

## Homework 5

Due Wednesday, before 1 p.m., November 15, 2023

### 1 Fabry-Perot

#### 1.1 Empty cavity

Find the linewidth, free spectral range of the transmission modes of the Fabry-Perot with the following parameters:

1. thickness 1 mm.
2. 2 mirrors with equal (intensity) reflectivity of  $4R = 99\%$
3.  $\lambda = 500 \text{ nm}$
4. Index of refraction  $n = 1$

#### 1.2 Dispersion due to an absorber

The Fabry-Perot cavity is filled with an absorbing medium with an homogeneously broadened absorption line exactly resonant with a mode of this Fabry-Perot.

Linear absorption coefficient  $\alpha_0 = 1 \text{ mm}^{-1}$

The inverse linewidth of the line (phase relaxation time) is  $T_2 = 1 \text{ ps}$ .

Calculate the contribution of this line to the index of refraction  $n(\Delta\omega)$  where  $\Delta\omega$  is the detuning from the center of the line.

#### 1.3 Absorber in the Fabry-Perot

Calculate how the transmission of laser light for the mode at resonance and for two adjacent modes is affected by the absorber inserted in the cavity.

#### 1.4 Calculate the shift in frequency for the two modes adjacent to the center mode