

Answer on question #72807, Physics / Electromagnetism

A proton with energy 1 MeV move perpendicular to the earth B field of 0.5 gauss or 0.00005T find radius & frequency of orbit?

Solution:

$$E = \frac{mv^2}{2} \rightarrow v = \sqrt{\frac{2E}{m}} - \text{non-relativistic case, as energy is much less than mass of the proton.}$$

$$\text{According to 2}^{\text{nd}} \text{ Newtons law: } F = ma \rightarrow qBv = \frac{mv^2}{r} \rightarrow r = \frac{mv}{qB} = \frac{m}{qB} \sqrt{\frac{2E}{m}} = \frac{\sqrt{2mE}}{qB}$$

$$r = \frac{\sqrt{2 * 1.67 * 10^{-27} * 1.6 * 10^{-13}}}{1.6 * 10^{-19} * 5 * 10^{-5}} = 2.9 * 10^3 \text{ m} - \text{radius of the orbit}$$

$$\vartheta = \frac{\omega}{2\pi} = \frac{v}{2\pi r} = \frac{1}{r} \sqrt{\frac{E}{2m}} = \frac{1}{2.9 * 10^3} \sqrt{1.6 * \frac{10^{-13}}{2 * 1.67 * 10^{-27}}} = 2.4 * 10^2 \text{ Hz} - \text{frequency}$$

Answer:

$$2.9 * 10^3 \text{ m}, 2.4 * 10^2 \text{ Hz}$$

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