Sandia National Laboratories

III-V OPTOELECTRONICS GROUP INTERNSHIP

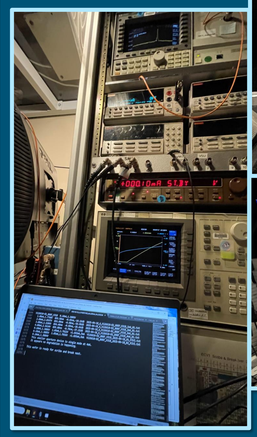
JACK YU – SENIOR PROJECT

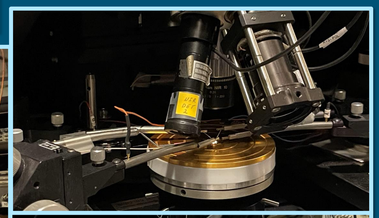
SUMMARY & GOAL

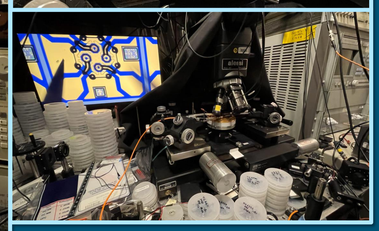
As a student intern at Sandia National Laboratories, I am contributing to the design and construction of an optical apparatus to characterize novel optoelectronic devices. My work includes characterizing VCSELs (vertical cavity surface emitting lasers) and constructing an external cavity diode laser (ECDL) in the Littman-Metcalf configuration. I have also supported fabrication efforts by machining custom components using a mill and lathe, and I am currently learning device packaging through wire bonding. The goal of my project is to help evaluate how changes in device design and fabrication impact performance, to support research in optoelectronics.

CHARACTERIZING VCSELs (Vertical Cavity Surface Emitting Laser)

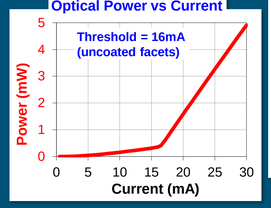
PROBE STATION

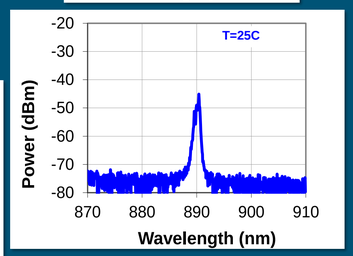






DATA COLLECTION

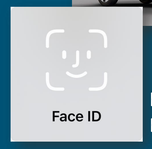




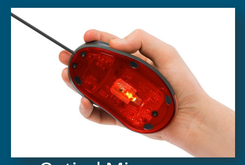
APPLICATIONS

VCSELs

LiDAR



Facial Recognition



Optical Mice

ECDLs

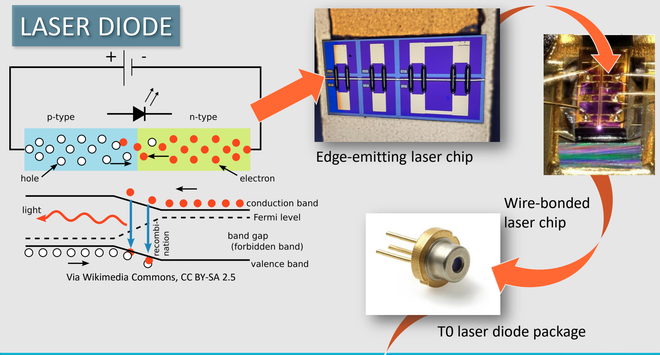
Atomic clocks and GPS

Medical diagnostics

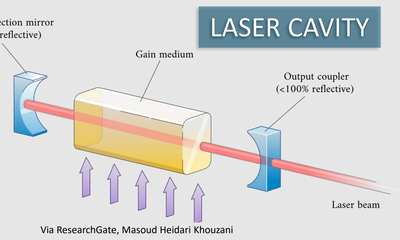
Air quality monitoring

EXTERNAL CAVITY DIODE LASER (ECDL)

