Advanced Optics I (463)
Test 2, November 18, 2020
Please return before November 19, 5 pm.

1 Resolving the D lines of Sodium

The D lines of sodium have the wavelengths:

D_1 589.756 nm

D_2 589.158 nm

Design a simple Fabry-Perot (index of refraction = 1) to resolve these two lines. The free spectral range of the Fabry-Perot should be twice the difference between these two spectral lines. The second condition is that, to ensure good transmission of either line when at resonance, the FWHM of the Fabry-Perot resonance should be half of the splitting between the lines. The two numbers to give are:

1. What is the spacing between the two reflecting faces of this Fabry-Perot?
2. What is the reflectivity of either face?

2 Scanning Fabry-Perot

Design a scanning Fabry-Perot to analyze the output of a He-Ne laser (wavelength 628.3 nm, cavity length $L = 1.5$ m). Take the gain line to be rectangular with a bandwidth of 500 MHz. The Fabry-Perot mirrors have equal reflectivity R. Designing the scanning Fabry-Perot implies selecting the Fabry-Perot thickness d, the scanning range Δd, and the reflectivity R. The criteria are that the modes of the laser be clearly resolved (Fabry-Perot linewidth $\leq$ 1/2 the mode spacing of the laser), that the scanning covers two free spectral ranges of the Fabry-Perot, and that the spectral range covers all the modes within the gain bandwidth. Index of refraction = 1 everywhere.

Please do not just give numbers. Explain/justify your selections

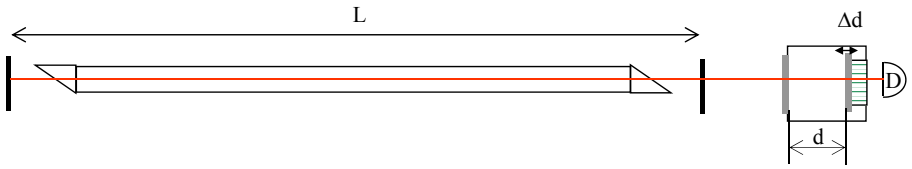

Figure 1: He-Ne laser and scanning Fabry-Perot.