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U(N) gauged $\mathcal{N} = 2$ supergravity and partial breaking of local $\mathcal{N} = 2$ supersymmetry

Supersymmetry has become the dominant framework of formulating physics beyond the standard model. Partial breaking of supersymmetry is interesting phenomenon which connect supersymmetric theories of a different kind. In particular, it is known that, in the $\mathcal{N} = 2$ U(N) gauge theory, $\mathcal{N} = 2$ supersymmetry can be broken to $\mathcal{N} = 1$ spontaneously. Therefore we have expected that in supergravity theory $\mathcal{N} = 2$ supersymmetry can be broken partially as well.

Since supergravity includes the graviton field, it is non-renormalizable theory. Therefore we have to think supergravity as the low energy effective theory of some high energy theory. However, it have not known that, in the effective supergravity theory, $\mathcal{N} = 2$ supersymmetry can be broken to $\mathcal{N} = 1$. So, we have shown it.

We have considered the low energy effective U(N) gauged $\mathcal{N} = 2$ supergravity model. The theory with $\mathcal{N} = 2$ supersymmetry is governed by the prepotential, the holomorphic function of the scalar fields. Here we have chosen the prepotential as single trace function. In the following, we summarize the main results.

- We have obtained the vacuum expectation value of the scalar field, by extremizing the scalar potential. In this vacuum, we compute the masses of all the fields, and the field content become $\mathcal{N} = 1$ supersymmetric. Moreover, we have shown that a Numbu-Goldstone fermion appears by seeing the supersymmetric transformation lows.

- We have concluded that U(N) gauge symmetry breaks to SU(N) by the U(1) gauge boson mass.

- In the $\mathcal{N} = 1$ vacuum we have written down the Lagrangian in terms of the fluctuation of the scalar field.

- If we consider U(1) case, that is $N = 1$, we can use prepotential as arbitrarily function.

By the preceding result, we have concluded that, in the U(N) gauged $\mathcal{N} = 2$ supergravity model, $\mathcal{N} = 2$ supersymmetry can be broken to $\mathcal{N} = 1$ counterpart spontaneously.