ELEC 413 Project 1 & 2 Report (Draft)

Semiconductor Lasers

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Abstract

Preliminary Findings

To start off my research, I began by simulating a waveguide in Lumerical MODE. I chose a 220 nm thickness and a width of 350 nm, at 1310nm wavelength for this experiment. From here, I was able to simulate using the FDE to do Modal Analysis and found both the effective index and the group index.

Effective Index	Group Index	Optical Loss (dB/cm)
2.430237	4.496526	0.000661

Table 1: Modal Analysis of 220x350nm Wavelength Waveguide @ 1310nm Wavelength
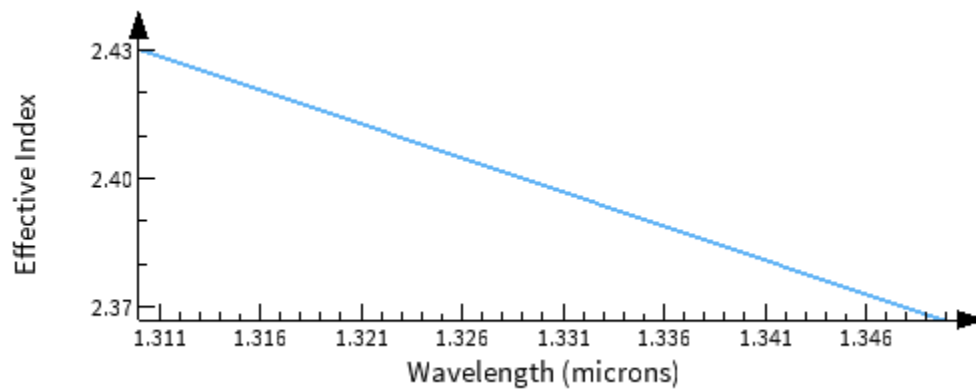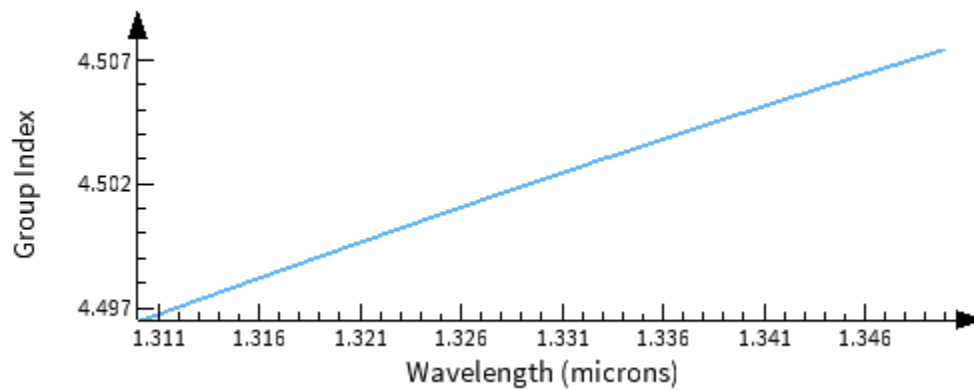

