## Lecture 13 :

**Radiation reaction :** While an accelerated charged particle radiates, as a consequence of this emission it loses kinetic energy at the same time. Radiation is thus exerts a recoil force on the particle.

**a) Abraham-Lorentz** formula for the radiation reaction force.

Power = P = $\boldsymbol{F} \cdot \boldsymbol{v}$ in general. Replacing the Larmor formula (with a minus sign in front because energy is beeing lost) and integrating over time one can obtain

radiation reaction force $\boldsymbol{F}_{rad} = \frac{\mu_0 q^2}{6\pi c} \dot{\boldsymbol{a}}$

**b) Runaway solutions**

Writing Newton's second law as $F_{rad}$ = ma, this immediately gives exponentially increasing solutions :

$a(t) = a_0 e^{t/\tau}$ where $\tau = \frac{\mu_0 q^2}{6\pi mc}$ . For an electron $\tau \approx 10^{-24}$ $s$ !

**c) Physical basis of the radiation reaction**

Radiation reaction is due to force exerted by the fields generated by different parts of the charge distribution; so it is a self force. See the textbook D.Griffiths Int. to Electrodynamics. See also "F. Rohrlich, The self-force and radiation reaction, American Journal of Physics 68, 1109 (2000); "Jacques D. Templin, An approximate method for the direct alculation of radiation reaction**,** American Journal of Physics 66, 403 (1998); Abraham–Lorentz versus Landau–Lifshitz, David J. Griffiths, Thomas C. Proctor, and Darrell F. Schroeter American Journal of Physics 78, 391 (2010

Homework :

Solve the following problems from the textbook D.Griffiths' "Int. to Electrodynamics"

Solve Problem 11.22

Solve Problem11.29

Solve Problem 11.31