Problem Set 10

PHYSICS 443
November 30, 2020

Kevin Evans
ID: 11571810

---

1. For the values of v_2, the corresponding values of $C(v)$ and $S(v)$ are

v	$C(v)$	$S(v)$
1.4	0.5431	0.7135
1.0	0.7799	0.4383
-1.0	-0.7799	-0.4383

   Then using the formula from in-class, the unnormalized U_p are given by

$$U_p = \frac{1}{1+i}\left[C(v_2) + iS(v_2) + \frac{1}{2} + \frac{1}{2}i\right]$$

   For each v_2,

$$\begin{aligned} U_p(1.4) &= 1.1283 + 0.0852i \\ U_p(1.0) &= 1.1091 - 0.1708i \\ U_p(-1.0) &= -0.1091 + 0.1708i \end{aligned}$$

2. The beam waist diameter is $3.0\,\mathrm{mm}$, so $w_0 = 1.5\,\mathrm{mm}$. So projected on the wall, the light will have a radius of

$$\begin{aligned} w(100\,\mathrm{m}) &= w_0\left[1 + \left(\frac{\lambda z}{\pi w_0^2}\right)^2\right]^{1/2} \\ &= (1.5\,\mathrm{mm})\left[1 + \left(\frac{632.8\,\mathrm{nm}\times 100\,\mathrm{m}}{\pi\,(1.5\,\mathrm{mm})^2}\right)^2\right]^{1/2} \\ &= 13.51\,\mathrm{mm} \end{aligned}$$