# Rectangular Waveguide TE Modes – Phys 442 Winter 2017

891

```
In[1]:= (* for dimensions of a = 10 cm, b = 7 cm *)
        a = 0.10;
        b = 0.07;
        wcutoff[m_, n_] := 3*^8 Sqrt[(m Pi / a) ^2 + (n Pi / b) ^2]
        cutofftable = Table[wcutoff[m, n], {m, 0, 3}, {n, 0, 3}] ;
        cutofftable // MatrixForm
        cutofftable // Flatten // Sort
```

→ chosen arbitrarily

Out[5]//MatrixForm=

$$\begin{pmatrix} 0. & 1.3464\times10^{10} & 2.69279\times10^{10} & 4.03919\times10^{10} \\ 9.42478\times10^{9} & 1.64349\times10^{10} & 2.85296\times10^{10} & 4.14769\times10^{10} \\ 1.88496\times10^{10} & 2.31643\times10^{10} & 3.28697\times10^{10} & 4.45737\times10^{10} \\ 2.82743\times10^{10} & 3.13164\times10^{10} & 3.90455\times10^{10} & 4.93046\times10^{10} \end{pmatrix}$$

cutoff ω's, in table form (rad/s)

Out[6]= $\{0.,\ 9.42478\times10^{9},\ 1.3464\times10^{10},\ 1.64349\times10^{10},\ 1.88496\times10^{10},\ 2.31643\times10^{10},\ 2.69279\times10^{10},\ 2.82743\times10^{10},\ 2.85296\times10^{10},\ 3.13164\times10^{10},\ 3.28697\times10^{10},\ 3.90455\times10^{10},\ 4.03919\times10^{10},\ 4.14769\times10^{10},\ 4.45737\times10^{10},\ 4.93046\times10^{10}\}$

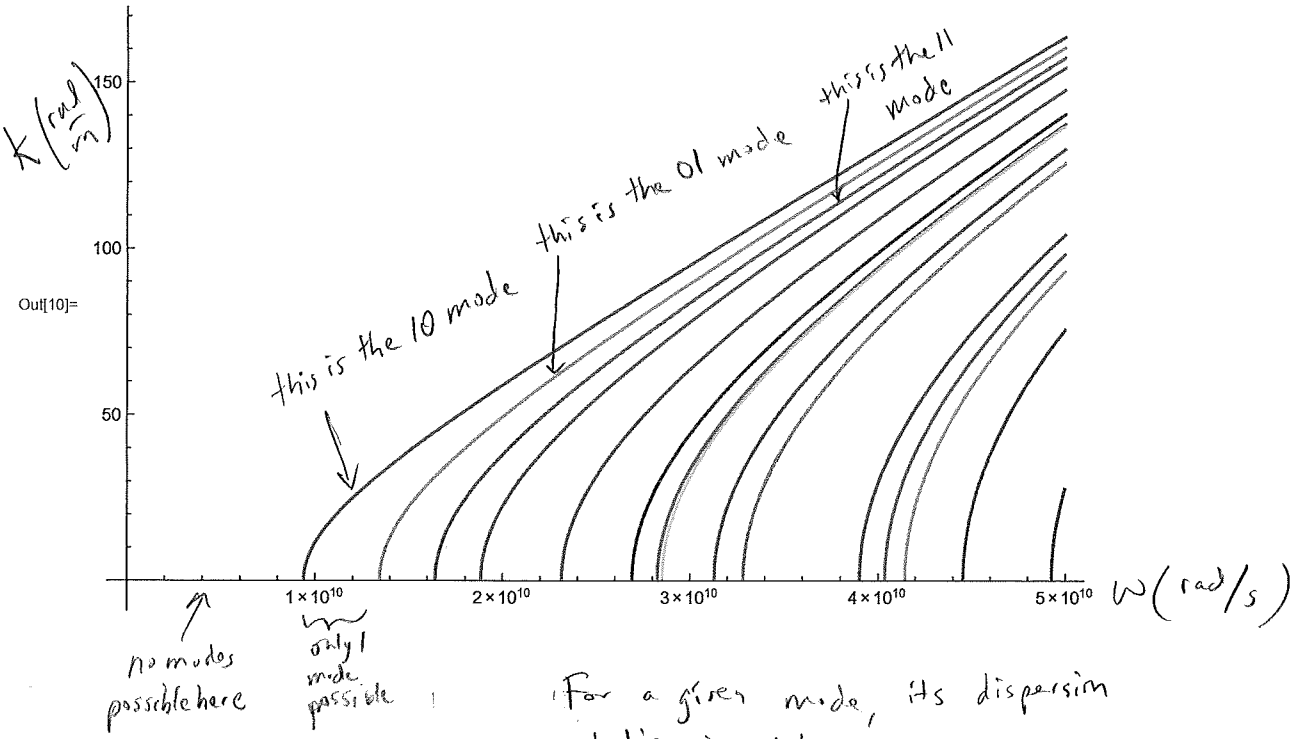
cutoff ω's sorted in a list

(continued on next page)

In[7]:=
```
c = 3*^8;
k[w_, m_, n_] := Sqrt[w^2/c^2 - Pi^2 m^2/a^2 - Pi^2 n^2/b^2]
Table[k[w, m, n], {m, 0, 3}, {n, 0, 3}] // Flatten // Drop[#, 1] & // Sort // Reverse
Plot[%, {w, 0, 5*^10}]
```

Out[9]=
$$\left\{\sqrt{-986.96+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-2014.2+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-3001.17+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-3947.84+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-5962.05+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-8056.82+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-8882.64+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-9043.78+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-10\,896.8+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-12\,004.7+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-16\,939.5+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-18\,127.8+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-19\,114.8+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-22\,075.7+\frac{w^2}{90\,000\,000\,000\,000\,000}},\ \sqrt{-27\,010.5+\frac{w^2}{90\,000\,000\,000\,000\,000}}\right\}$$

Out[10]=




For a given mode, its dispersion relation is set by these curves

pictures of $B_z$ for these modes. Tan = positive antinode, Blue = negative antinode

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In[11]:=
```
Table[DensityPlot[Cos[m Pi x / a] Cos[n Pi y / b] , {x, 0, 0.10}, {y, 0, 0.07}],
  {m, 0, 3}, {n, 0, 3}] // TableForm
```

Out[11]//TableForm= (00 = not a mode)