Sandia National Laboratories

Exceptional service in the national interest

OPTICAL MICROSYSTEMS INTERNSHIP SUMMER 2024

Jack Yu

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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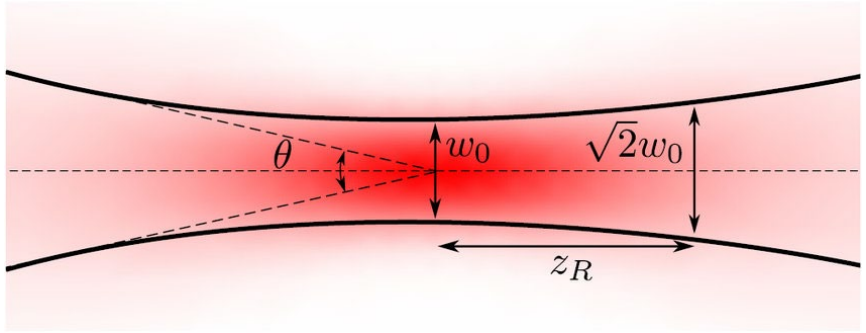
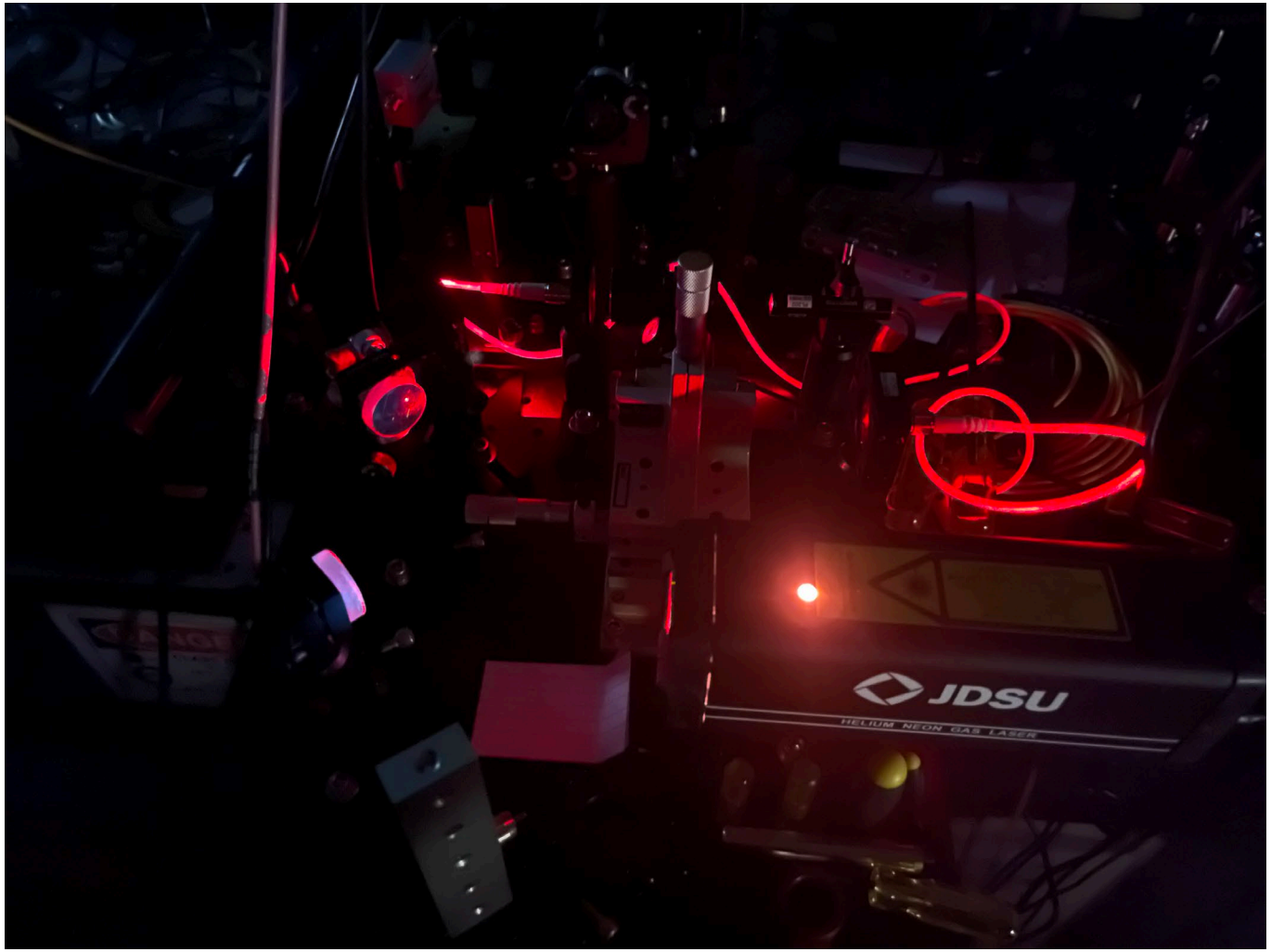
PRELIMINARY INVESTIGATIONS

