Commun. Math. Phys. 128, 191–196 (1990)

Communications in
Mathematical
Physics

$N=2$ Super Yang-Mills Theory in Projective Superspace

U. Lindström* and M. Roček**

Institute for Theoretical Physics, State University of New York, Stony Brook, NY 11794-3840, USA

Abstract. We construct $N=2$ Yang-Mills theory in projective superspace by exploiting the analogy to Ward's twistor construction of self-dual Yang-Mills fields.

In a series of papers [1, 2] we have developed a formalism for describing $N=2$, $d=4$ (or equivalently, $N=1$, $d=6$ or $N=4$, $d=2$) supersymmetry, useful for studying scalar multiplets off shell. This *projective* superspace adjoins to the usual $N=2$ superspace a complex coordinate, which can be viewed as a coordinate on $CP(1)$, and parametrizes the $N=1$ subspaces of $N=2$ superspace (see below). This development largely parallels that of harmonic superspace [3, 4] which instead of using a projective coordinate on $CP(1)$ uses spinor harmonic analysis on S^2. Though the two approaches are presumably essentially equivalent, the projective approach is concerned with analytic properties on the Riemann sphere, while the harmonic approach focuses on group theoretical properties under $SU(2)$ (acting on S^2). We have concentrated entirely on classical properties of various scalar multiplets and non-linear σ-models, whereas the harmonic superspace methods have also been applied to super Yang-Mills and supergravity systems, as well as quantum calculations [4]. Recently a harmonic approach to self-dual Yang-Mills theory, based on the harmonic superspace formulation of $N=2$ super Yang-Mills theory, has been proposed [5]. This article also discusses the relation to Ward's construction of self-dual Yang-Mills fields [6, 7]. Here we give a projective superspace description of $N=2$ supersymmetric Yang-Mills theory which is completely analogous to Ward's twistor construction of self-dual Yang-Mills. We find our approach simpler and more direct than that of [4], but we have not carried our program as far, since we have not found the unconstrained prepotential for the Yang-Mills field.

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* Permanent address: ITP, University of Stockholm, Vanadisvägen 9, S-11346 Stockholm, Sweden

** Work supported in part by NSF grant No. PHY 85-07627