Answer on Question #50852, Physics, Electromagnetism

In the Bohr model of hydrogen atom, the electron follows a circular orbit centred on the nucleus containing a proton. The motion of the electron along the circular orbit constitutes a current. Calculate the magnetic field produced by the orbiting electron at the site of the proton.

Answer

In the Bohr model of the hydrogen atom, an electron in the 1st excited state moves at a speed of 2.19 10^6 m/s in a circular path having a radius of 5.29 10-11 m.

Current may be expressed by ratio of charge of electron and one round time:

$$I = \frac{\Delta q}{\Delta t} = \frac{e}{\frac{2\pi r}{v}} = \frac{ve}{2\pi r} \approx \frac{2.2\frac{10^6 m}{s} \cdot 1.6 \cdot 10^{-19} C}{2 \cdot 3.14 \cdot 5.3 \cdot 10^{-11} m} \approx 1.1 \cdot 10^{-3} A$$

Magnetic field for such circular current is:

$$B = \mu_0 \frac{I}{2r} \approx 1.26 \cdot \frac{10^{-6} H}{m} \cdot \frac{1.1 \cdot 10^{-3} A}{2 \cdot 5.3 \cdot 10^{-11} m} \approx 13\ T$$