# Physics 5970. Homework 10

Due Friday, May 13, at 5pm

1. Compute the one-loop gluon propagator correction due to two gluon and two ghost intermediate states, and show that you get the following divergent contribution to the vacuum polarization operator:

$$i\Pi^{ab}_{\alpha\beta} = -i\delta^{ab}\frac{g^2}{8\pi^2}C_2(\mathbf{8})\frac{5}{3}\left(\frac{q^2}{\mu^2}\right)^{-\epsilon/2}\frac{1}{\epsilon}(q_\alpha q_\beta - q^2 g_{\alpha\beta}).$$

2. Compute the two graphs contributing to the one-loop quark-gluon vertex correction, and obtain the following result for $Z_1$:

$$Z_1 = 1 - \frac{g^2}{8\pi^2}[C_2(\mathbf{3}) + C_2(\mathbf{8})]\left(\frac{\mu}{\mu_R}\right)^\epsilon\frac{1}{\epsilon}.$$

3. Compute the one loop correction to the quark propagator, and find

$$Z_2 = 1 - \frac{g^2}{8\pi^2}C_2(\mathbf{3})\left(\frac{\mu}{\mu_R}\right)^\epsilon\frac{1}{\epsilon}.$$