What’s up with IR gluon and ghost propagators in Landau gauge? An answer from huge lattices

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Several analytic approaches predict for SU($N_c$) Yang-Mills theories an enhanced ghost propagator $G(p^2)$ and a suppressed gluon propagator $D(p^2)$ at small momenta in Landau gauge. This prediction applies to two, three and four space-time dimensions. Moreover, the gluon propagator is predicted to be null at $p = 0$. Numerical studies by several groups indeed support an enhanced ghost propagator when compared to the tree-level behavior $1/p^2$ and a finite infrared gluon propagator. However, the agreement between analytic and numerical studies is only at the qualitative level in three and in four dimensions. In particular, the infrared exponent of the ghost propagator seems to be smaller than the one predicted analytically and the gluon propagator seems to display a (finite) nonzero value at zero momentum. It has been argued that this discrepancy might go away once simulations are done on much larger lattice sizes than the ones used up to now. Here we present data in three and four space-time dimensions using huge lattices, i.e. up to $320^3$ at $\beta = 3.0$ and up to $128^4$ at $\beta = 2.2$, corresponding to $V \approx (85$ fm$)^3$ and $V \approx (27$ fm$)^4$. 