

8.325 Homework 7

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Due: Thur. May 15.

Problem 1) Some algebra used to study θ -vacua and instantons

a) Let $\tilde{G}^{\mu\nu} = \epsilon^{\mu\nu\alpha\beta} G_{\alpha\beta}$ and

$$K^\mu = 2\epsilon^{\mu\alpha\beta\gamma} \text{Tr} \left[G_{\alpha\beta} A_\gamma + \frac{2i}{3} A_\alpha A_\beta A_\gamma \right] \quad (1)$$

and show that $\partial_\mu K^\mu = \text{Tr}[G_{\mu\nu} \tilde{G}^{\mu\nu}]$. Feel free to use the Bianchi identity, $D_\mu \tilde{G}^{\mu\nu} = 0$, without proof.

b) Show that the instanton

$$A_\mu = \frac{r^2}{r^2 + \rho^2} (-i) g^\dagger \partial_\mu g, \quad g = \frac{x_4 + i\vec{x} \cdot \vec{\sigma}}{r} \quad (2)$$

where $r^2 = x_4^2 + \vec{x}^2$ satisfies the Euclidean field equations $D_\mu G^{\mu\nu} = 0$.

Problem 2) Scalar production, $e^+e^- \rightarrow q\bar{q}S$

Peskin & Schroeder, page 596, Problem 17.2, part a).

Problem 3) Parton distributions and deep inelastic scattering.

Peskin & Schroeder, page 648, Problem 18.2 parts a), b), c), d), and e). [Except in e), you do not need to find the result for W_{3fL} . And note that I'm not asking you to do part f).]