

SUPERSTRING FIELD THEORY
WITH THE
PURE SPINOR FORMALISM

NATHAN BERKOVITS
(IFT-UNESP, São Paulo)

REF: NB, hep-th/0509120 "Pure spinor formalism as on $N=2$ top. string"

Yuri Aisaka and NB, hep-th/0903.3443 "Pure spinor vertex op's in
Siegel gauge and loop amp. regularization"

MOTIVATION

Most approaches to superstring field theory are based on RNS formalism.

- Good for describing NS sector (both $GSO(+)$ and $GSO(-)$), but awkward for describing R sector (e.g. spinfields, bosonization, pictures, etc..)
- Can describe NS sector with manifest $d=10$ covariance, but R sector appears to require breaking of manifest Lorentz covariance,
- Spacetime susy is not manifest.

Can define light-cone ssft using GS formalism

- $SO(8)$ susy is manifest. Requires contact terms.

To define covariant ssft, use pure spinor formalism

- Ssft equations of motion are manifestly $SO(9,1)$ super-Poincaré invariant.
- Can formally construct a cubic open ssft action.
- Gauge-fixing is problematic.

Pure spinor formalism is based on superspace description of super-YM

$N=1$ $d=10$ superspace: x^m, θ^α $m=0$ to 9 , $\alpha=1$ to 16

$$D_\alpha = \frac{\partial}{\partial \theta^\alpha} + \frac{1}{2} \gamma_{\alpha\beta}^m \theta^\beta \frac{\partial}{\partial x^m}, \quad \{D_\alpha, D_\beta\} = \gamma_{\alpha\beta}^m \partial_m$$

To describe super-YM, covariantize superspace derivatives

$$D_\alpha \rightarrow \nabla_\alpha \equiv D_\alpha + A_\alpha(x, \theta), \quad \partial_m \rightarrow \nabla_m \equiv \partial_m + A_m(x, \theta)$$

Superfields $A_\alpha(x, \theta), A_m(x, \theta)$ are defined up to gauge transformation

$$\delta A_\alpha(x, \theta) = \nabla_\alpha \Omega(x, \theta), \quad \delta A_m(x, \theta) = \nabla_m \Omega(x, \theta)$$

Super-YM eqns. of motion are implied by $\{\nabla_\alpha, \nabla_\beta\} = \gamma_{\alpha\beta}^m \nabla_m$

$$\Rightarrow \gamma_m^{\alpha\beta} (D_\alpha A_\beta + D_\beta A_\alpha + \{A_\alpha, A_\beta\}) = 16 A_m$$

$$\gamma_{mnpqr}^{\alpha\beta} (D_\alpha A_\beta + D_\beta A_\alpha + \{A_\alpha, A_\beta\}) = 0$$

$$\Rightarrow A_\alpha = \frac{1}{2} a_m(x) (\gamma^m \theta)_\alpha + \chi^\beta(x) (\gamma^m \theta)_\alpha (\gamma_m \theta)_\beta + \dots, \quad A_m = a_m(x) + \dots$$

