Kazuhito Fujiwara

Results

Supersymmetry is one of the most attractive theoretical ideas not only for mathematical physics but also for phenomenological physics. In particular, $\mathcal{N}=1$ supersymmetry is closely related to our real world. For example, possibilities of restoring $\mathcal{N}=1$ supersymmetry attract much attention recently . It is important also to derive $\mathcal{N}=1$ information from extended supersymmetries in the light of string theory which requires supersymmetries for its consistency . For that purpose, we have to get $\mathcal{N}=1$ supersymmetry from spontaneous partial breaking of extended supersymmetries. Antoniadis-Partouche-Taylor (APT) constructed the $U(1)$ gauge model which breaks $\mathcal{N}=2$ supersymmetry to $\mathcal{N}=1$ spontaneously by the electric and magnetic Fayet-Iliopoulos (FI) terms . I studied the $U(N)$ generalization of the APT model in the following papers;

[1] K. Fujiwara, H. Itoyama and M. Sakaguchi, "Supersymmetric U(N) gauge model and partial breaking of N = 2 supersymmetry," Prog. Theor. Phys. **113** (2005) 429 .

We constructed the $\mathcal{N}=2$ $U(N)$ gauge model which is equipped by the FI D-term and the superpotential. At vacua, there is one Nambu-Goldstone fermion, which represents spontaneous breaking of supersymmetry.

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[2] K. Fujiwara, H. Itoyama and M. Sakaguchi, "Partial breaking of N = 2 supersymmetry and of gauge symmetry in the U(N) gauge model," Nucl. Phys. B **723** (2005) 33 .

We studied partial breaking of $\mathcal{N}=2$ supersymmetry and partial breaking of $U(N)$ gauge symmetry. Examining vacua of the model, we showed that the Nambu-Goldstone fermion exists in the overall $U(1)$ part of $U(N)$ and there are three types of multiplets, massless $\mathcal{N}=1$ vector multiplets, massive $\mathcal{N}=1$ chiral multiplets, and massive $\mathcal{N}=1$ vector multiplets.

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[3] K. Fujiwara, H. Itoyama and M. Sakaguchi, "Partial supersymmetry breaking and N = 2 U(N(c)) gauge model with hypermultiplets in harmonic superspace," Nucl. Phys. B **740** (2006) 58 .

We considered a manifestly $\mathcal{N}=2$ formulation of $U(N)$ gauge model [1,2] with/without $\mathcal{N}=2$ hypermultiplets in the harmonic superspace . We introduced the electric and magnetic FI terms guided by the shift of the auxiliary field in the $\mathcal{N}=2$ vector superfield . It overcomes the difficulty in coupling hypermultiplets to the APT model.

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[4] K. Fujiwara, "Partial breaking of N = 2 supersymmetry and decoupling limit of Nambu-Goldstone fermion in U(N) gauge model," Nucl. Phys. B **770** (2007) 145 .

I studied the decoupling limit of the Nambu-Goldstone fermion.Under the decoupling limit, the action becomes a classical $\mathcal{N}=2$ action. But there is non-trivial superpotential due to the electric and magnetic FI terms . Thus we can identify the origin of the fermionic shift symmetry with the second, spontaneously broken supersymmetry.