Steinhauser, Marc; Sternbeck, André; Wellegehausen, Björn; Wipf, Andreas
$\mathcal{N} = 1$ super-Yang-Mills theory on the lattice with twisted mass fermions. (English)
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Summary: Super-Yang-Mills theory (SYM) is a central building block for supersymmetric extensions of the Standard Model of particle physics. Whereas the weakly coupled subsector of the latter can be treated within a perturbative setting, the strongly coupled subsector must be dealt with a non-perturbative approach. Such an approach is provided by the lattice formulation. Unfortunately a lattice regularization breaks supersymmetry and consequently the mass degeneracy within a supermultiplet. In this article we investigate the properties of $\mathcal{N} = 1$ supersymmetric SU(3) Yang-Mills theory with a lattice Wilson Dirac operator with an additional parity mass, similar as in twisted mass lattice QCD. We show that a special 45° twist effectively removes the mass splitting of the chiral partners. Thus, at finite lattice spacing both chiral and supersymmetry are enhanced resulting in an improved continuum extrapolation. Furthermore, we show that for the non-interacting theory at 45° twist discretization errors of order $O(a)$ are suppressed, suggesting that the same happens for the interacting theory as well. As an aside, we demonstrate that the DD $\alpha$ AMG multigrid algorithm accelerates the inversion of the Wilson Dirac operator considerably. On a $16^3 \times 32$ lattice, speed-up factors of up to 20 are reached if commonly used algorithms are replaced by the DD $\alpha$ AMG.

MSC:
81T60 Supersymmetric field theories in quantum mechanics
81V74 Fermionic systems in quantum theory
83C27 Lattice gravity, Regge calculus and other discrete methods in general relativity and gravitational theory
70S15 Yang-Mills and other gauge theories in mechanics of particles and systems

Keywords:
lattice QCD; lattice quantum field theory; supersymmetric gauge theory

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