

Question #83187, Physics / Electromagnetism |

you and a few friends were to charge up your hair by rubbing a balloon against your head, you could run in a circle and create a current. What is the magnitude and the direction of the magnetic field that would be created in the middle of this circle?

During friction of the rubbing a balloon, a positive charge is formed on the hair. The total charge that was formed on the hair is n - the number of electrons passed to by rubbing a balloon.

Current that occurs when running in a circle - $I = \frac{e}{T} = N \frac{ne}{T}$, where N - number of friends, n - number of electrons and e - charge of electron, T -period

Magnetic moment $p_m = IS, S = 2\pi r^2$, then $p_m = N \frac{ne}{T} 2\pi r^2$

the direction of the magnetic field is shown in the figure

magnitude of the magnetic field - $B = \mu_0 \mu \frac{I}{2r} = \mu_0 \mu N \frac{ne}{2rT}$

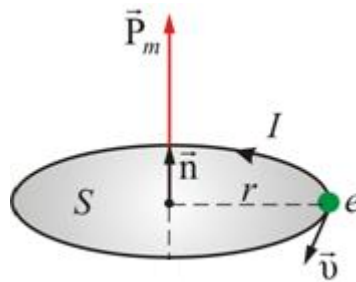
Let's try to estimate the magnitude of the magnetic moment

Let - $N = 4, n = 50, T = 4 \text{ s}, r = 2 \text{ m}$

$e = 1.6 \times 10^{-19} \text{ C}, \mu_0 = 4\pi \times 10^{-7} \text{ H/m}$

$$p_m = 4 \cdot \frac{50 \cdot 1.6 \times 10^{-19}}{4} 2 \cdot 3.14 \cdot 4 = 2.1 \times 10^{-16} \text{ A} \cdot \text{m}^2$$

$$B = 4\pi \times 10^{-7} \cdot 4 \cdot \frac{50 \cdot 1.6 \times 10^{-19}}{2 \cdot 2 \cdot 4} = 2.51 \times 10^{-24} \text{ Wb}$$



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