Perturbative dynamics of fuzzy spheres at large N

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The large-N reduced models incorporating the fuzzy sphere classical solutions have been hitherto widely studied. There are two motivations to work on the fuzzy sphere. First is the relation between the string theory and the noncommutative field theory. Second is that the fuzzy sphere is a prototype of the curved spacetime, which is a fundamental property of the gravitational interaction. In [1], Iso et. al. advocated a toy model defined in the three-dimensional Euclidean spacetime, which has the Chern-Simons term so that it should have a fuzzy sphere classical solution.

In this talk, we introduce our work [3], in which we have scrutinized the two-loop perturbative dynamics of the bosonic matrix model

$$S = N\mathrm{tr}\left(-\frac{1}{4}\sum_{\mu,\nu=1}^{3}[A_\mu, A_\nu]^2 + \frac{2i\alpha}{3}\sum_{\mu,\nu,\rho=1}^{3}\epsilon_{\mu\nu\rho}A_\mu A_\nu A_\rho\right),$$

which has the fuzzy S^2 classical solution $A_\mu = \alpha L_\mu$, where L_μ is the $N \times N$ representation of the SU(2) Lie algebra. This satisfies the commutation relation

$$[A_\mu, A_\nu] = i\alpha\epsilon_{\mu\nu\rho}A_\rho.$$

In our previous work [2], we have carried out a Monte Carlo simulation of the above bosonic matrix model and found that its fuzzy sphere classical solution is stable above a certain critical point $\alpha > \alpha_{\mathrm{cr}}$. In this work [3], we evince interest in the fuzzy sphere dynamics in this regime, and have performed a two-loop perturbative calculation. While its effective action is saturated at the one-loop level in the large-N limit, this is *not* the case for generic observables. This is because the two-loop effect of generic observables comes from the one particle *reducible* diagrams, which do not contribute to the effective action.

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参考文献

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