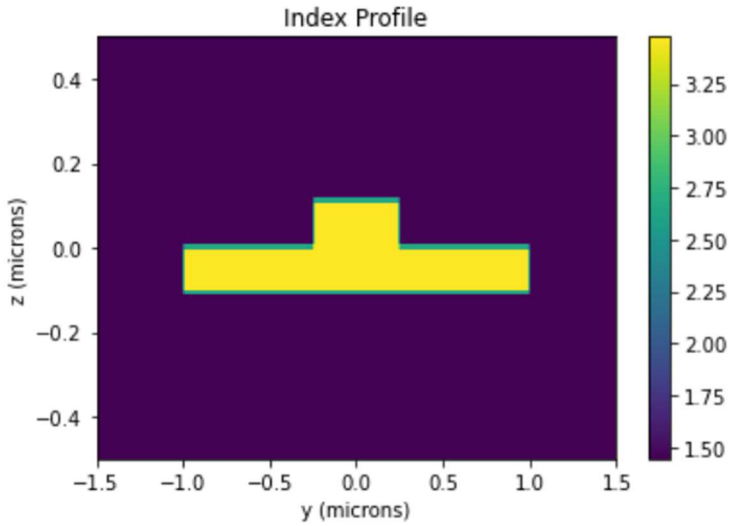
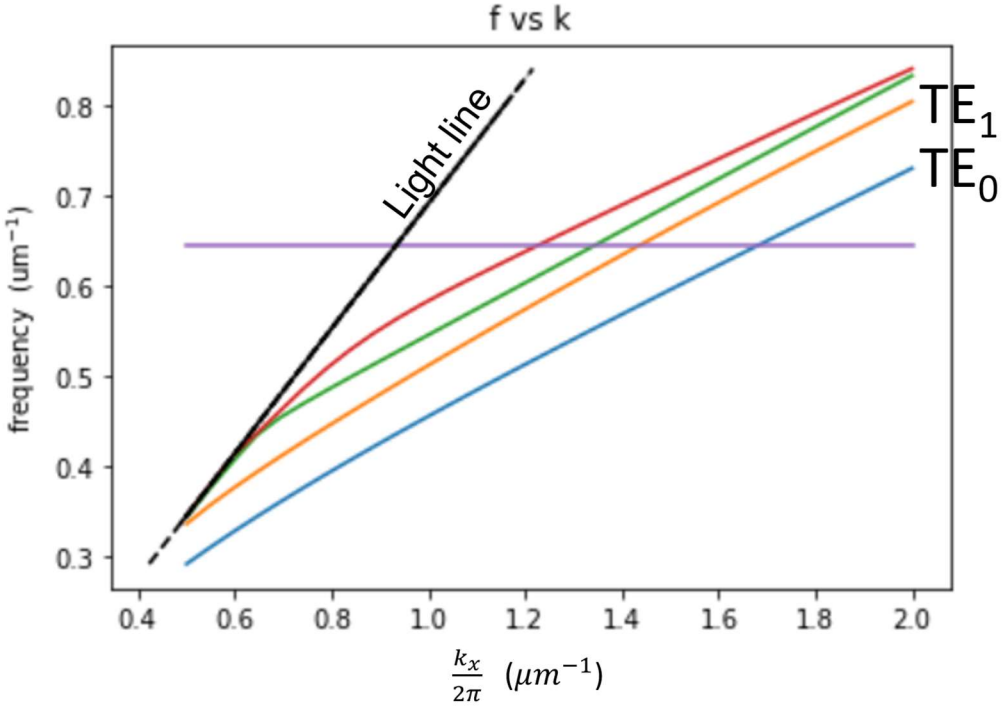
We define the following cross-section for our slab waveguide in MPB (MIT Photonic Bands solver):



Light propagates in the x-direction (coming out of the page).

We can then use MPB to help us solve for the dispersion of the various guiding modes.

