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Pauli-Villars regularization of non-Abelian gauge theories

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As an extension of earlier work on QED, we construct a BRST-invariant Lagrangian for $SU(N)$ Yang-Mills theory, regulated by the inclusion of massive Pauli-Villars (PV) gluons. The underlying gauge symmetry for massless PV gluons is generalized to accommodate the PV-index-changing currents that are required by the regularization. Auxiliary adjoint scalars are used, in a mechanism due to Stueckelberg, to attribute mass to the PV gluons. The addition of Faddeev-Popov ghosts then establishes a residual BRST symmetry. Further extension to QCD is also considered. Although there are drawbacks to the approach, in particular the computational load of a large number of PV fields and a nonlocal interaction of the ghost fields, this formulation could provide a foundation for renormalizable nonperturbative solutions of light-front QCD in an arbitrary covariant gauge.

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