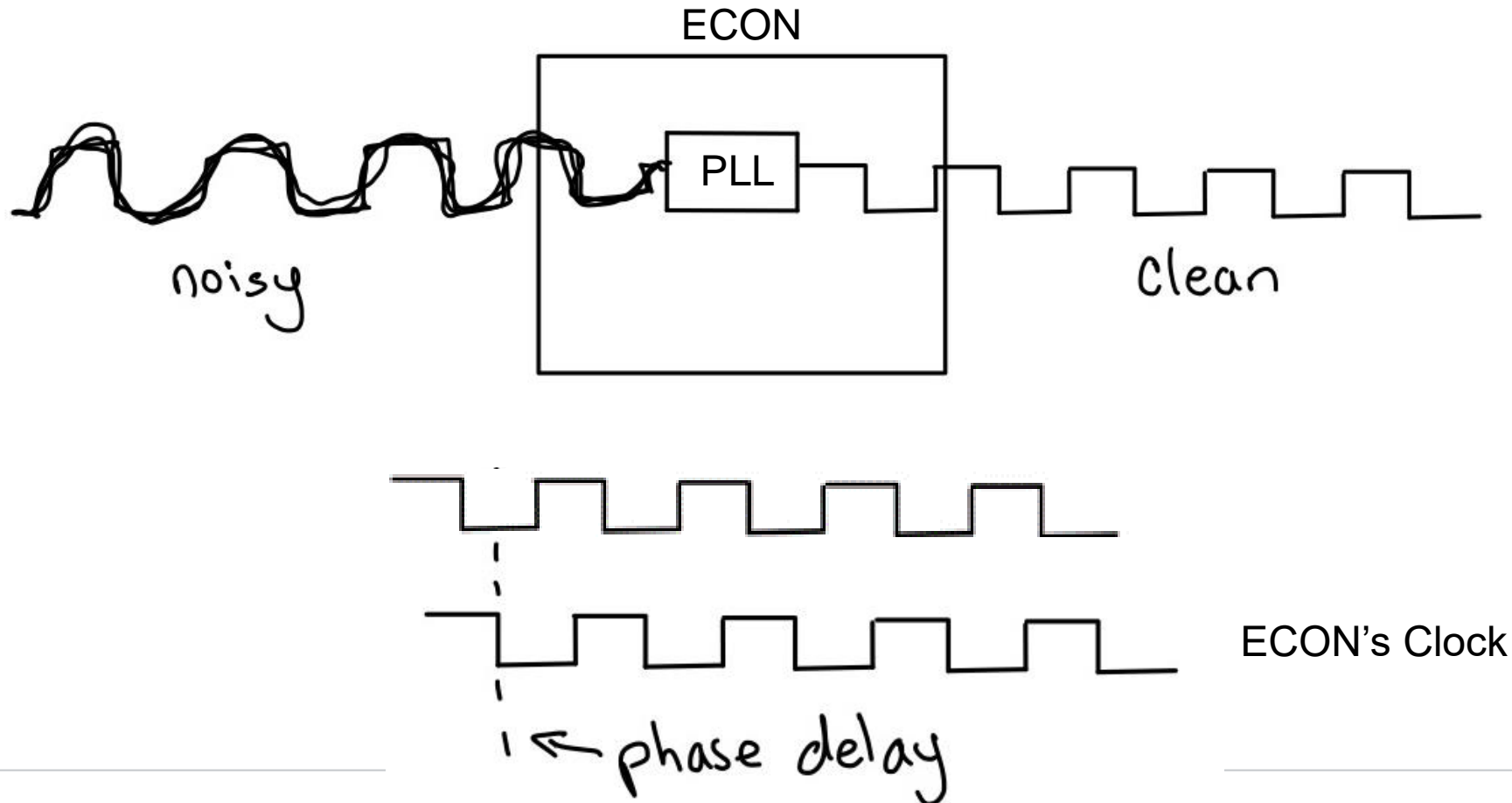
ECON Project





PLL's Functionality

The HGICAL project has thousands of ECON chips on it to filter the data. For all the chips to synchronize a Reference Clock (320 MHz) is sent to the ECON chip and the Phase Locked Loop inside the ECON chip modifies the Reference Clock to synchronize to the ECON's clock inside the chip. The PLL can lock in the frequency range of 285 – 355 MHz.