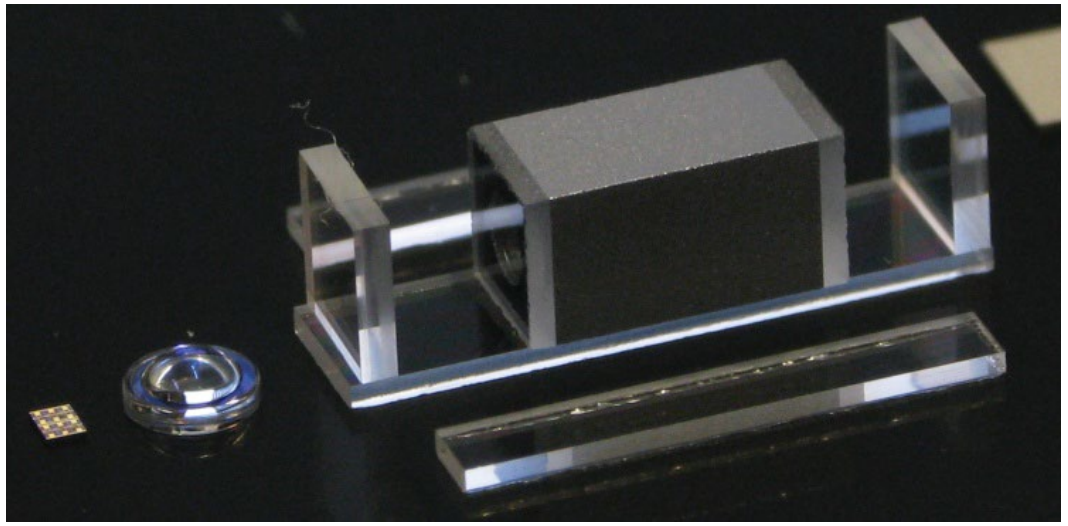
- Fiber Coupling
  - Measured beam waist
  - Picked lens for mode matching
  - Achieved 70% of total photocurrent (coupling)

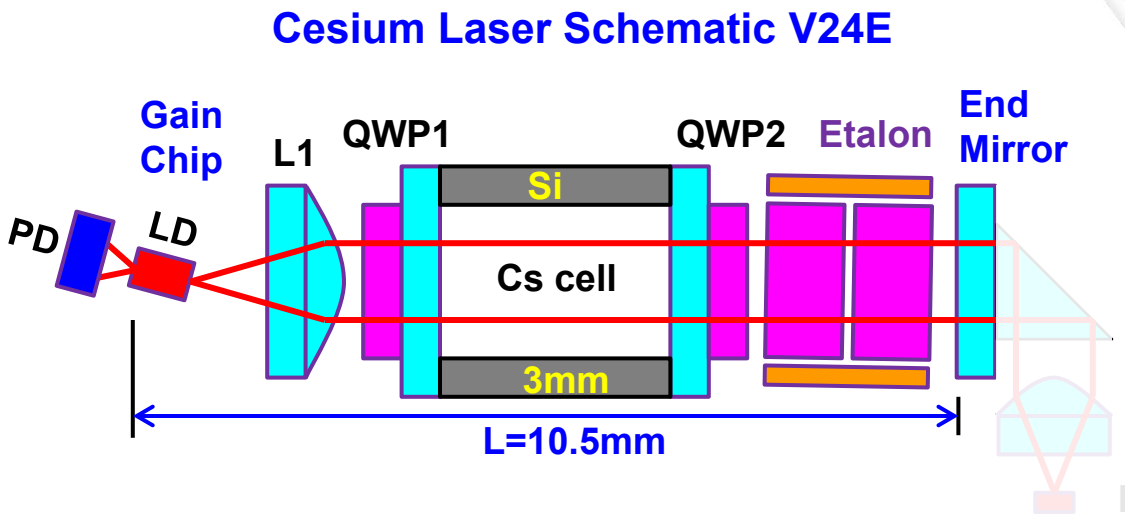




PROJECT OBJECTIVES

- Chip-scale atomic clock
- Fabry-Perot interferometer
  - Make two reflecting surfaces exactly parallel
  - ~894nm VCSEL
  - ~67µm cavity





Transmitted Power:

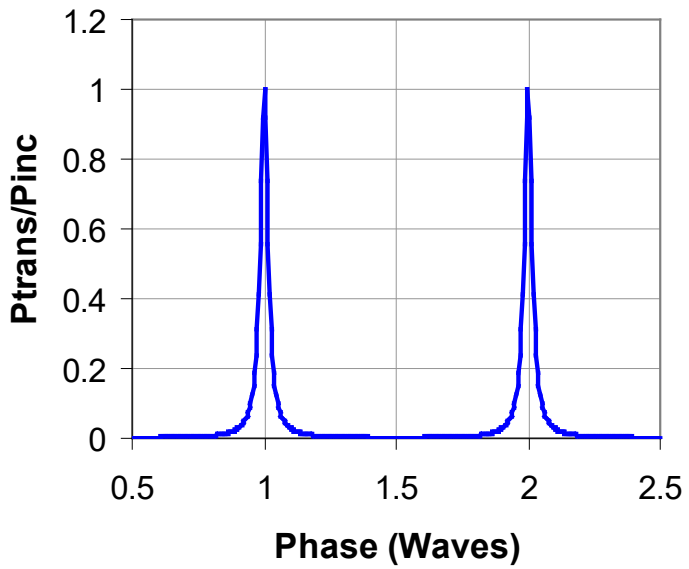
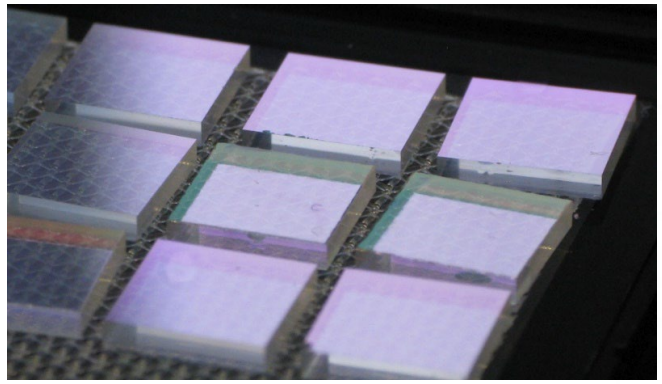


