UiO : Fysisk institutt
Det matematisk-naturvitenskapelige fakultet

Lecture 28

This week

- **Wednesday:** Potentials from point charges and charge/current distributions. Radiation fields. (Sections 12.2 and 12.3)
- **Thursday:** We look at last years exam! (Old exams are starting to appear on the web-page.)
- **Friday:** Electric dipole radiation. Larmor's radiation formula. (Sections 12.4 and 12.5) Hopefully last lecture with new content.
- **Next week:** lecture only on Friday. Thursday devoted to the exam from 2015.

Recap

- The scalar and vector potential for time-dependent sources is

$$\phi(\vec{r},t) = \frac{1}{4\pi\epsilon_0}\int \frac{\rho(\vec{r},t_-)}{|\vec{r}-\vec{r}\,'|}\, d^3\vec{r}\,'$$

$$\vec{A}(\vec{r},t) = \frac{\mu_0}{4\pi}\int \frac{\vec{j}(\vec{r},t_-)}{|\vec{r}-\vec{r}\,'|}\, d^3\vec{r}\,'$$

where the time for the source is the **retarded time**

$$t_- = t - |\vec{r}-\vec{r}\,'|/c$$

Today

- Scalar & vector potential from a point charge
  - Lienard – Wiechart potentials.
- Scalar & vector potential from a general charge or current distribution
  - Approximation of being far away from the source.
  - Magnetic and electric fields far away – radiation fields.

Summary

- The scalar & vector potential of a point source is

$$\phi(\vec{r},t) = \frac{q}{4\pi\epsilon_0}\left(\frac{1}{R-\vec{\beta}\cdot\vec{R}}\right)_{\text{ret}}, \quad \vec{A}(\vec{r},t) = \frac{\mu_0 q c}{4\pi}\left(\frac{\vec{\beta}}{R-\vec{\beta}\cdot\vec{R}}\right)_{\text{ret}}$$

- The scalar & vector potential for a general charge and current distribution is

$$\phi(\vec{r},t) = \frac{Q}{4\pi\epsilon_0 r} + \frac{\vec{r}\cdot\dot{\vec{p}}_{\text{ret}}}{4\pi\epsilon_0 r^2 c} + \ldots$$

$$\vec{A}(\vec{r},t) = \frac{\mu_0}{4\pi r}\left(\dot{\vec{p}} + \frac{1}{c}\dot{\vec{m}}\times\hat{n} + \frac{1}{2c}\ddot{\vec{D}}_{\hat{n}} + \ldots\right)_{\text{ret}}$$