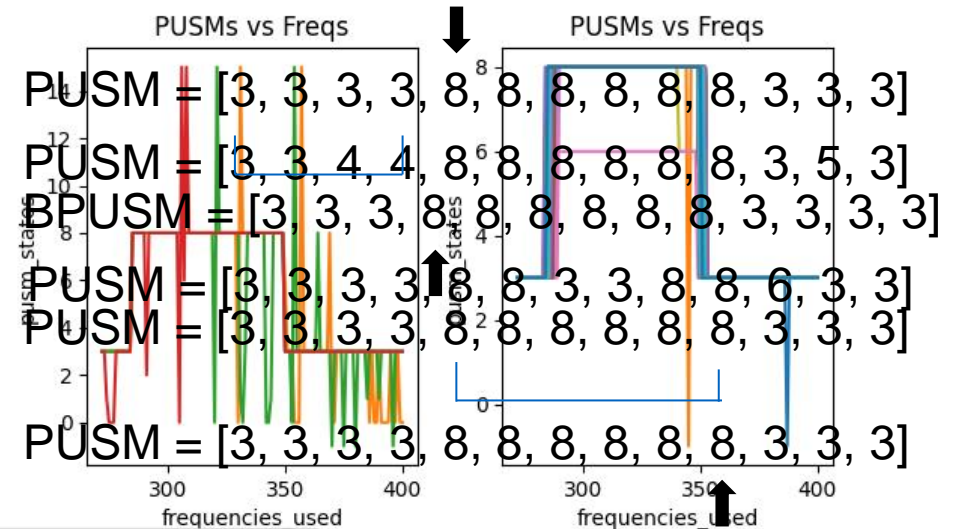
PLL Lock

Once the clock is synchronized the ECON is “booted up” and ready to start filtering data. The Power Up State Machine is a sequence of numbers that tells us when the ECON is “booted up”

- 3: Not Ready for data
- 8: Ready for data
- Supposed to stay at 8, but once the

frequency range is outside 285-355 MHz, it is back to 3

The PLL Lock pytest script collects the PUSM States and the Frequencies to see if the ECON is “booted up.”



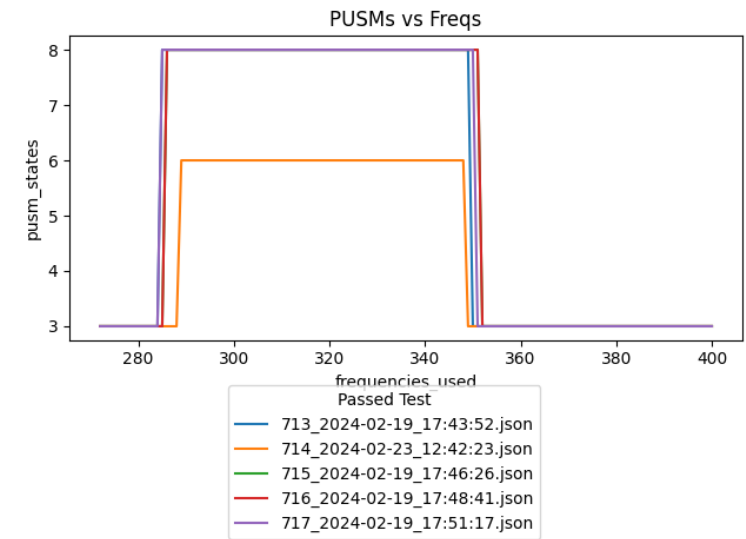
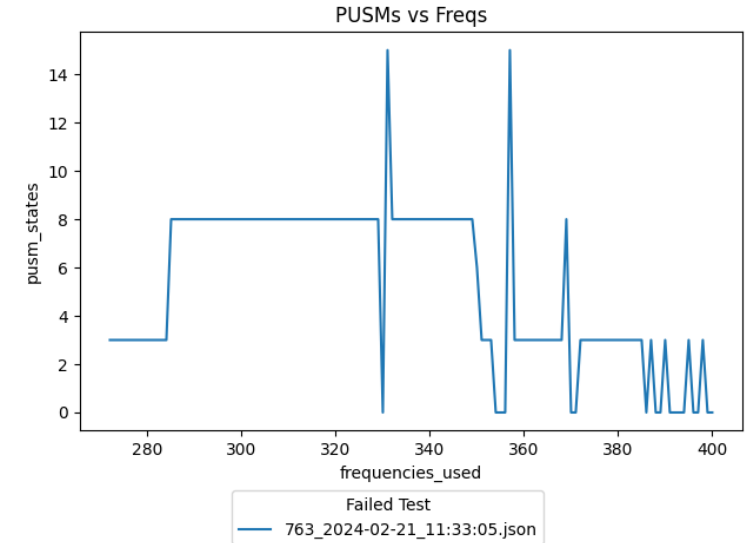
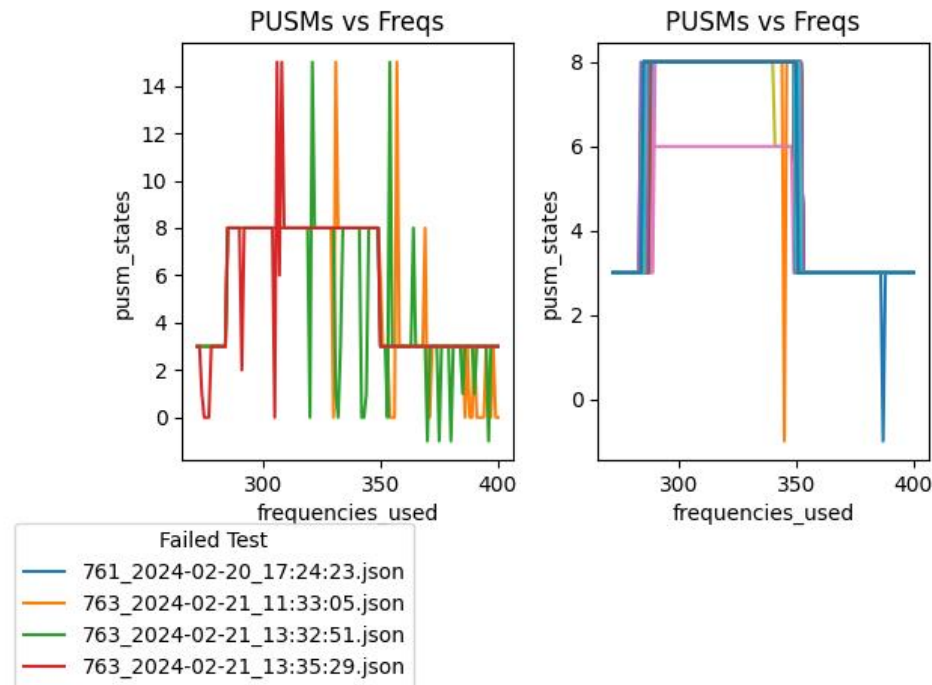
Failed Test

