Lecture 12 : **Radiation in dielectric medium :**

Bremsstrahlung : When a high speed charged particle hits a metal target it decelerates rapidly and therefore radiates. In this case the velocity and acceleration of the particle are in opposite directions but the formulas obtained before apply because the radiation power depends on the square of the acceleration. Angular dependence of the power turns out to be :

$$\frac{dP}{d\Omega}=\frac{\mu_0 q^2 a^2}{16\pi^2 c}\frac{\sin^2\theta}{(1-\beta\cos\theta)^5}$$

and total power radiated can be obtained by integration over the solid angles :

$$P=\frac{\mu_0 q^2 a^2 \gamma^6}{6\pi c}$$

Cherenkov radiation : A charged particle moving at a speed greater than phase velocity c/n through a medium with index of refraction n emits a characteristic blue light called Cherenkov radiaition. Using the Liénard-Wiechert retarded potantials we can obtain the frequency dependence of the Cherenkov radiation : energy per frequency per unit path length becomes

$$\frac{d^2E_{rad}}{d\omega dl}=\frac{\mu q^2}{4\pi}(1-\frac{c^2}{v^2n^2(\omega)})\omega$$

On the path of the charged particle spherical waves are emitted at retarded times (namely at previous positions) of the particle and propagete outward at speed c/n; wavefronts lie inside a Mach cone similar to the case of the supersonic flights.

Homework Problem 1 :

a) Obtain the expressions for the electric and magnetic fields in Cherenkov effect.
b) Derive the expression for the Cherenkov angle simply by using geometric arguments.
c) Discuss the correction needed for the above angle due to the recoil effects.

Homework Problem 2 :

Discuss the possible uses of the Cherenkov effect in particle and nuclear detectors.