Physical Significances of Nonlinear and Linear Supersymmetry

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Abstract

Basic ideas and some particle astrophysical consequences of nonlinear supersymmetric general relativity (NLSUSY GR) are presented. NLSUSY GR action : $L_{\rm NLSUSYGR}(w) = \frac{c^4}{16\pi G}|w|\{\Omega(w) - \Lambda\}$, $w^a{}_\mu = e^a{}_\mu + t^a{}_\mu(\psi)$, $t^a{}_\mu(\psi) = \frac{\kappa^2}{2i}(\bar{\psi}^i\gamma^a\partial_\mu\psi^i - \partial_\mu\bar{\psi}^i\gamma^a\psi^i)$, $|w| = \det w^a{}_\mu$, is obtained by performing the ordinary Einstein's geometric arguments on *four dimensional, unstable and empty spacetime* whose tangent space is specified by Minkowski coordinates x_a for $SO(1,3)$ *and* Grassmann coordinates ψ_α for holomorphic $SL(2,C)$ of NLSUSY recasted subsequently as Nambu-Goldstone fermions for spontaneous breakdown of (space-time) SUSY. Due to the (unstable) NLSUSY $L_{\rm NLSUSYGR}(w)$ decays spontaneously to ordinary Riemann space-time($e^a{}_\mu$) and NG fermion matter(ψ), i.e. $L_{\rm NLSUSYGR}(w) = L_{\rm SGM}(e,\psi)$. We show explicitly that the vacuum of NLSUSY $L_{\rm SGM}(e,\psi)$ theory in asymptotic flat sace-time reproduces the familiar LSUSY model and that the vacuum structure of $L_{\rm SGM}(e,\psi)$ predicts the relations between the large scale structure of the universe and the tiny scale structure of the particle physics, e.g. the observed mysterious relation between the (dark) energy density and the dark matter of the universe and the neutrino mass and the SUSY breaking mass scale of the particle physics. NLSUSY GR gives new insight to unsolved problems of the particle physics, cosmology and their relations and describes a particular superfluidity of space-time and matter. We discuss these problems explicitly for $N = 2$ SUSY QED case.

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