Non-perturbative aspects of gauge theories
Exercise sheet 9 – Slavnov-Taylor Identities

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Exercise 17: Modified Slavnov-Taylor Identity of the longitudinal gluon two-point function

In this exercise you are deriving the (modified) Slavnov-Taylor Identity (STI/mSTI) for the longitudinal gluon dressing

$$p^2 Z_A^{\parallel}(p)\,.$$

All details that are necessary in order to solve the exercise can be found in Section 5.7 in the lecture notes.

a) Start by taking a $\frac{\delta^2}{\delta A_\mu(x)\delta c(y)}$ derivative of the Quantum Master Equation (without regularization) and derive a relation for the longitudinal gluon two-point function $\Gamma_{AA}^{\parallel,(2)}$, its Slavnov-Taylor Identity.

b) Consider the modification of the STI arising from the cutoff term and derive the modified Slavnov-Taylor identity (mSTI).

c) Derive the one loop expression for the longitudinal mass function

$$(m_A^{\parallel})^2 = \lim_{p\to 0} p^2 Z_A^{\parallel}(p)\,.$$