

Quantum Field Theory I

Problem Set 9

Due: 5 December 2007

1. S, Problem 61.1. (The notation of this problem is that \tilde{e} is a charged scalar particle. In supersymmetric theories there are opposite statistics partners for every particle, so \tilde{e} is the bosonic partner of the electron, the selectron).
2. a) Calculate the linear response of the vacuum of a charged massive scalar field to a weak external electromagnetic field. As in the case of the Dirac field, you will have to make a polynomial adjustment to the result to guarantee gauge invariance.
 - b) Obtain expressions for $\epsilon(k^2)$ and $\mu(k^2)$ for the “medium” corresponding to this vacuum.
 - c) Discuss charge renormalization in this case.
 - d) Combining the results of this problem with our results for the Dirac field, display the answers to parts a), b), and c) for a system of N_f Dirac fields and N_b scalar fields.
3. S, Problem 62.3.
4. S, Problem 67.2