

Superspace Formulation of $N = 4$ Twisted Super Yang-Mills Theory with a Central Charge

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As is discussed in some recent works on SUSY on a lattice, twisted SUSY plays an important role for the formulations of lattice SUSY [1]. In such formulations, it is crucial, from technical reasons, to develop especially an off-shell theory of $N = 4$ twisted SUSY in four dimensions, which has not been constructed so far. Motivated by these facts, we construct in this work off-shell $N = 4$ Dirac-Kähler twisted SYM action on a central charge superspace in four dimensions which can be interpreted as a twisted variant of the action proposed long ago by Sohnius, Stelle and West [2].

The actual construction of the theory is based on the usual methods using superconnections and supercurvatures on a superspace, which is, though lengthy, merely an elementary algebra, so that the off-shell closure of the superalgebra and the associated gauge covariance are manifestly and automatically assured once we set an appropriate constraints on the supercurvatures. The action can also be constructed on the superspace as supertransformations of some quantities. Although this construction is somewhat different from those of the usual, say 4D $N = 2$ SYM, actions, we can show that the action obtained here preserves manifestly all of sixteen supercharges as well as the central charge of the 4D $N = 4$ SUSY off-shell, which is one of the most remarkable features of the action.

The action should be considered to be topological, as is often the case for those with twisted SUSY. In fact, we can show the topological features using the manifest twisted supercharge-exactness w.r.t. the scalar and pseudo scalar supercharges of the action and of the energy-momentum tensor computed from the action. In the context of introducing the theory on a lattice the scalar and the pseudo scalar supercharge-exactness of the action might also play a key role to analyze the quantum effects on the lattice beyond the classical theory.

The work to be followed should be on a further analysis of the model, especially, in the context of lattice SUSY, and the relation to the other supersymmetric models, among them the usual $N = 4$ SYM without central charge in particular. These are all the topics for the work in progress.

References

- [1] A. D’Adda, I. Kanamori, N. Kawamoto and K. Nagata, hep-lat/0507029; Nucl. Phys. **B707** (2005), 100, hep-lat/0406029.
- [2] M. F. Sohnius, K. S. Stelle and P. C. West, Phys. Lett. **92B** (1980), 123; Nucl. Phys. **B173** (1980), 127.