

1. Consider the gauge U(1) theory with the Lagrangian density of the electromagnetic field

$$\mathcal{L}_e(x) = E_k \dot{A}_k - \frac{1}{2} [(E_k)^2 + (B_k)^2] + A_0 \partial_k E_k.$$

For the primary constraint  $\partial_k E_k(x) = 0$ , choose as subsidiary (gauge fixing constraint) the following nonlinear expression:

$$\partial_k A_k(x) - b A_k(x) A_k(x) = 0.$$

- i) Find the determinant of the primary and subsidiary constraints.
- ii) Write the path integral in the covariant gauge

$$\partial^\mu A_\mu(x) - b A^\mu(x) A_\mu(x) = 0.$$

Are there any ghosts appearing? What is their Lagrangian?

2. Consider the Yang-Mills theory in axial gauge

$$n^\mu A_\mu^a(x) = 0,$$

where  $n_\mu$  is a unit four-vector. Find  $\Delta_{axial}(A_\mu^a(x))$ . Are there any ghosts in the axial gauge?

Please return the solutions into the box on the second floor of the Physicum building by Monday 2 May, 10 o'clock.

**NOTE! Also the homework set 11 should be returned by 2 May. No homework session on 18 April.**

The exam will be on Monday 9 May, at 12:00, in the room D116.