Faddeev-Popov ghosts

$$Z[A^a_\mu] = \int \mathcal{D}A^a_\mu \, e^{-S[A^a_\mu]}$$

* <u>Gauge transf.</u>: $A^{a\prime}_\mu = A^a_\mu + \frac{1}{g}\partial_\mu \Lambda^a + f^a{}_{bc} A^b_\mu \Lambda^c = A^a_\mu + \frac{1}{g} D_\mu \Lambda^a$
* <u>Gauge slice</u>: $\partial^\mu A_\mu = 0$

  $\hookrightarrow$ define: $G[A^a_\mu] = \partial^\mu A^a_\mu(x) + \omega^a(x)$

* $1 = \int \mathcal{D}\Lambda^a \, \delta(G[A^a_\mu]) \det\left(\frac{\delta G[A^a_\mu]}{\delta \Lambda^b}\right)$

<u>Gauge fixing</u>:

$$Z[A^a_\mu] = \int \mathcal{D}A^a_\mu \, \mathcal{D}\Lambda^b \, \delta(G[A^{a\prime}_\mu]) \det\left(\frac{\delta G[A^{a\prime}_\mu]}{\delta \Lambda^b}\right) e^{-S[A^a_\mu]} =$$

$$= \int \mathcal{D}A^{a\prime}_\mu \, \mathcal{D}\Lambda^b \, \delta(G[A^{a\prime}_\mu]) \det\left(\frac{\delta G[A^{a\prime}_\mu]}{\delta \Lambda^b}\right) e^{-S[A^{a\prime}_\mu]}.$$

$$S[A^a_\mu] = S[A^{a\prime}_\mu] \qquad \int \mathcal{D}A^a_\mu = \int \mathcal{D}A^{a\prime}_\mu$$

$$\frac{\delta\left(\partial^\mu A^a_\mu + \frac{1}{g}\partial^\mu D_\mu \Lambda^a\right)}{\delta \Lambda^b} = \frac{1}{g}\partial^\mu D_\mu$$

$$Z[A^a_\mu] = \int \mathcal{D}\Lambda^b \int \mathcal{D}A^a_\mu \, \delta(\partial^\mu A^a_\mu + \omega^a) \int \mathcal{D}c \, \mathcal{D}\bar{c} \, e^{\frac{i}{g}\int d^4x \, \bar{c} \, \partial^\mu D_\mu c} \, e^{-S[A^a_\mu]} =$$

$$= \mathcal{N}(\xi) \cdot \mathrm{Vol}(SU(N)) \int \mathcal{D}A^a_\mu \, \mathcal{D}c^b \mathcal{D}\bar{c}^c \mathcal{D}\omega^d \, e^{-\int d^4x \frac{1}{2\xi}\omega^d \omega_d} \, e^{-S[A^a_\mu] + \frac{i}{g}\int d^4x \, \bar{c}^b \partial^\mu (D_\mu)_{bc} c^c} \, \delta(\partial^\mu A^a_\mu + \omega^a)$$

$$= K(N,\xi) \int \mathcal{D}A^a_\mu \, \mathcal{D}c \, \mathcal{D}\bar{c} \, e^{-\int d^4x \left\{ -\frac{1}{4} F^a_{\mu\nu} F^{\mu\nu}_a + \frac{1}{2\xi} \partial^\mu A^a_\mu \cdot \partial^\nu A_{\nu,a} - \frac{i}{g} \bar{c}^b \partial^\mu (D_\mu)_{bc} c^c \right\}}$$

The ∞ factor $K(N,\xi)$ drops out in n-point correlator functions.