

Quiz #6

Consider the pure rotational spectrum of HI.

- 1) Make a rough sketch of intensity vs energy (in terms of the rotational constant B). Indicate the spacings. What does the profile look like and why?

- 2) For $^1\text{H}^{131}\text{I}$
 $B = 6.6 \text{ cm}^{-1}$

What is the spectral line spacing for D^{131}I ?
($\text{D} \equiv ^2\text{H}$)

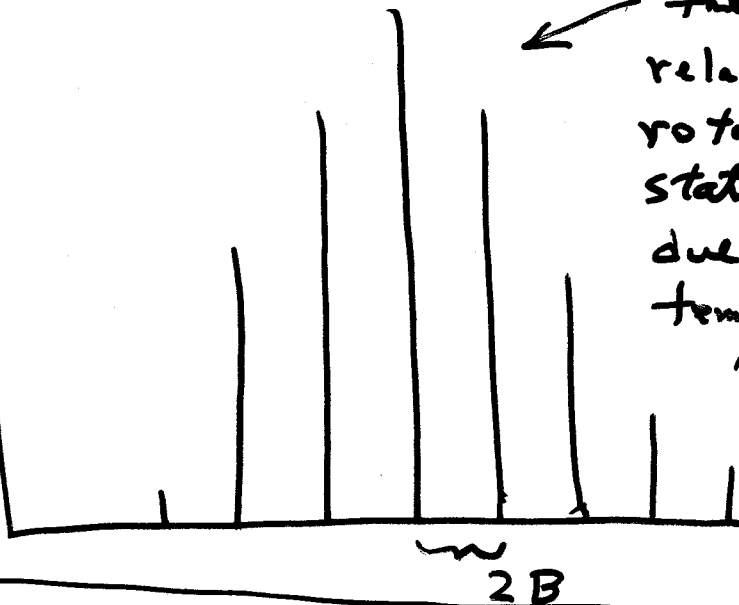
Quiz #6 Answers

①

I

$$E_J = J(J+1)hcB$$

$$\Delta E = 2hcBJ$$



the profile is related to the rotational state population due to a finite temperature = "Boltzmann" population

$$B \propto \frac{1}{I} \quad I = \mu r^2 \quad r = \text{same}$$

$$\mu_{HI} = \frac{m_1 m_2}{m_1 + m_2} = \frac{1(131)}{132}$$

$$\mu_{DI} = \frac{2(131)}{133}$$

$$\frac{B_{DI}}{B_{HI}} = \frac{\frac{1}{\mu_{DI}}}{\frac{1}{\mu_{HI}}}$$

$$B_{DI} = \frac{1}{2} (6.6) = 3.3 \text{ cm}^{-1}$$

$$= \frac{1(131)133}{132(2)131}$$

$$\approx \frac{1}{2}$$

$$\text{Line Spacing} = 2B$$

$$= 6.6 \text{ cm}^{-1}$$

②