Certain large N reduced models have been suggested as a constructive definition of superstring theory. One of the successful candidate is IIB matrix model, the dimensional reduction of 10-dimensional SYM to 0 dimension.

IIB matrix model has only flat Minkowskian spacetime as a classical solution and it cannot be used to study perturbation around curved backgrounds. It is thus important to find a way to describe curved background spacetimes in the context of large N reduced models, if they are to be an eligible framework to describe gravitational interactions. To this purpose, the bosonic part of IIB matrix model with a tachyonic mass term has been previously studied. This model possesses a non-commutative classical solution described by spacetime fields satisfying any arbitrary Lie algebra and thus it can be expanded around various curved spaces, such as a fuzzy sphere and a fuzzy torus.

In this work, we study the $osp(1|32, R)$ supermatrix model with a mass term, to investigate whether non-commutative classical solutions similar to the massive IIB matrix model arise or not. If one expands the bosonic part of an $osp(1|32, R)$ matrix with respect to 11-dimensional gamma matrices, all fields can be expressed by rank-1, 2 and 5 fields. Among these fields, the rank-1 and rank-5 fields have a positive mass term and have thus a trivial classical solution. Whereas, the rank-2 fields have a tachyonic mass-term and hence the trivial solution is unstable. This has led us to think that it might have instead an interesting stable non-commutative solution.

In a 10-dimensional reduction, the 2-form decomposes into a 2-form and a vector. Since a vector is susceptible to describe a 10-dimensional spacetime, we integrate out the 2-form to obtain an effective action for the vector field. The resulting effective action adds an infinite series of higher-order commutators to the bosonic part of the IIB matrix model with a tachyonic mass term. Looking at the ensuing equations of motion, we find that our massive supermatrix model indeed possesses non-trivial curved classical solutions. Specifically, we study the simple case of a solution satisfying an $SO(3) \times SO(3) \times SO(3)$ Lie algebra, which describes a space formed by the Cartesian product of three fuzzy spheres, and we explain why this solution is not perturbed by the infinite tower of higher-order commutators. We then compare its energy at the classical level to that of the trivial solution, which suggests that this curved-space solution might indeed be stable.