

Answer on Question #55054, Physics / Astronomy | Astrophysics

An electron is “wiggling” in one dimension such that its position is $x(t) = A\cos(\omega t)$. What is the average power radiated by the particle? Note how it scales with the wiggle frequency ω ?

Answer

The average power radiated by the particle is

$$P = \frac{2e^2\langle a^2 \rangle}{3c^3},$$

,where e – charge of an electron, a – average acceleration of an electron, c – speed velocity.

$$a = \ddot{x} = -A\omega^2 \cos(\omega t).$$

$$\langle a^2 \rangle = \langle A^2\omega^4 \cos^2(\omega t) \rangle = \frac{A^2\omega^4}{2} \langle 1 + \cos(2\omega t) \rangle = \frac{A^2\omega^4}{2}$$

$$P = \frac{e^2 A^2 \omega^4}{3c^3} \rightarrow P \sim \omega^4.$$