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Superconformal transformations of the $N = 2$, $D = 4$, SSYM

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Abstract. We obtain the superconformal transformation laws for the $N = 2$, $D = 4$ SSYM. The transformations involve Yang-Mills fields and the corresponding field strength tensor is not constrained to be self antidual. We explicitly demonstrate the closure of the superconformal algebra.

Keywords. Extended supersymmetry; superconformal symmetry.

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Supersymmetric theories have an important property that some of the perturbative ultraviolet divergences due to bosons and fermions cancel each other. Extended supersymmetric theories have more than one supersymmetry. Such theories have even better ultraviolet behaviour than $N = 1$ SUSY (supersymmetric) theory. For example, the SSYM (supersymmetric Yang-Mills theory) with two generators ($N = 2$) of SUSY is believed to be finite beyond one loop, (Grisaru and Siegel 1982 and Howe *et al* 1983) and $N = 4$ SSYM is believed to be finite to all orders in perturbation (Mandelstam 1983; Howe *et al* 1983; Brink *et al* 1983; Salam *et al* 1983). Classical SSYM theories are conformally invariant and hence are also superconformally invariant. The $N = 2$ superconformal algebra is known (Sohnius 1985), a representation of which was found by Dondi and Sohnius (1974). However, that representation involved only self anti-dual, antisymmetric tensor field, and no Yang-Mills gauge fields. In the following we obtain a representation of the $N = 2$ superconformal algebra which involves Yang-Mills fields and the corresponding field strength tensor is not restricted to be self anti-dual.

The $N = 2$ superconformal algebra in $3 + 1$ dimensions contains fifteen generators of the usual conformal group corresponding to four translations P_μ, six rotations $M_{\mu\nu}$, one dilatation D, and four conformal boosts K_μ. In addition there are four four-component Majorana fermionic generators (Sohnius 1985), or equivalently four two-component Weyl fermions and their hermitian conjugates. These are SUSY generators $Q_{i\alpha}$ and $\bar{Q}_i^{\dot\alpha}$; and superconformal generators $S_{i\alpha}$ and $\bar{S}_i^{\dot\alpha}$ with $i = 1, 2$—and, the Weyl spinor indices are α and $\dot\alpha$. In this Weyl representation $Q_{i\alpha}$'s can be rotated into each other under global SU(2) transformations. The generators of this SU(2) will be represented by traceless part of B_i^j. Further, the algebra also involves the chiral charge R, which is represented by 2 (trace B_i^j). In four-component notation these charges can be combined into a Dirac SUSY charge and a Dirac superconformal charge,

$$Q = \begin{pmatrix} Q_{1\alpha} \\ i\bar{Q}^{2\dot\alpha} \end{pmatrix} \quad \text{and} \quad S = \begin{pmatrix} iS_\alpha^2 \\ \bar{S}_1^{\dot\alpha} \end{pmatrix}. \tag{1}$$