High Energy Physics - Theory

N = 4 mechanics of general (4, 4, 0) multiplets

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We construct the manifestly N=4 supersymmetric off-shell superfield "master" action for any number n of the N=4 supermultiplets (4, 4, 0) described by harmonic analytic superfields q^{+a}(\zeta, u), a= 1, ... 2n, subjected to the most general harmonic constraints. The action consists of the sigma-model and Wess-Zumino parts. We present the general expressions for the target space metric, torsion and background gauge fields. The generic target space geometry is shown to be weak HKT (hyper-K\"ahler with torsion), with the strong HKT and HK ones as particular cases. The background gauge fields obey the self-duality condition. Our formulation suggests that the weak HKT geometry is fully specified by the two primary potentials: an unconstrained scalar potential {\cal L}(q^+, q^-, u) |_{\theta = 0} which is the \theta = 0 projection of the superfield sigma-model Lagrangian, and a charge 3 harmonic analytic potential {\cal L}^{+ 3a}(q^+, u)|_{\theta = 0} coming from the harmonic constraint on q^{+ a}. The reductions to the strong HKT and HK geometries amount to simple restrictions on the underlying potentials. We also show, using the N=2 superfield approach, that the most general bosonic target geometry of the N=4, d=1 sigma models, of which the weak HKT geometry is a particular case, naturally comes out after adding the mirror (4, 4, 0) multiplets with different transformation laws under N=4 supersymmetry and SO(4) R symmetry. Thus the minimal dimension of the target spaces exhibiting such a "weakest" geometry is 8, which corresponds to a pair of the mutually mirror (4, 4, 0) multiplets.

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