#2

$$\Delta\nu = -\left(\frac{L}{2\pi\beta}\right)^2 \frac{r_0 \lambda}{\gamma^3 \beta^2 a^2 \nu_0}$$

$N = 1.5 \times 10^{14}$
$B = 2.0$
$L = 248$

$$\lambda = \frac{NB}{L}$$

$E_0 = 1.938$
$\nu_0 = 6.2$
$a = 3\,\text{cm}$

$$\beta^2 = 1 - \frac{1}{\gamma^2}$$
$$\gamma^3\beta^2 = \gamma\gamma^2\left(1-\frac{1}{\gamma^2}\right) = \gamma(\gamma^2-1)$$

$$\Delta\nu = -\left(\frac{L}{2\pi}\right)^2 \frac{r_0 \lambda}{\gamma^3 \beta^2 a^2 \nu_0}$$

$$= -\left(\frac{L}{2\pi}\right)^2 \frac{r_0 B N_0/L}{\nu_0 a_0^2} \left(\frac{a_0}{a}\right)^2 \frac{N}{N_0} \frac{1}{\gamma(\gamma^2-1)}$$

$a_0 = 1\,\text{cm}$
$N_0 = 10^{14}$

$$\Delta\nu = -\left(\frac{248}{2\pi}\right)^2 \frac{1.535 \times 10^{-18} \times 2 \times 10^{14}}{248 \times 6.2 \times 10^{-4}} \left(\frac{1}{a}\right)_{cm} \times N_{14} \frac{}{\gamma(\gamma^2-1)}$$

$$\Delta\nu = -3.11 \frac{1}{a_{cm}} \frac{N_{14}}{\gamma(\gamma^2-1)}$$

$$\gamma = \frac{1.938}{0.938} = 2.066$$

$a_{cm} = 3$
$N_{14} = 1.5$

$$\Delta\nu = \frac{-3.11 \times 1.5}{3 \times 2.066\left(2.066^2-1\right)}$$

$$= -0.23$$