Figure 1: Effective Index over Wavelength Range

Figure 2: Group Index over Wavelength Range

I then began my models in KLayout with three different variations to test the ΔL over several permutations. Overall, I made sure to have a wide range of ΔL and one model utilizing a paperclip waveguide for better testing purposes.
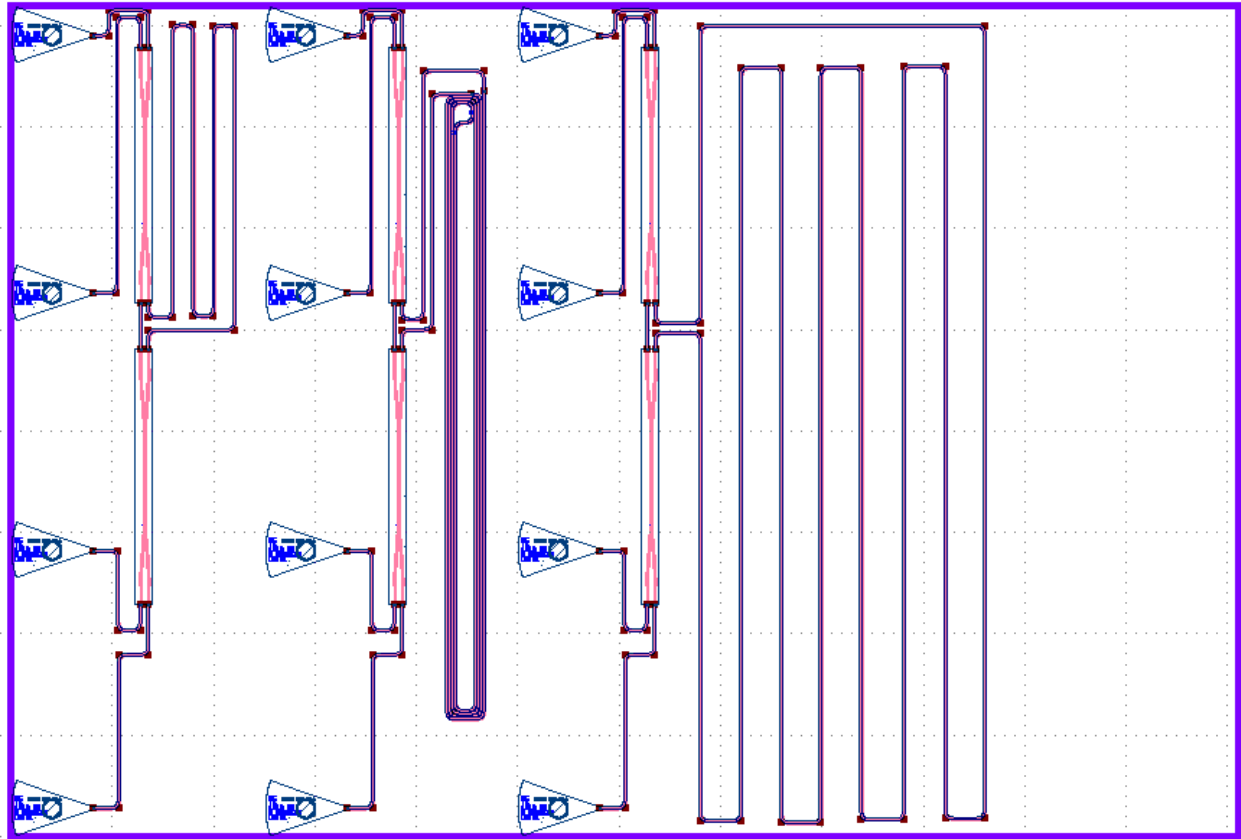

Figure 3: Three Variations of MZI (1 to 3 respectively)

With these modelled, I began doing calculations for Δv using the group index found previously.

