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ELEC 413 REPORT DRAFT 1

CHIP1: MZI 25GHz

Objective: Design both an optical multiplexer that can be used to combine two lasers separated at a 25 GHz channel spacing, into a single optical output, and a demultiplexer that can separate two optical signals from a single waveguide, into separate waveguides.

Wavelength of operation between 1270 and 1330 nm (O Band, centred at 1.31 μm)

A waveguide width of 350nm was chosen to align with waveguide width of the following PDK components being used:

GC_TE_1310_8degOxide_BB

ebeam_splitter_swg_assist_te1310

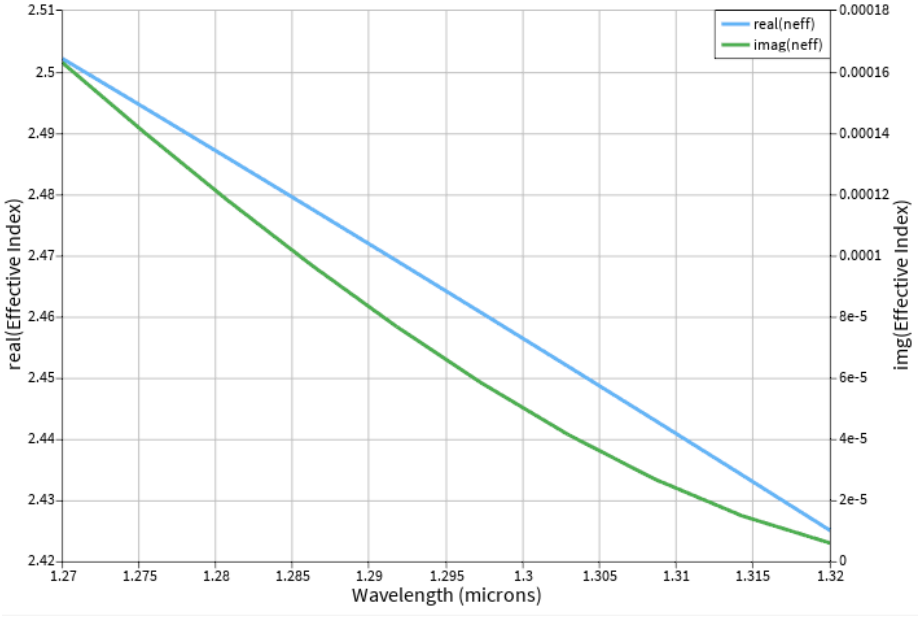
Simulations were done in Lumerical MODE at a waveguide width of 350nm (chosen above), and height of 220nm (defined by the EBEAM process). A simulation boundary of 2.5um x span by 1.7um y span was used to ensure the field had sufficiently decayed at the simulation span to obtain the most accurate simulation results.

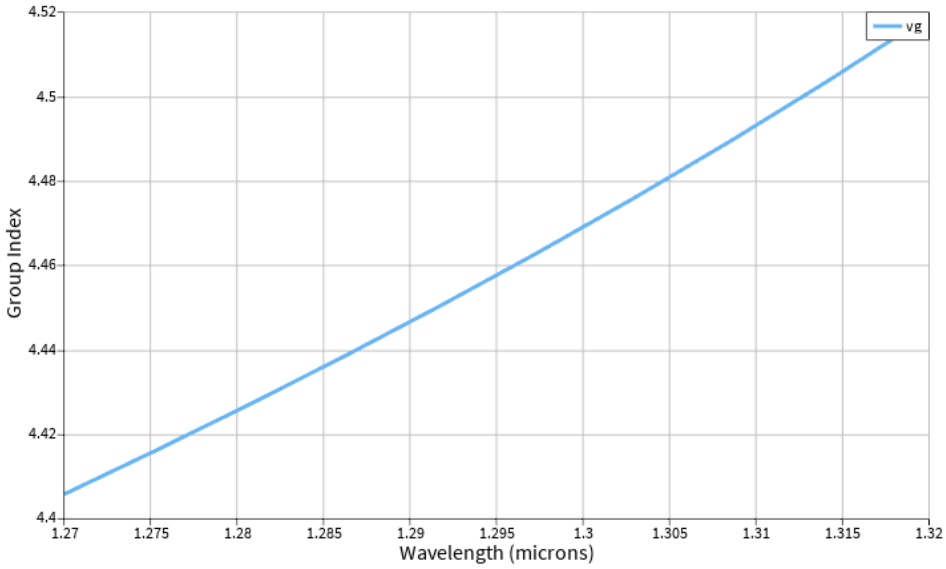
An effective index for the mode of interest (TE1 mode) was shown to be 2.441 at 1310nm

Mode list

mode #	effective index	wavelength (μm)	loss (dB/cm)	group index	TE polarization fraction (Ex)	waveguide TE/TM fraction (%)	effective area (μm^2)
1	2.440878+2.373791e-05i	1.31	9.8893	4.493114+0.002949084i	98	70.15 / 84.17	0.142118
2	2.011471+2.007677e-05i	1.31	8.3641	4.622060+0.002539477i	5	62.16 / 87.94	0.202395
3	1.466968+3.661936e-06i	1.31	1.5256	2.005771+0.0004790121i	54	93.32 / 98.92	0.930291
4	1.380098+3.113386e-06i	1.31	1.2970	2.022918+0.0004581894i	9	99.08 / 71.64	2.38258
5	1.375990+8.535328e-07i	1.31	0.35558	1.684371+0.0001008537i	0	94.04 / 93.04	2.80603
6	1.375024+3.662307e-07i	1.31	0.15257	1.579772+4.477688e-05i	100	97.48 / 93.03	2.19078
7	1.371651+3.125131e-08i	1.31	0.013019	1.540493+4.050932e-06i	56	99.74 / 99.8	2.43214

Next, a wavelength sweep was performed, tracking the mode of interest TE1 from 1270-1330nm to calculate the effective index and group index across the frequency band.





To calculate the required delta L for an FSR of 25GHz, the following calculations were done:

$$\Delta L = \frac{c}{n_g * FSR}$$

$$\Delta L = \frac{3 * 10^8}{4.4931 * 25 * 10^9}$$

=2.67076 mm

The target ΔL will be 2670.76um

To account for various tolerances (waveguide width, waveguide height, path length differences, material properties and thermal effects) multiple variants will also be fabricated where I have adjusted ΔL by up to +/- 3% in hopes of hitting the desired 25GHz FSR target.

Design Variant	ΔL
MZI1= TARGET	2670.076
MZI2= +2%	2724.1752
MZI3= +3%	2750.8828
MZI4= -2%	2617.3448
MZI5= -3%	2590.6372

A 6th circuit was added consisting of 2 grating couplers connected by a waveguide in order to calibrate the measurement system insertion loss.