LASER DIODE



LASER CAVITY

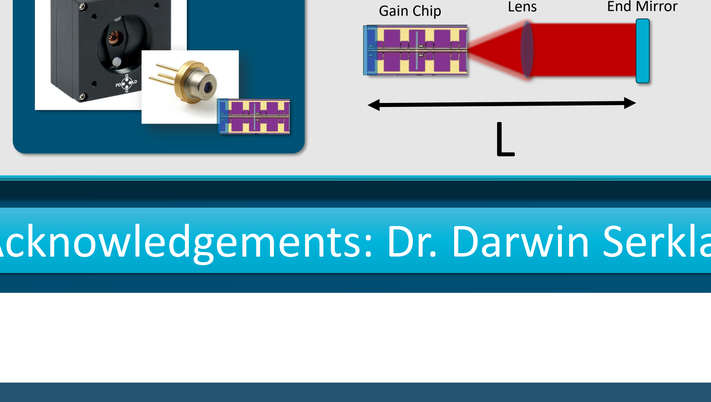


1. Energy source
2. Gain medium or laser medium.
3. Two or more mirrors that form an optical resonator.

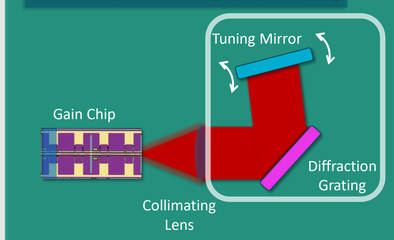
$$2L = m\lambda$$

EXTERNAL CAVITY SETUP

- Simple “mirror feedback“ design with a diode laser and a mirror for optical feedback
- Extends the laser cavity, narrowing the linewidth
- Demonstrating external control of diode laser behavior



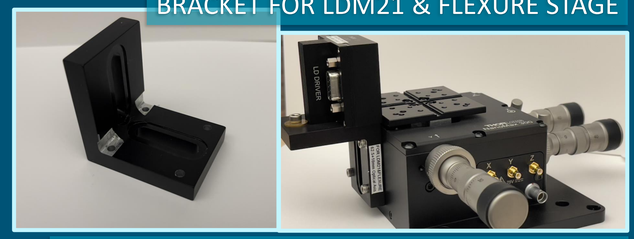
FUTURE SETUP (Littman-Metcalf)



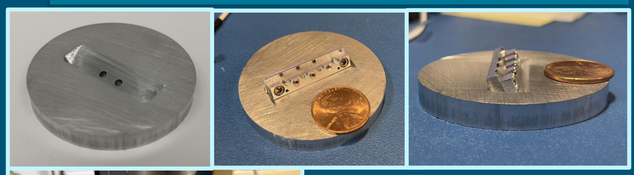
- Will incorporate a diffraction grating and pivoting mirror
- Enables fine and precise wavelength tuning
- Reduces output linewidth even further
- Common in spectroscopy and atomic physics applications

MACHINING CUSTOM OPTOMECHANICAL PARTS

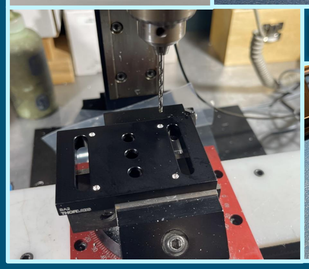
BRACKET FOR LDM21 & FLEXURE STAGE

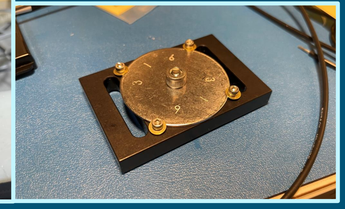


20° MOUNT FOR ANTIREFLECTIVE (AR) COATING

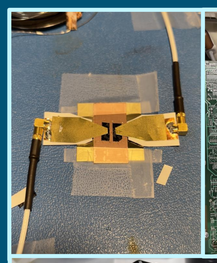


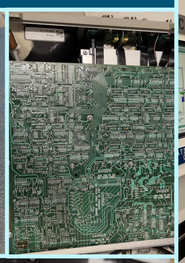
CLAMP FOR ABOVE PART

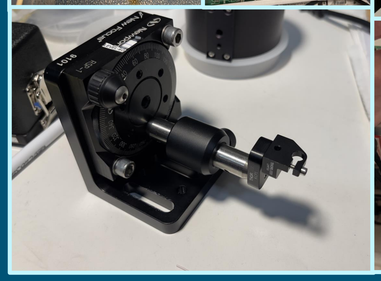




MISCELLANEOUS







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