$$\Delta v \; = \; \frac{c}{\Delta L * n_g}$$

MZI	ΔL(μm)	Δv(GHz)
1	644.677	103.49145
2	2822.6	23.63727
3	3297.453	20.2333

Table 2: Free Spectral Range for Interferometers

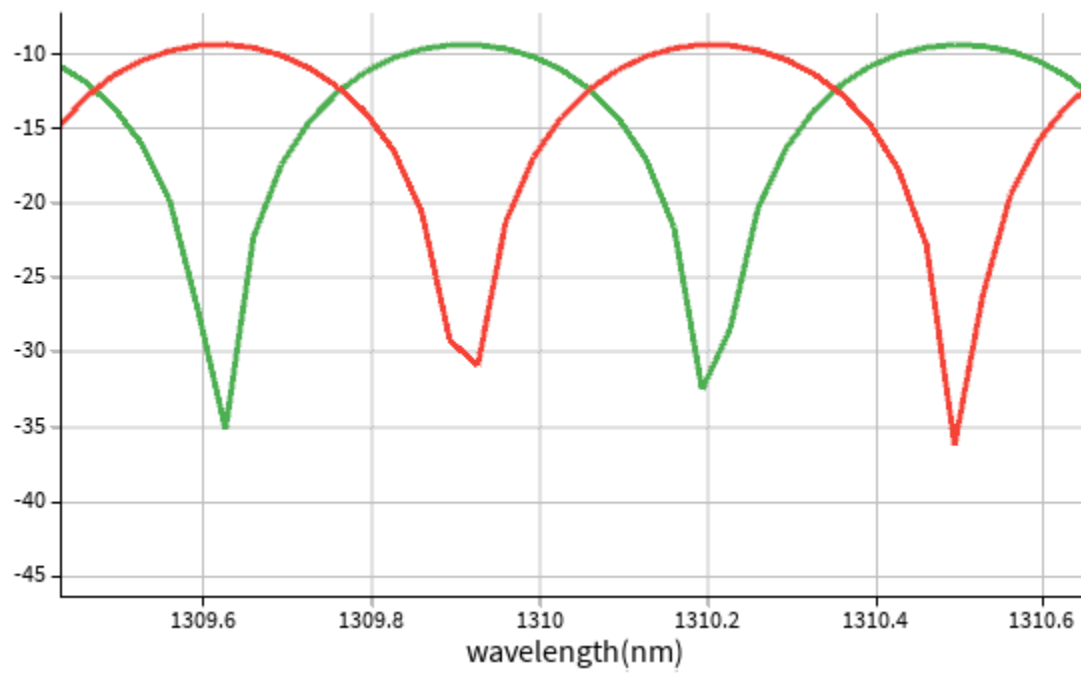From these calculations with the specific waveguide, I can see the desired 25Ghz corresponds to a ΔL of 2668.742355μm.
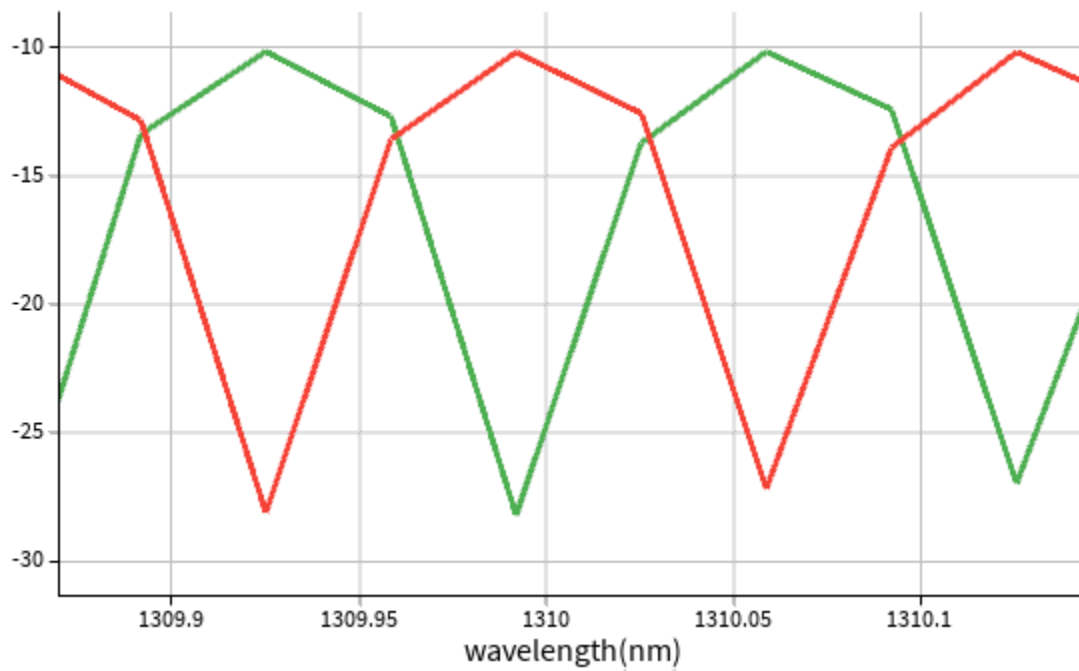
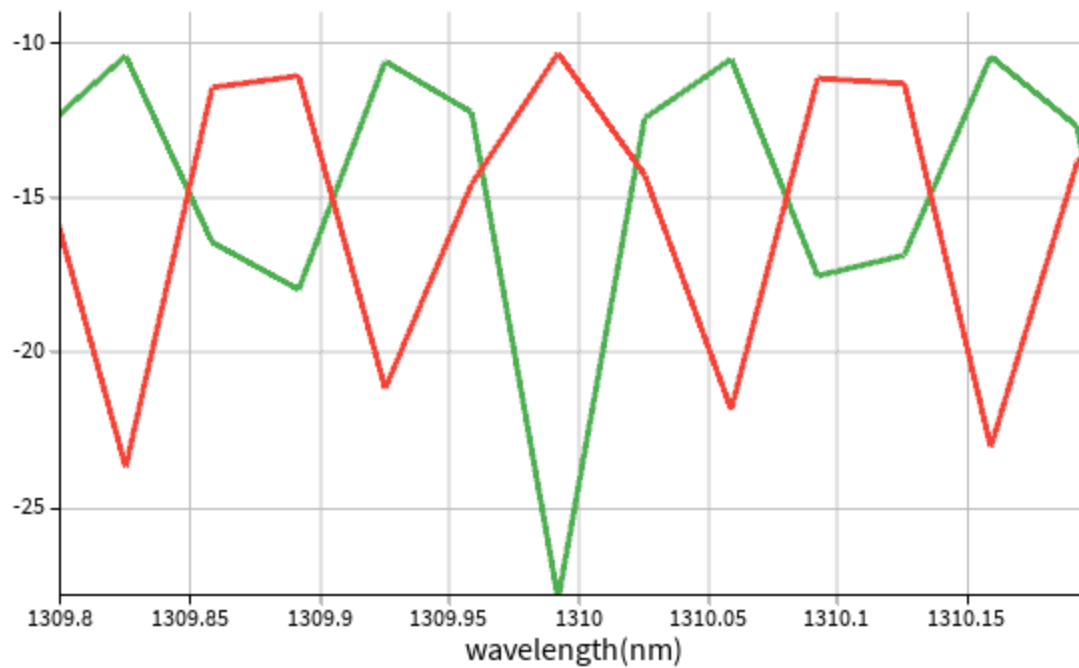Figure 4: MZI 1 Transmission Pattern

Figure 5: MZI 2 Transmission Pattern

Figure 6: MZI 3 Transmission Pattern

Verification via MATLAB

After finding these results, I began building a MATLAB script that would calculate the effective and group index. (Incomplete)