761_2024-02-20_17:24:23.json
763_2024-02-21_11:33:05.json
763_2024-02-21_13:32:51.json
763_2024-02-21_13:35:29.json



Complete "Autolock" Graphing Script

Overall Graph: ECON2 February (411 chips)





Importance of Research

Research in STEM is crucial for:

- driving innovation
- addressing societal challenges
- advancing knowledge in science, technology, engineering, and mathematics
- providing students with critical thinking skills and practical experience needed for successful careers in STEM
- a vital role in developing new technologies,
- understanding complex phenomena
- promoting scientific progress
- ultimately improving quality of life across various sectors.

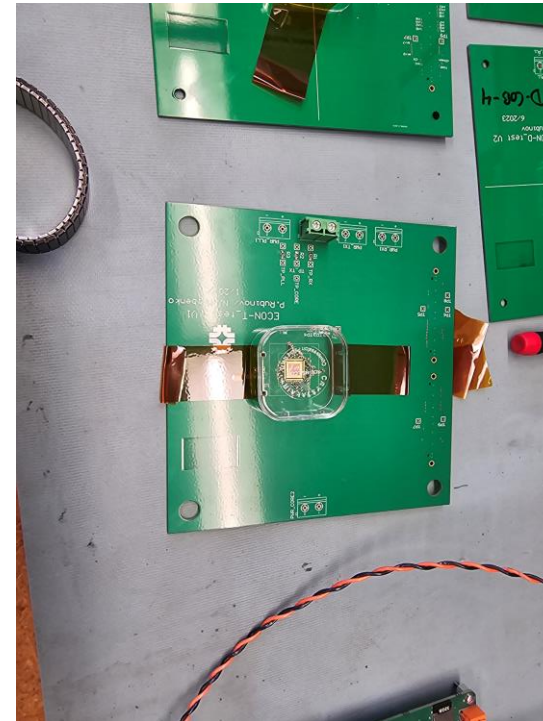
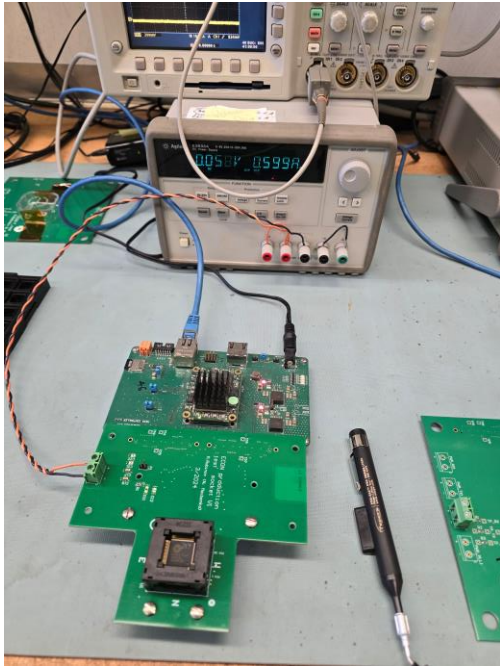
What has research in STEM done for me:

- Understanding of how real-world science is conducted
- Developed into a scientific thinker
- skills in presenting, critical thinking, problem solving
- Software, hardware, data analysis, navigating further research
- Independent learning, team collaboration, contributing to a team project
- Career building, path finding, and networking
- Bettered my chances in gaining a career or graduate program that suits me



What I loved most about Pursue

- Connections- working with my mentor and the team
- Feeling productive and part of the team
- The learning and hands on experiences
- Hearing from the other interns and how their experience went





Acknowledgement

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Any Questions?

Thank you!