Test PDF

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Fixing the gauge breaks gauge invariance on the total Lagrangian, but a new symmetry has emerged: the **BRST symmetry**. The gauge fixing term is:

$$\mathcal{L}_{g.f.} = e^{-\frac{i}{2\xi}\int f_\alpha^2(x)} = \int \mathcal{D}N e^{\frac{i\xi}{2}N\circ N - if\circ N}$$

where f_α is the gauge fixing term (e.g. for Lorentz gauge, $f_\alpha = \partial_\mu A^\mu_\alpha$), and $f \circ g = \int d^4x\, f(x)g(x)$.

The total Lagrangian becomes: $\mathcal{L}_{tot} = \mathcal{L} + \mathcal{L}_{Ghosts} + \underbrace{\frac{\xi}{2}N^2(x) - f_\alpha N^\alpha}_{\mathcal{L}_{in}}$

This density is invariant under the transformation: $\delta A = \theta Dc = \theta(dc - i[A, c]), \quad \theta$ is a Grassmann variable.
And the transformation for (ϕ): $\delta\phi = \theta i\pi(c)\phi$
where $\pi(c)$ puts (c) in the appropriate representation for (ϕ).

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$$\binom{2}{3}\mathbb{C}$$

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