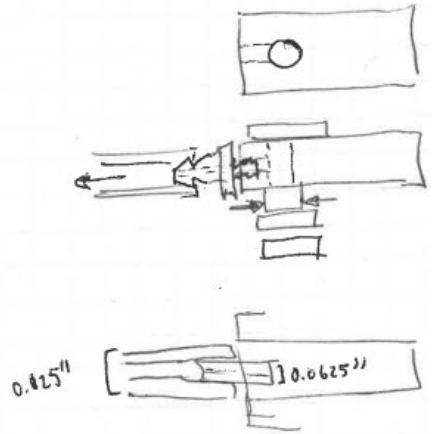
Image Credits:

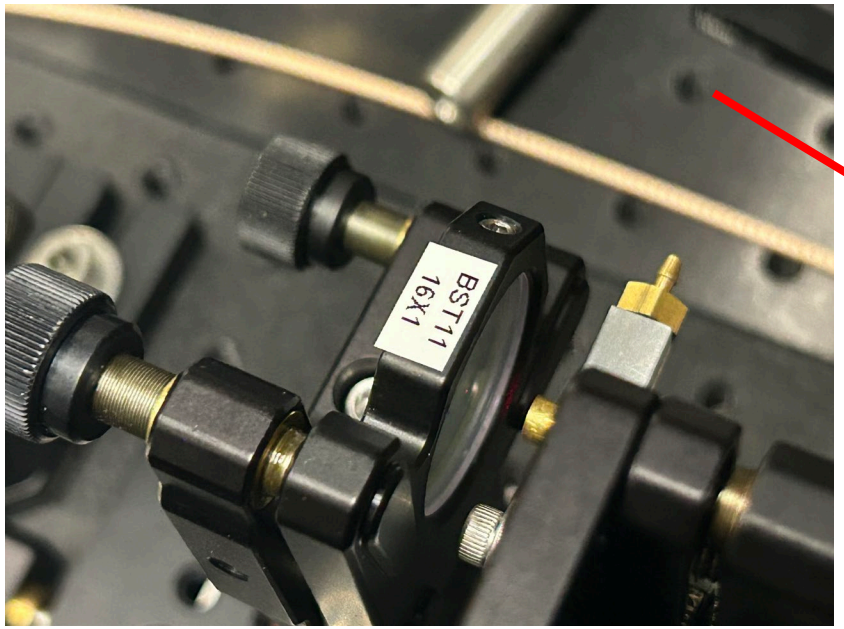
Darwin Serkland

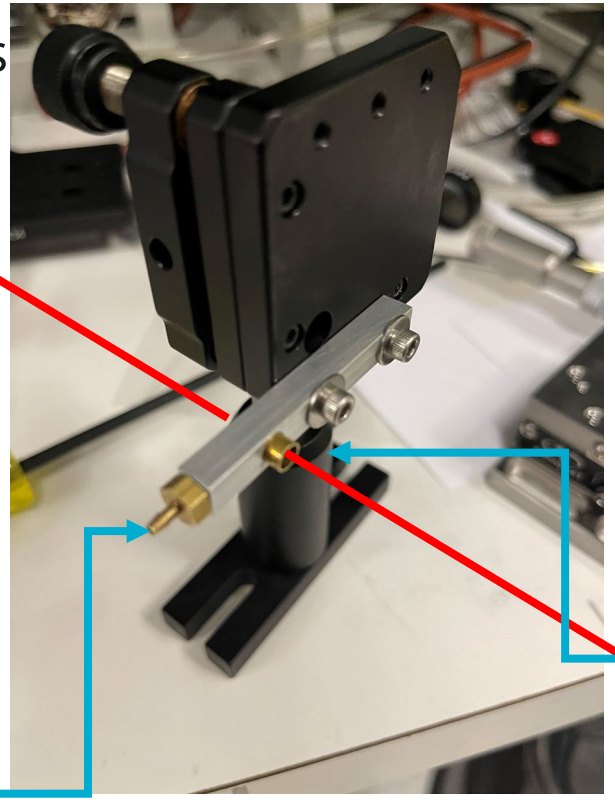
VACUUM CHUCK

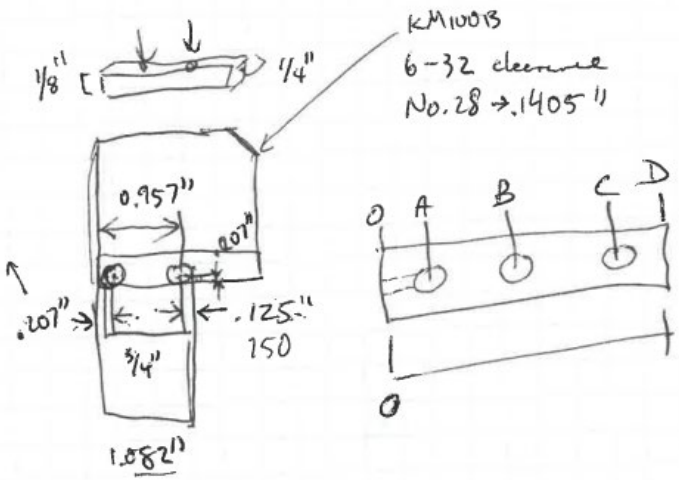
- Machined custom part
- Hold etalon surfaces
- Adjust for distance and angle
- Mill, lathe, tap, epoxy, hand tools











