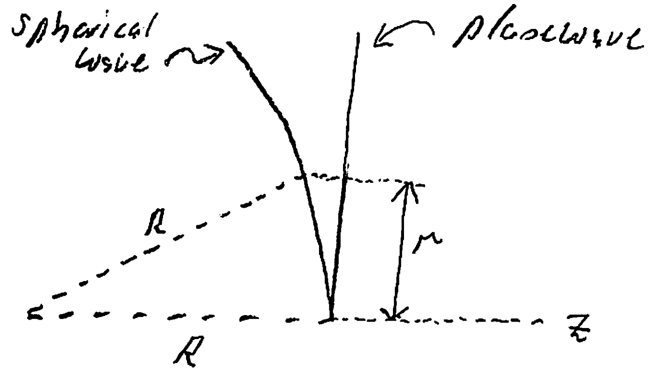
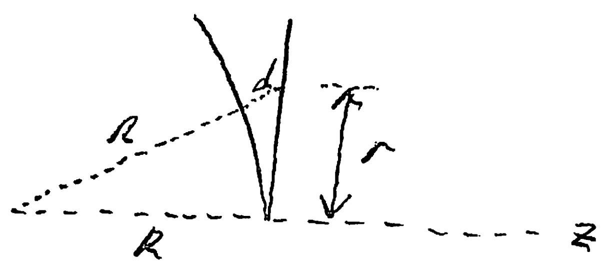
(1) Here's a geometry useful for getting the Δz in the text



I used something similar, solving for d in the figure:



(2a) The answer is close to 60 mW.

(2b) You can use a generalization of figure 5.10(b) and associated discussion or you can use the generalized equation for the phase difference between the local osc. and signal beams.

phase difference for aligned beams: $\Delta\delta = (k_{LO} - k_s)x - (\omega_{LO} - \omega_s)t + (\varphi_{LO} - \varphi_s)$

general expression for the phase difference: $\Delta\delta = (\vec{k}_{LO} - \vec{k}_s) \cdot \vec{r} - (\omega_{LO} - \omega_s)t + (\varphi_{LO} - \varphi_s)$

(3) For 500 nm, I get $v_g = 1.929 \times 10^8$ m/s.

(4) The discussion on pages 235 – 236 basically explains how to solve this problem.

(5) Unless told otherwise, the medium between the mirrors is just air. The mirror separation is large compared to a wavelength, so expect numbers appropriate for a precision instrument.

(6) This is, in class, what I called an etalon. It's just a slab of germanium, but it can be analyzed the same way as in the previous problem. Assume the light is normally incident.