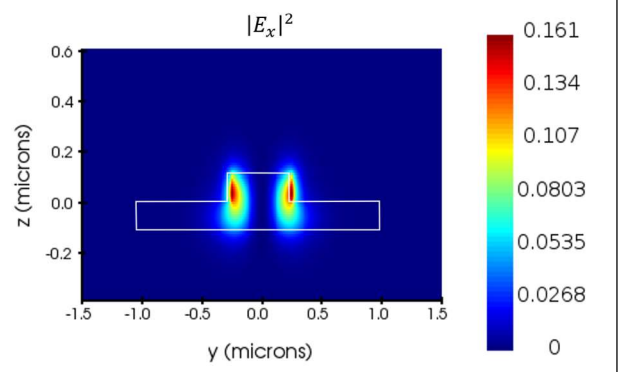
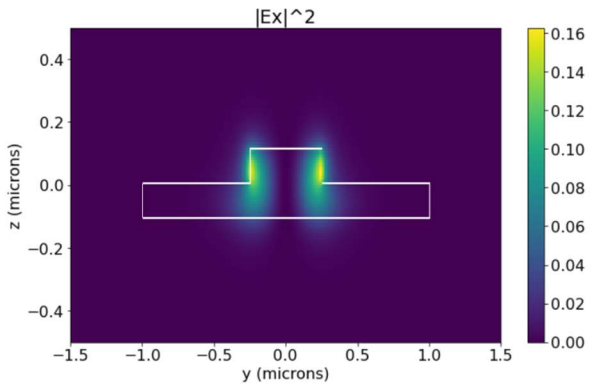
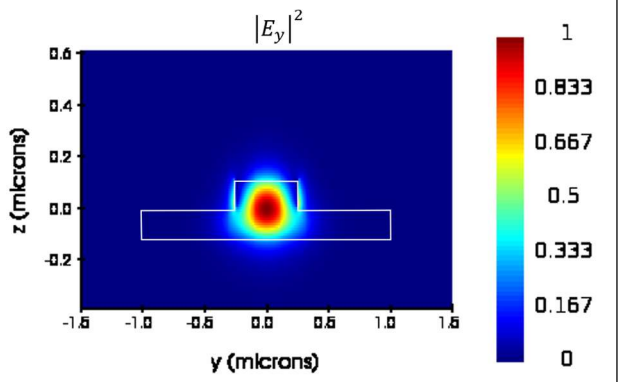
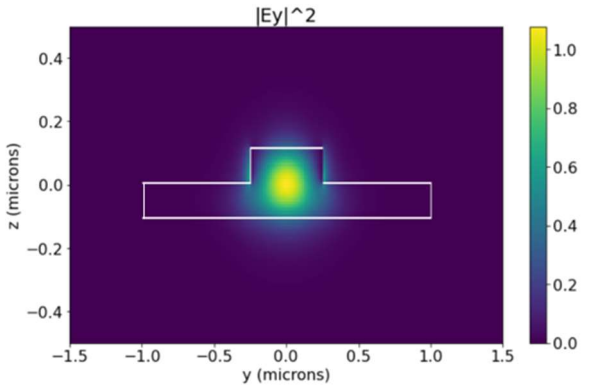
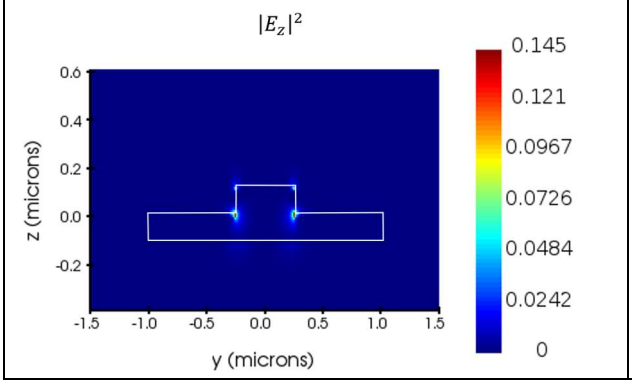
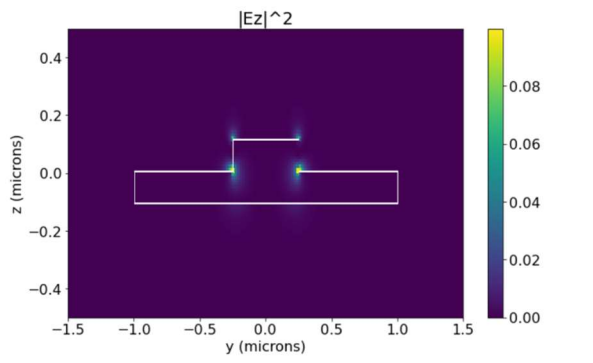


On the vertical axis, we are plotting the Frequency$\left(\equiv \frac{1}{\lambda}\right)$; on the horizontal axis, we are plotting $k_{MEEP} = \left(\frac{k_x}{2\pi} = \frac{n_{eff}}{\lambda}\right)$. The fundamental ($TE_0$) and first-excited ($TE_1$) modes have the lowest frequencies for a given k-value. Everything to the right of the light line corresponds to the total internal reflection (TIR) condition; all guiding modes are to the right of this line.

Now let's compare the mode profiles of the TE0 and TE1 modes calculated from MPB with the same modes calculated in Lumerical MODE (FDE) at λ = 1.55 microns.

Here's a comparison of the effective indices for the TE0 mode:

$$n_{eff}^{TE_0}(MODE) = 2.607 \qquad\qquad n_{eff}^{TE_0}(MPB) = 2.604$$

Lumerical Results (TE0 mode)	**MPB Results (TE0 mode)** (set antisymmetric about y=0) $\Rightarrow E_{\parallel} = 0$: $E_z = E_x = 0$ @ y = 0
	
	
	

Here's a comparison of the effective indices for the TE1 mode:

$$n_{eff}^{TE_1}(MODE) = 2.227 \qquad n_{eff}^{TE_1}(MPB) = 2.224$$

Lumerical Results (TE1 mode)	**MPB Results (TE1 mode)** (set symmetric about y=0) $\Rightarrow E_{\perp} = 0$: $E_y = 0$ @ y = 0