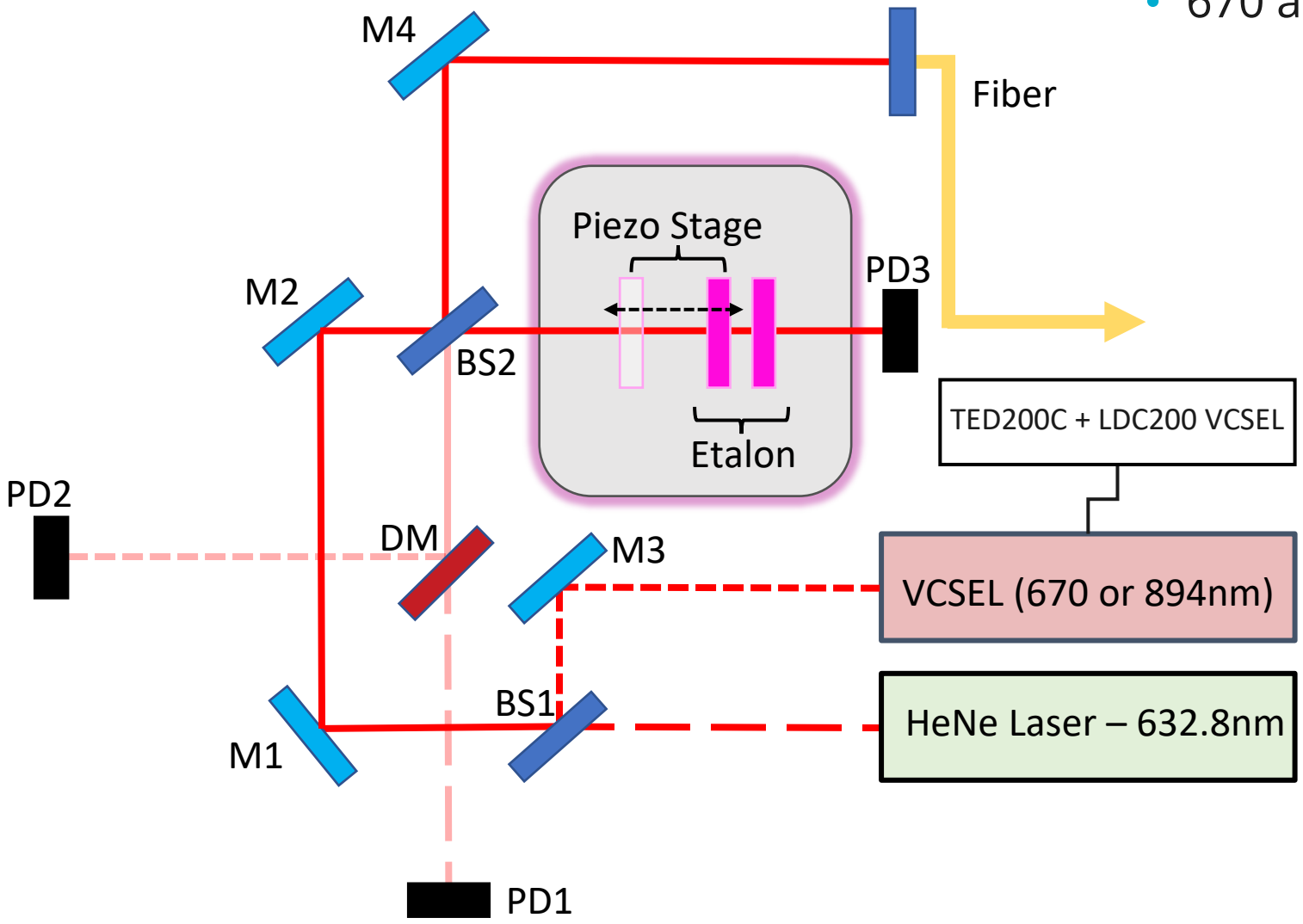
O → A = 0.25"
A → B = 0.50"
B → C = 0.75"
C → D = 0.50"

