String coupling and interactions in type IIB matrix model

arXiv:0812.3460[hep-th]

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IIB matrix model as a nonperturbative formulation of superstring theory

[Ishibashi-Kawai-Kitazawa-Tsuchiya '96]

$$S = -\frac{1}{g^2} tr \left(\frac{1}{4}[A^\mu, A^\nu][A_\mu, A_\nu] + \frac{1}{2}\bar{\psi}\Gamma^\mu[A_\mu, \psi] \right)$$

A_μ: N×N Hermitian matrices

ψ: Ten dimensional Majorana-Weyl spinor, N×N matrices

- Higher dimensional objects are constructed as the solutions of IIB matrix model.

- This model will describe not only perturbative Yang-Mills theories, but perturbative superstring theory.

- We focus on the two dimensional noncommutative background in IIB matrix model.

2D Yang-Mills as a nonperturbative formulation of superstring theory

**Matrix string theory** [Dijkgraaf-Verlinde-Verlinde '97]

$$S = \frac{1}{l_s^2} \int_{-\infty}^{\infty} d\tau \int_0^{2\pi} d\sigma \, tr \left((l_s^2 g_s^2) F_{z\bar{z}}^2 + 2(D^+ \phi_i D_+ \phi_i + D^- \phi_i D_- \phi_i) \right.$$

$$\left. + \frac{1}{l_s^2 g_s^2} [\phi_i, \phi_j][\phi_i, \phi_j] + 2\bar{\psi}(\Gamma^+ D_+ + \Gamma^- D_-)\psi + \frac{2}{g_s l_s} \bar{\psi} \Gamma_i [\phi_i, \psi] \right)$$

$$g_{YM}^{-2} = \alpha' g_s^2$$

- N=8 SUSY, N×N matrices

8 scalar fields, 8×2 spinor fields

- Various descriptions are related to each other in 2 dim:

Free orbifold CFT, dual IIB supergravity description, perturbative YM description, …

depending on N, g_{YM}

Perturbative interactions of strings

The basic perturbative interactions of the closed strings are the recombination between two intersecting strings.

Locally seeing,

recombination : local process
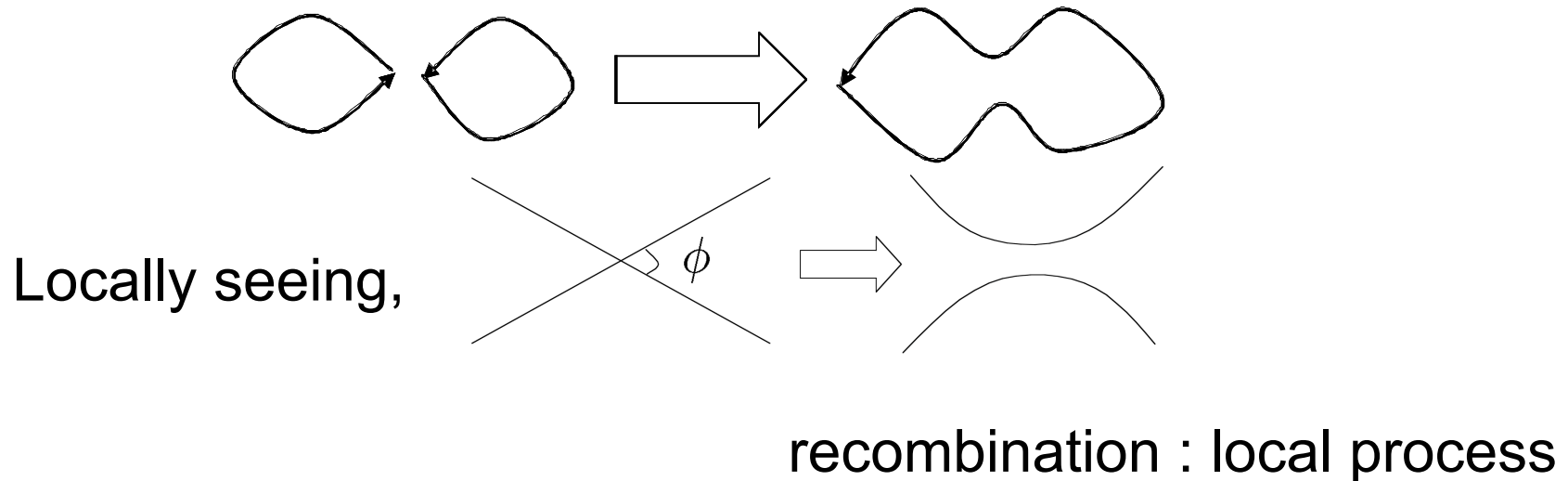
We realize this process in IIB matrix model.

String coupling g_s is identified in IIB matrix model.

Plan of talk & summary

1. Derivation of Green-Schwarz string action (identification of α` in IIB matrix model) [arxiv:07081077]

2. Recombination (identification of g_s in IIB matrix model) [arxiv:0812.3460]

2-1. Effective action of intersecting strings in IIB matrix model

2-2. Fluctuation analysis and the recombination

2-3. Recombination probability

2-4. Recombination in matrix string theory

3. Superstring vertex operators (derivation of SUSY trf.) [arxiv:0710.0709]