4/17/13 Lecture outline

⋆ Reading: Zwiebach chapters 2 and 3

• The electric and magnetic fields themselves have a lagrangian, with action

$$S = \int d^4x \mathcal{L}, \qquad \mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + \frac{1}{c} A_\mu j^\mu.$$

The two Maxwell's equations expressing absence of magnetic monopoles are, again, solved by setting $F_{\mu\nu} = \partial_{[\mu} A_{\nu]}$. The other two Maxwell's equations then come from the Euler -Lagrange equations of the above action upon varying $A_\mu \to A_\mu + \delta A_\mu$: the action is stationary when

$$\partial_\nu \frac{\partial \mathcal{L}}{\partial(\partial_\nu A_\mu)} - \frac{\partial \mathcal{L}}{\partial A_\mu} = 0.$$