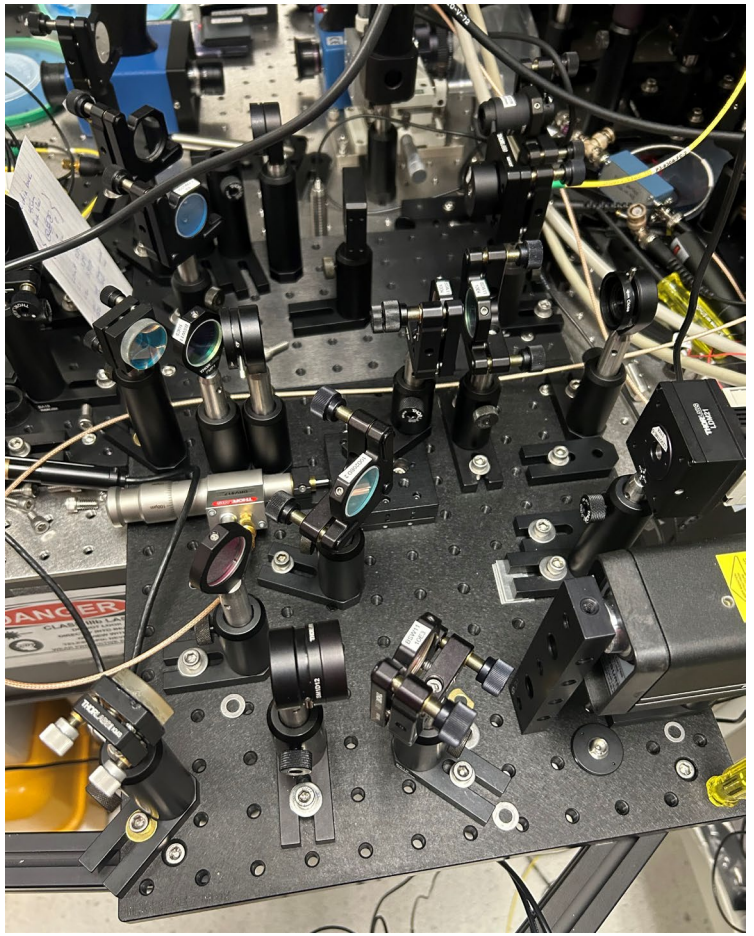
6x6mm mirror held here

Vacuum tube here

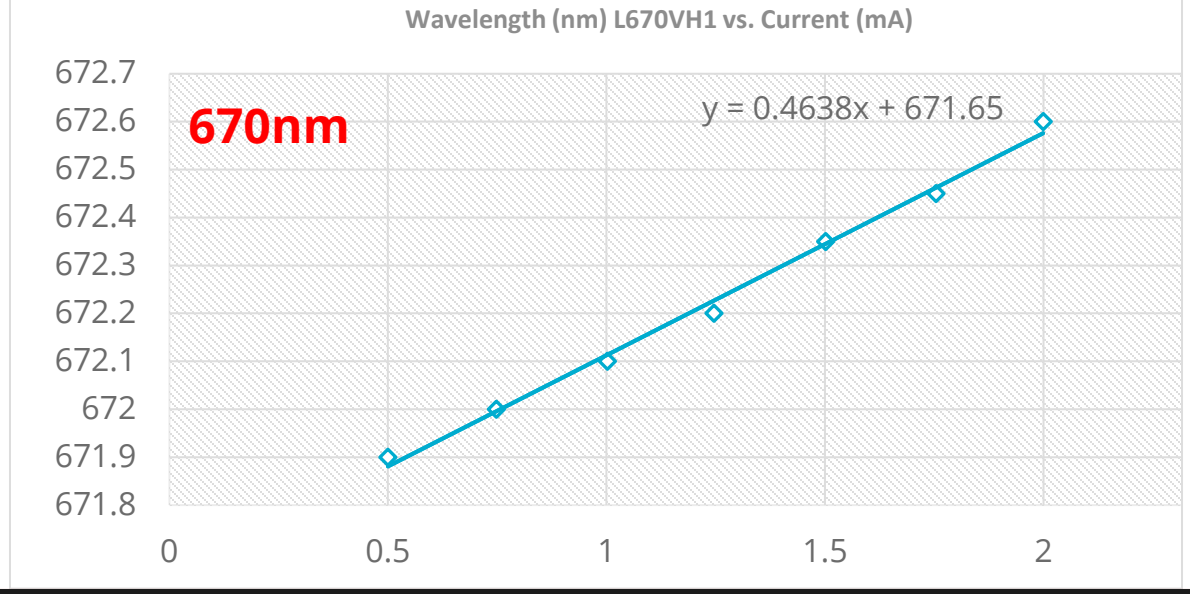
OPTICAL TABLE SETUP

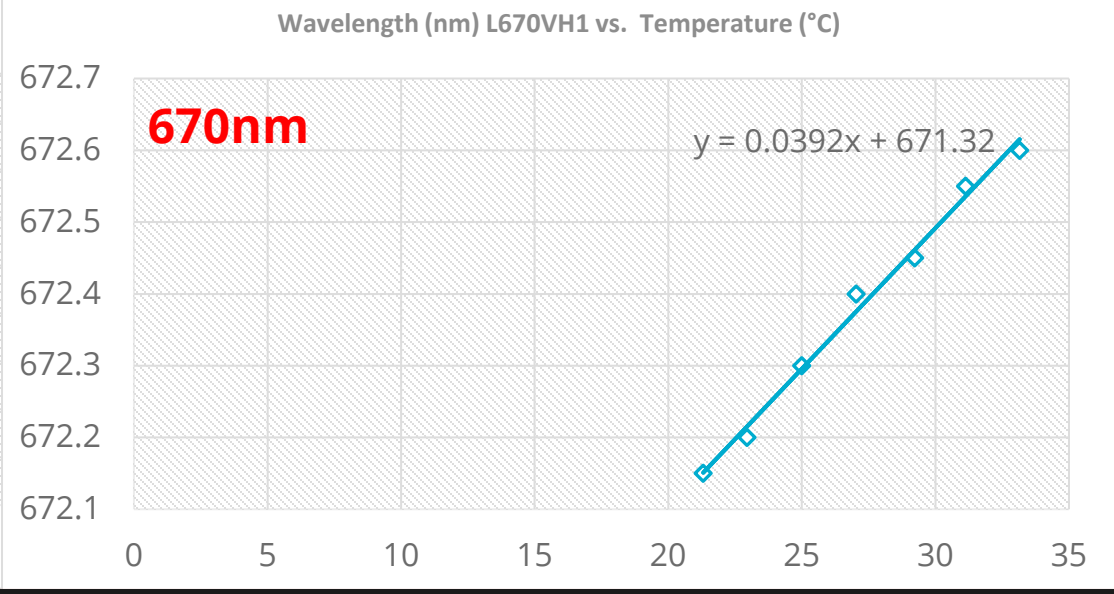
- Align Mirrors in Etalon
- 670 and 894

