Quantum Field Theory I

Instructor: Shehu AbdusSalam

Shahid Beheshti University

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Problem Set 1

Please answer the following questions and provide us by the end of the class on Esfand 15.

1. Show below equation of motion is related to a "massless" vector field.

$$\Box \chi_i = 0. \tag{1}$$

   In other words, you must show, $p^2 = 0$.

2. Show that $\omega_p \delta^3(\vec{p} - \vec{k})$ is lorentz invariance. For this reason, coefficient $\frac{1}{\sqrt{2\omega_p}}$ has been placed in equation 2.70 of [Sch14]. In this way, the expression $\left\langle \vec{p} \middle| \vec{k} \right\rangle$ will be Lorentz invariant.

3. Please asnwer to problem 2.6 of [Sch14].

4. Proof equation 2.87 of [Sch14].

5. First obtain equation 2.91 of [Sch14], then show equation 2.93.

6. (Bonus) Why commutators instead of anticommutators have been used to express the second quantization?

References

[Sch14] Matthew Dean Schwartz. *Quantum field theory and the standard model*. Cambridge University Press, New York, 2014.