

今後の研究計画（英訳）

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One of the important insights in recent years in theoretical physics is the discovery of duality in super Yang-Mills theory and superstring theory. It is interesting that, by using duality, the non-perturbative effects of super Yang-Mills theory can be seen from the perturbative computation of superstring theory. The duality conjecture is checked in many contexts.

In the following, I concentrate on the suggestion by Dijkgraaf and Vafa that super Yang-Mills theory is dual to matrix model which is obtained from superstring theory by the dimensional reduction. They have said that the exact low energy effective superpotential of the $\mathcal{N} = 2$ $U(N)$ gauge theory, which *softly* broken to $\mathcal{N} = 1$ by adding the tree level superpotential, is obtained from the perturbative computation of the corresponding matrix model.

I propose to find new matrix model and new description of superstring theory which are dual to the gauge theory where $\mathcal{N} = 2$ supersymmetry is *spontaneously* broken to $\mathcal{N} = 1$. As first step, I consider the low energy effective theory of the gauge theory. The low energy effective superpotential is evaluated by integrating out the massive degree of freedoms as follows:

1. Compute the 1-loop and 2-loop Feynman diagram explicitly.
2. Solve Schwinger-Dyson equations.

By above computations, I can read off the new effect causing from the spontaneous breaking of supersymmetry.

As second step, I correct the matrix model such that it includes the above new effect. If we believe the existence of the dual matrix theory, I can find new matrix model. I expect that either the structure of the Riemann surface of the matrix model or the well-known formula of the geometrically induced superpotential will change. Furthermore, since matrix model is the dimensional reduction of superstring theory, I can find new configuration of superstring theory which is dual to the gauge theory with spontaneously broken $\mathcal{N} = 2$ supersymmetry.