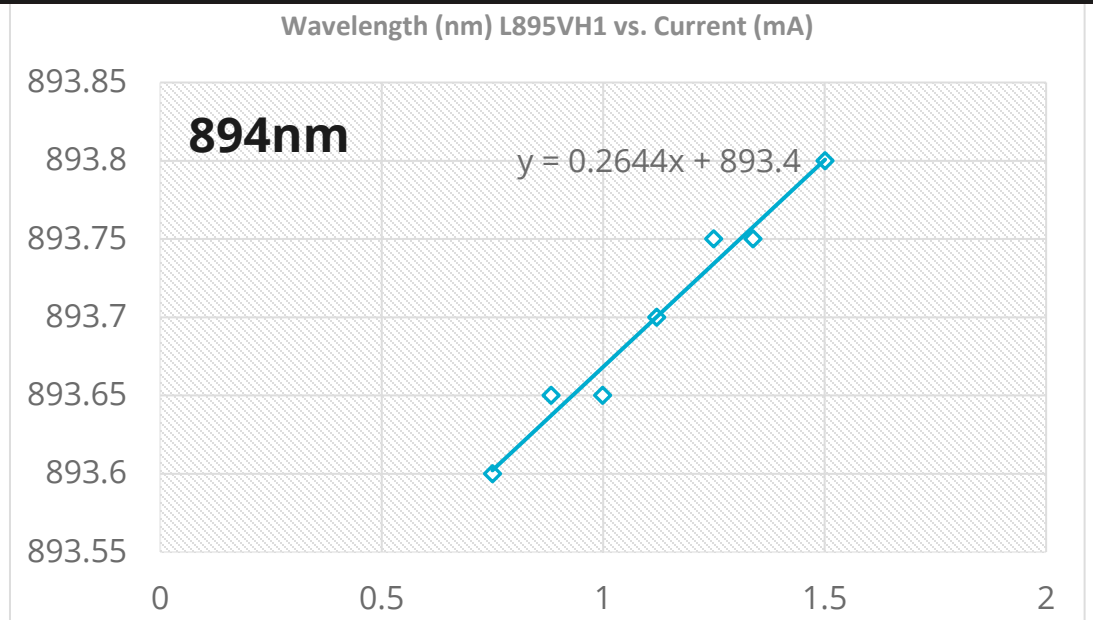


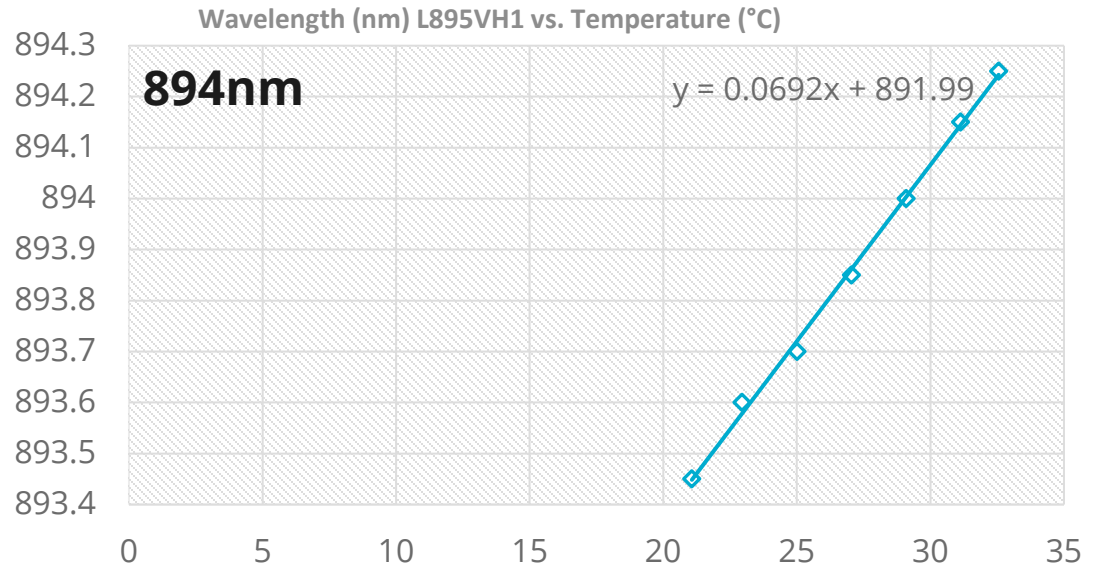


DATA USING TED200C + LDC200

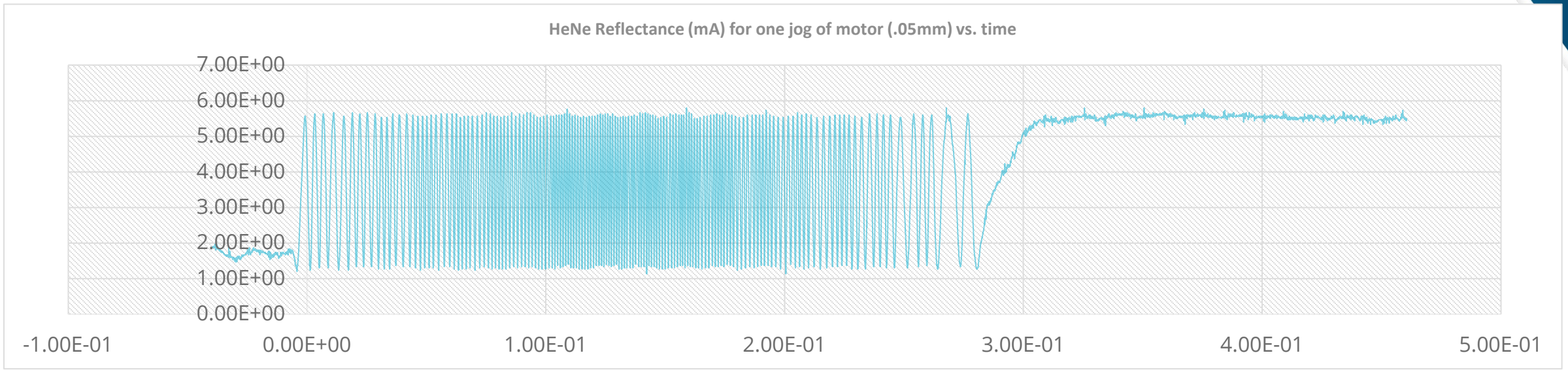


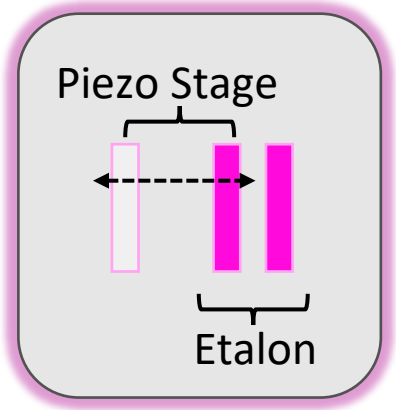


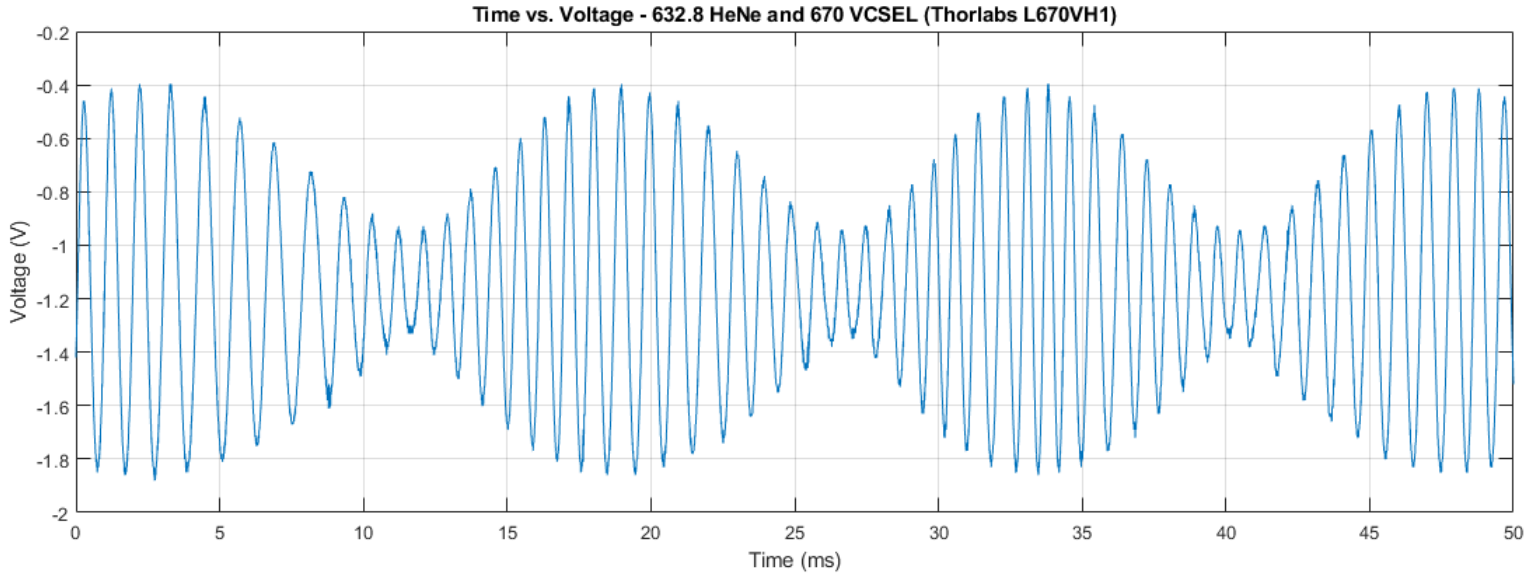




