Theories of particle physics Fall 1998, Exercise 7

1. Derive eqs. (4.2.24–28) of Chaichian and Nelipa in detail.

2. Derive eq. (4.2.33) of Chaichian and Nelipa in detail.

3. As in lectures, show that for the Lorentz gauge $\partial_\mu A^\mu = 0$ one has $\Delta_L(A) = \det M_L$. What is $\Delta(A)$ for the axial gauge $n_\mu A^\mu = 0$?
   Hint: In addition to the lectures see the literature (e.g. Bailin and Love section 10.4).

4. The polarization vectors $\epsilon_\mu^{(\lambda)}(k)$, $(\lambda = 1, 2, 3)$ of a vector field with mass M satisfy

$$\epsilon_\mu^{(\lambda)}(k) k^\mu = 0$$
$$\epsilon_\mu^{(\lambda)}(k) \epsilon^{\mu(\lambda')}(k) = -\delta^{\lambda\lambda'}.$$

   Show that

$$\sum_\lambda \epsilon_\mu^{(\lambda)}(k) \epsilon_\nu^{(\lambda)}(k) = -\left(g_{\mu\nu} - \frac{k_\mu k_\nu}{M^2} \right).$$

   What is the respective relation for massless photon field?
   Hint: See e.g. Itzykson-Zuber, Halzen-Martin, ...

Return the solved problems to the downstairs box in Laurikainen building on Monday November 2nd at 12 o'clock at latest. There are two problems solving sessions: Tuesdays 16-18 in the Exercise room (harjoitussali) in the basement of the Laurikainen bldg [English] and Fridays 10-12 in Hall 5, Tallqvist bldg [Finnish].
The www-page of this course is: http://www.physics.helsinki.fi/%7Epuolamak/hitu/