Part 1: A convenient way of frequency-stabilizing a laser cavity is by observing the beat frequency between two orthogonally polarized modes and using the frequency error to readjust the cavity length. The modes are produced by inserting a wave plate with retardation, aλ, in a cavity of length L = 1.5 meters. If the desired beat frequency is 10 MHz, what is the fraction retardation, aλ ? (2 pts)

Part 2: Some bi-stable optical elements depend upon the saturation of an optical absorber to detune a Fabry-Perot cavity. Consider such a cavity with mirror reflectance R = 0.9 and length ℓ. The *power* absorption at the atomic resonance ($\upsilon = \upsilon_0$) is $\exp(-\alpha(\upsilon_0)\ell) = \exp(-0.2)$. At low optical power input, the Fabry-Perot cavity is tuned to resonate at υ_c, the lower half-power frequency of the atomic transition as shown in the figure. As the input power at υ_c increases, the transition saturates ($N_2 \approx N_1$) and the cavity is detuned. Find the intensity transmission *I* under fully saturated conditions.