Mach-Zehnder and Michelson-interferometer

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Solution: *Be* $I_0(0,t) = e^{\imath(kx-\omega t)} = e^{-i\omega t}$ *the signal immediately in front of the first beam splitter. Immediately behind it we have two waves* $I_{1,2}(0,t) = 2^{-1/2}e^{\imath(kx-\omega t)} = 2^{-1/2}e^{-i\omega t}$. *With the interferometer arm lengths* $d_{1,2}$ *we have, just in front of the second separator, the signals* $I_{1,2}(d_{1,2},t) = 2^{-1/2}e^{\imath(kd_{1,2}-\omega t)}$. *Immediately behind it we have the recombined wave,*

$$I_s(t) = 2^{-1/2}e^{\imath(kd_1-\omega t)} + 2^{-1/2}e^{\imath(kd_2-\omega t)} = 2^{1/2}\cos k(d_1+d_2)e^{-i\omega t} \ .$$

That is, after the second beam splitter the signal oscillates with an amplitude that depends on the length difference of the interferometer arms like $\cos k(d_1+d_2)$.