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I am interested in spontaneous partial breaking of $\mathcal{N}=2$ supersymmetry which is closely related to the gauge/string duality. It was conjectured by R. Dijkgraaf and C. Vafa that non-perturbative quantities in a low energy effective gauge theory can be computed by a bosonic matrix model. (Here the matrix model is one of the non-perturbative formulation of the string theory.) This conjecture was confirmed by F. Cachazo, M. R. Douglas, N. Seiberg and E. Witten for the case of an $\mathcal{N}=1$ $U(N)$ gauge theory with a chiral superfield Φ in the adjoint representation of $U(N)$. The $\mathcal{N}=1$ action is obtained from "soft" breaking of $\mathcal{N}=2$ supersymmetry by adding the tree-level superpotential $\int d^2\theta \mathrm{Tr} W(\Phi)$. The group $SU(N)$ is confined and there is a symmetry of shifting the $U(1)$ gaugino by an anticommuting c-number $\mathcal{W}_\alpha \to \mathcal{W}_\alpha - 4\pi\chi_\alpha$. It is called "fermionic shift symmetry". Thanks to this symmetry, effective superpotential is written as $W_{\mathrm{eff}} = \int d^2\chi \mathcal{F}$, for some function $\mathcal{F}$. The gauge/string duality implies that this function $\mathcal{F}$ is given by the free energy $F_{\mathrm{m.m.}}$ of the bosonic matrix model. The fermionic shift symmetry is related to a second, spontaneously broken supersymmetry . In fact, it is known that the fermionic shift symmetry arises from the decoupling limit of the Nambu-Goldstone fermion in the $U(N)$ gauge model with partial breaking of $\mathcal{N}=2$ supersymmetry.

I will study the relation between the $U(N)$ gauge model and the gauge/string duality. There is a geometric description of the the gauge/string duality. The deformed conifold and the resolved conifold connect the gauge theory side with the string theory side. I think that the $U(N)$ gauge model with spontaneous partial breaking of $\mathcal{N}=2$ supersymmetry represents the deformation of the conifold geometry. The deformation function f_{n-1} seems to be related with the third derivative of the prepotential in $\mathcal{N}=2$ lagrangian. In particular, I am interested in the partially broken $U(N)$ gauge case: $U(N) \to \prod_i U(N_i)$.

I will also study the relation between the $U(N)$ gauge model and the domain wall solutions. The supercurrent algebra of the $U(N)$ gauge model denote that the central charge agrees with the tension of the domain wall. I expect that we can reconstruct the $U(N)$ gauge model with the use of the domain wall solutions. The domain wall solutions will help us to figure out spontaneous partial breaking of $\mathcal{N}=2$ supersymmetry in graphical methods.