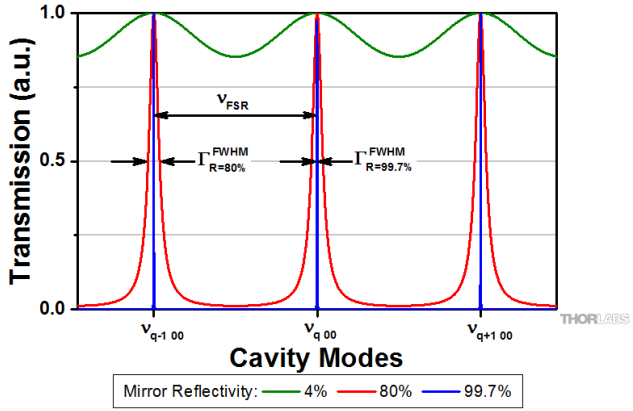
INITIAL DATA COLLECTION

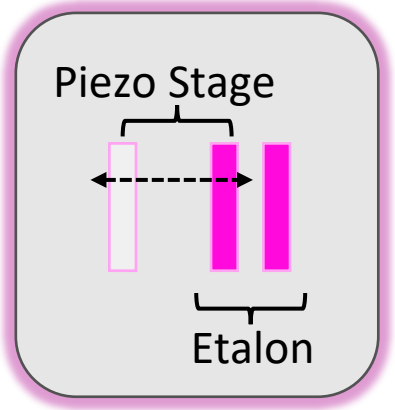


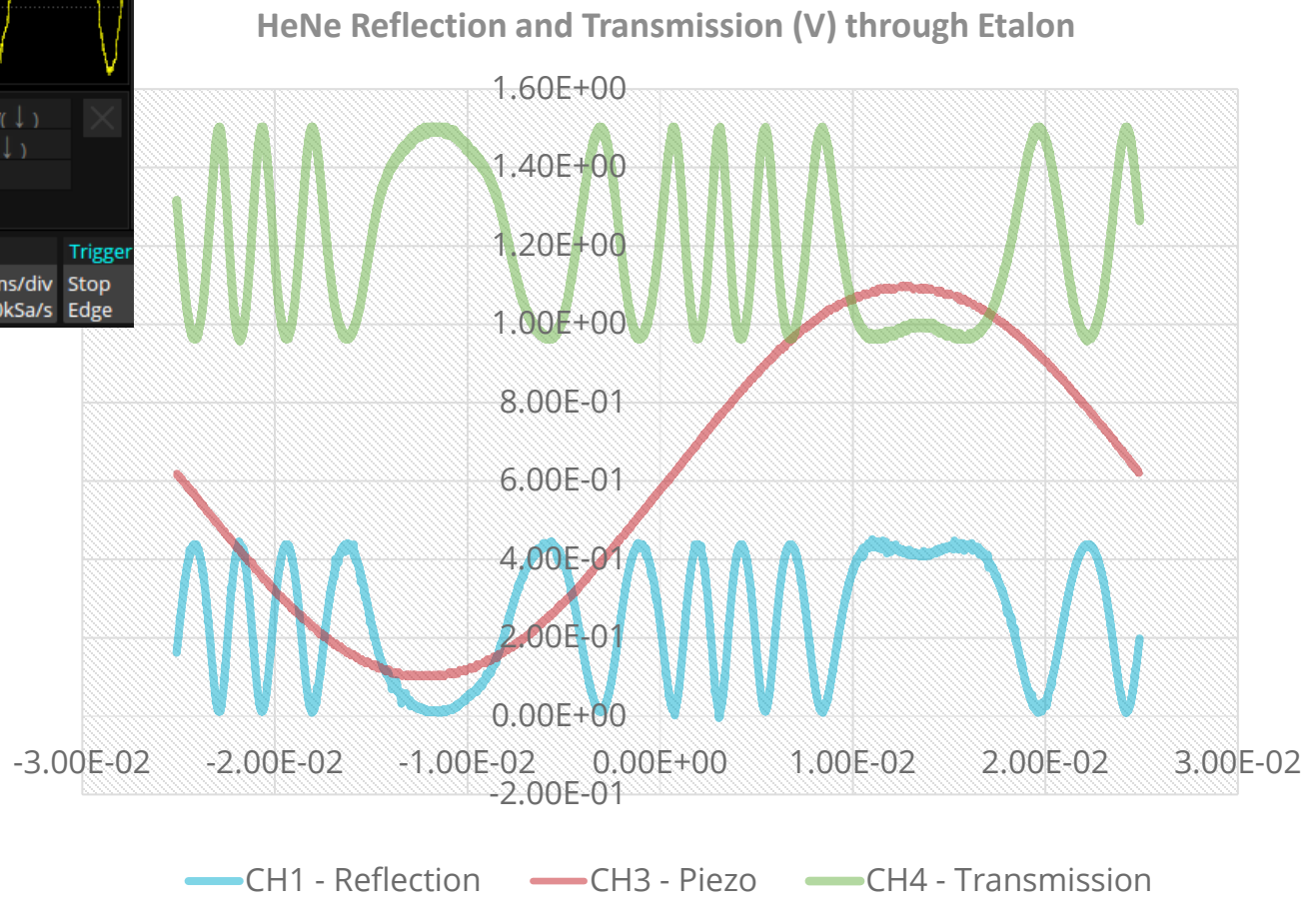




These were done with 50% reflectance mirrors, hence the softer shape (refer to graph on the right)

