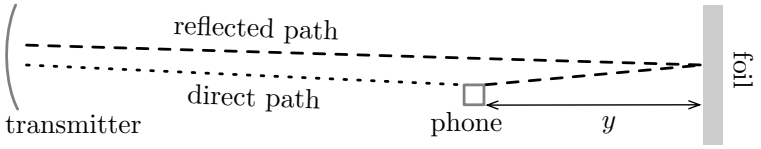
You are trying to increase the signal to your phone and flatten a piece of aluminum foil to act as a mirror so that you can reflect the signal to your phone. In this way the phone receives the signal twice. You are holding the aluminum foil $y = 5$cm from the phone as shown. Suppose that the reflected signal has an amplitude of $3.0\frac{\text{N}}{\text{C}}$ and the direct signal has an amplitude of $4.0\frac{\text{N}}{\text{C}}$. What is the amplitude of the combined signal? The wavelength of the signal is 30cm.



Physics 11 - Quiz 11 5/13/2020

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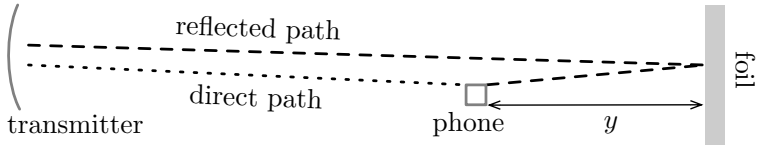

Solution:

$$\Delta\phi_{\text{path}} = 2\pi\frac{\Delta r}{\lambda} = 2\pi\frac{2y}{\lambda} = 2\pi\frac{10\text{cm}}{30\text{cm}} = \frac{2\pi}{3}$$

$$\Delta\phi_{\text{reflection}} = \pi$$

$$\Delta\phi = \Delta\phi_{\text{path}} + \Delta\phi_{\text{reflection}} = \frac{2\pi}{3} + \pi = \frac{5\pi}{3}$$

so

$$\begin{aligned}
E^2 &= E_1^2 + E_2^2 + 2E_1E_2\cos(\Delta\phi) \\
&= E_1^2 + E_2^2 + 2E_1E_2 \ \ \tfrac{1}{2} \\
&= E_1^2 + E_2^2 + E_1E_2 \\
&= (3.0\tfrac{\text{N}}{\text{C}})^2 + (4.0\tfrac{\text{N}}{\text{C}})^2 + (3.0\tfrac{\text{N}}{\text{C}})(4.0\tfrac{\text{N}}{\text{C}}) \\
&= (9 + 16 + 12)(\tfrac{\text{N}}{\text{C}})^2 \\
&= 37(\tfrac{\text{N}}{\text{C}})^2
\end{aligned}$$

So

$$E = \sqrt{37}\ \tfrac{\text{N}}{\text{C}}$$