EC5103

Quiz #4

2021.04.12

Name:

In a Fabry-Perot interferometer (FPI) whose (nominal) cavity length (d_1) is 30 cm, the peak-to-peak separation of the transmitted light is measured at $d_{fsr} = 500\ nm$.

When two closely separated laser lights are incident on the FPI, and the peak separation between the transmitted lights is $\Delta d = 1$ nm for the same mode number, $m_1 = m_2 = m$,

(a) What is the wavelength of the nominal light?

(b) What is the wavelength difference $\delta\lambda$ $(= |\lambda_1 - \lambda_2|)$ between them?

Sol.)

$\phi = 2Kd = 2\frac{2\pi}{\lambda} d = 2m\pi \rightarrow d_m = m\frac{\lambda}{2}$

$\therefore\ d_{m+1} - d_m = \frac{\lambda}{2} \equiv d_{fsr}\quad (= 500\ nm)$

(a) $\therefore\ \underline{\lambda = 1\ \mu m}$

$\lambda_1 = 2d_1/m$

$\lambda_2 = 2d_2/m$

$\Delta\lambda = |\lambda_1 - \lambda_2| = \frac{2}{m}|d_1 - d_2| = \frac{2\Delta d}{m}$

Using $m = \frac{2d_1}{\lambda_1}$,

$\frac{\Delta\lambda}{\lambda_1} = \frac{\Delta d}{d_1}$.

$d_1 = 30\ cm$.

The λ_1 is close to the nominal λ.

(b) $\therefore\ \Delta\lambda = \frac{\Delta d}{d}\lambda = \frac{10^{-9}}{3\cdot 10^{-1}} = \underline{\frac{1}{3}\cdot 10^{-8}\lambda}$

$= \underline{3.3 \times 10^{-15}\ (m)}$