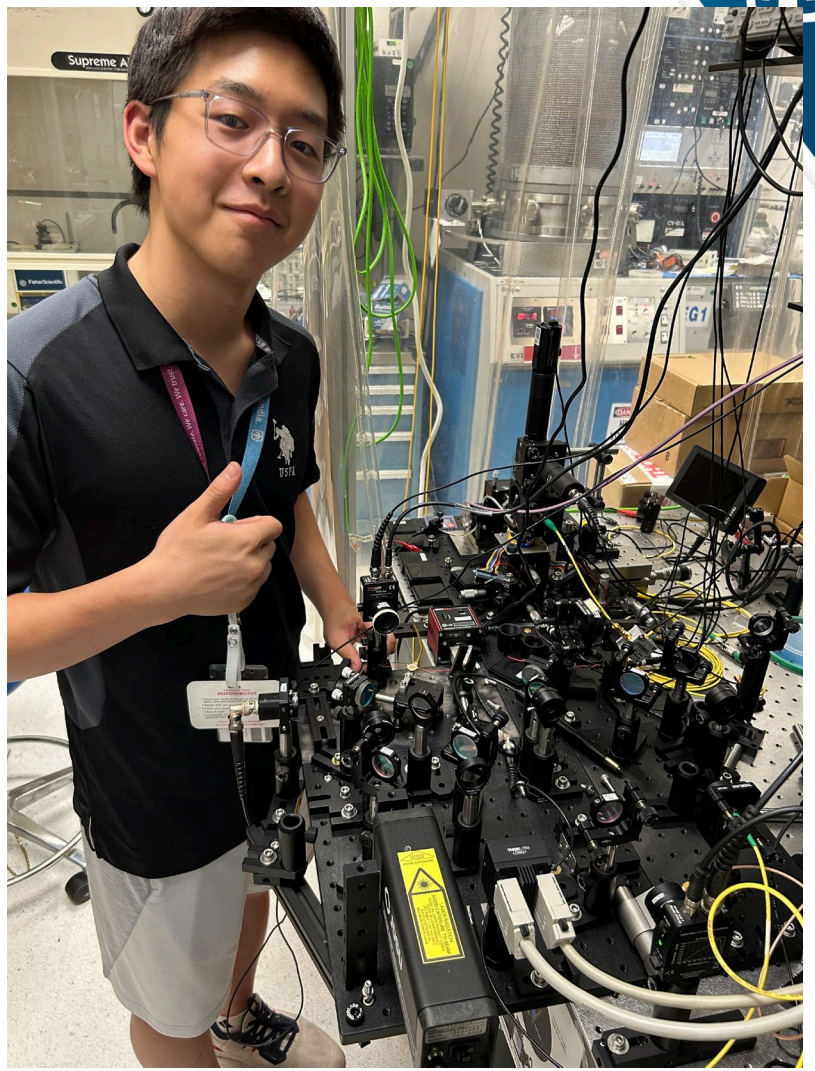






NEXT STEPS

- Use mode cleaner for optimization
  - Check if VCSEL is multimode?
- Replace photodiodes with PDA36A
- Measure transmission through Cs



THANK YOU & ACKNOWLEDGMENTS