Spectroscopy

Exercises Chapter 2E

1. What are the room temperature (20°C) Doppler linewidths for the pure rotational transition of CO at 115 GHZ, the infrared transition of CO_2 at 667 cm^{-1} and the ultraviolet transition of the Hg atom at 2537 Å?

2. Calculate the transit-time broadening for hydrogen atoms traversing a 1 mm diameter laser beam. For the velocity of the hydrogen atoms, use the root mean squared (RMS) speed

$$v = \sqrt{\frac{3k_B T}{m}}$$

   at room temperature.

3. At what pressure will the Doppler broadening (FWHM) equal the pressure broadening (FWHM) for a room temperature (20°C) sample of CO gas for a pure rotational transition at 115 GHZ, a vibration-rotation transition at 2140 cm^{-1}, and an electronic transition at 1537 Å? Use a "typical" pressure-broadening coefficient of 10 MHz/mBar in all three cases.

4. What are the minimum spectral linewidths of pulsed lasers with pulse durations of 10 femtoseconds (1 femtosecond = 10^{-15} sec), 1 picosecond (10^{-12} seconds), 10 nanoseconds, and 1 μsecond?