UiO : Fysisk institutt
Det matematisk-naturvitenskapelige fakultet

Lecture 21

Recap

- Maxwell's equations (differential form):

i) $\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\epsilon_0}$

ii) $\vec{\nabla} \times \vec{B} - \frac{1}{c^2} \frac{\partial \vec{E}}{\partial t} = \mu \vec{j}$

iii) $\vec{\nabla} \cdot \vec{B} = 0$

iv) $\vec{\nabla} \times \vec{E} + \frac{\partial \vec{B}}{\partial t} = 0$

Today

- Maxwell's equations in terms of electromagnetic potential
  - Reduces problem to two equations
- Gauge choices for the potential
  - Coulomb gauge
  - Lorentz gauge
- Maxwell's equations on covariant form
  - Reduction to just one equation.

Mid-term evaluation

- Please take five minutes and try to respond to the following points (in English or Norwegian):
  - How do you feel about the level of the lectures: too fast and confusing, or too detailed and boring?
  - Are there particular topics where you have trouble understanding the math, or relating to the math/physics you've learned in other courses?
  - How well did the lectures and problem sets prepare you for the mid-term exam?
  - Did you notice the gorilla?
  - Any other comments or suggestions for the course.

Summary

- We can write Maxwell's equations on covariant form as

$$\partial_\mu F^{\mu\nu} = \mu_0 j^\nu$$

where

$$F^{\mu\nu} = \partial^\mu A^\nu - \partial^\nu A^\mu$$

is the **electromagnetic field strength tensor**,

$$j^\nu = (c\rho, \vec{j})$$

is the **four-vector current density**, and

$$A^\mu = (\frac{1}{c}\phi, \vec{A})$$

is the **four-potential**.