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Consequences of the Complex Character of the Internal Symmetry in Supersymmetric Theories*

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Abstract. The consequences of the invariance of the superpotential under the complexification G^c of the internal symmetry group on the determination of the possible patterns of symmetry and supersymmetry breaking are established in a globally supersymmetric theory. In particular, in the case of global internal symmetry we show that a vacuum associaated to a point z, where $G_z{}^c \neq G^c{}_z$ is always degenerate with a vacuum associated to a point z', where $G^c{}_{z'} = G_{z'}{}^c$; all the other degeneracies of the minimum of the potential on an orbit of G^c are also determined and shown to be completely removed when the internal symmetry is gauged. The zeroes of the D-term of a supersymmetric gauge theory are characterized as the points of the closed orbits of G^c which are at minimum distance from the origin; at these points $G^c{}_z = G_z{}^c$. It is rigorously proved that the minimum of the potential is zero if the gradient of the superpotential vanishes somewhere. It is also shown that the D-term necessarily vanishes at the minimum of the potential if the direction of spontaneous supersymmetry breaking is invariant by G.

Introduction

Rigid supersymmetric theories, exhibiting additional global or local internal symmetries, have been the object of considerable interest lately [1]. The interest has survived the advent of local supersymmetry, as it is reasonable to believe that the breaking of supergravity takes place at very high scale such that the effective low energy theory is indeed a rigid supersymmetry, spontaneously broken or broken by explicit soft terms.

The possible patterns of supersymmetry and/or internal symmetry breaking are contained in the form of the superpotential of a supersymmetric theory. It has been remarked by many authors [2] that the complexification G^c of the compact internal symmetry group G may play an important role in this context,

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