<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
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$SDLCQ$

I. $P^- = \{Q^-, Q^-\}$

II. $DL CQ$ for $Q^-$

$$Q^- \sim \sum_i \overline{b}^+(k_1) b^+(k_2) b_i(k_1+k_2)$$

$$\left( \frac{1}{k_1} + \frac{1}{k_2} - \frac{1}{k_1+k_2} \right) + \cdots$$

$$\{k_i\} = \frac{n_i \pi}{L} \quad n_i = 1, 2, \ldots$$

III. $14 > a \sum_i \sum_{\{k_i\}} f(k_i) \text{Tr} \left( b_i^+ \cdots b_{ik_m}^+ \right) 10 >$

$$\sum \overline{n}_i = k$$

$$+ \cdots$$

Single trace $\Rightarrow$ large $N_c$. 
Properties of SDLCG

I. All the good light-cone properties.

II. For theories with enough super symmetry, no renormalization.

III. Rapid convergence in $K_\parallel$ & $K_\perp$. 
Starting Point:

Super symmetry with fundamental matter in $2+1$ Dimensions:

$$S = \int d^3x \text{ Tr} \left( -\frac{1}{4} F_{\mu \nu} F^{\mu \nu} + \frac{i}{2} \bar{\Lambda} \Gamma^\mu D_\mu \Lambda + \bar{D}_\mu \bar{\chi} + D^\mu \chi + i \bar{\Psi} \gamma_\mu \gamma_5 \Psi - g' \left[ \bar{\Psi} \Lambda \bar{\chi} + \bar{\chi} \gamma_5 \Psi \right] \right)$$

Dimensionally reduce to $1+1$.

Fields:

- $A^2$ adjoint scalar
- $\Lambda = (\lambda, \tilde{\lambda})$ adjoint fermion
- $\Psi = (\eta, \tilde{\eta})$ fundamental fermion
- $\tilde{\xi}$ fundamental scalar.

$\lambda, \tilde{\lambda}$ Majorana

$\eta, \tilde{\eta}, \tilde{\xi}$ complex.
Non-perturbative Spectrum of 2-D, N = (1,1) SYM at Finite and Large Nc

This is a SUSY of adjoint scalar \( \Phi_{ij} \) and adjoint fermion \( \Psi_{ij} \). It is the theory one obtains by dimensional reduction of SYM\(2+1 \to 1+1\)

- Theory is finite
- Compact in \( x^- \): \( x^- = x^- + l \eta \)
- Symmetric B.C. for \( \Phi \) and \( \Psi \).
- Drop all zero modes.
- Finite \( N_c \Rightarrow \) Multiple traces in states:
  \[ \text{tr}(\Phi \Phi \ldots) \text{tr}(\Psi \Psi \ldots) \] \[ \ldots \]
  - Super symmetric at every resolution \( K \).
- K=3 massive bound state appears 4 fold degenerate - 2 Fermions, 2 Bosons
- To indentify a state we follow it as a function of K and N
- States converge very fast i.e flat as a function of K.

As we increase K lower mass states with more and more partons appear.

Number of massless state appears to be \( 2^k \cdot \frac{K-1}{2(K-1)} \)

\( N=10 \)
- Trail heads of lowest mass states as a function of $k$
- There is an accumulation point $M_c$.

\[ \frac{\pi^2}{g^2 N} \]

Lightest Bound State with Non-Zero Mass (N=10)

- $M_c$ appears to be at or close to zero
SYM in 2+1 Dimension

\[ L_T > x_T \to \infty \]

\[ \{ Q^+, Q^\pm \} = 2 \sqrt{2} \, p^\pm, \quad \{ Q^-, Q^- \} = 2 \sqrt{2} \, p^- \]

\[ m^2 = 2 p^+ p^- - p_L^2 \]

L-C quantization \( \Rightarrow \) we can always work in \( p_L = 0 \) sector

\( \Rightarrow \) (1,1) SUSY.

\[ A^+(k^+, n_L) = -N_{\text{max}} \leq n_L \leq N_{\text{max}} \]

\( N_{\text{max}} = 0 \Rightarrow 2D \) theory \hspace{0.5cm} \( N_{\text{max}} = \infty \Rightarrow 3D \) theory.

\[ \{ Q^+, A_{tr} \} = \{ Q^+, A \} \]

\[ \{ Q^-_{tr}, Q^-_{tr} \} \neq 2 \sqrt{2} p^-_{tr} \]

but \( \quad \{ Q^-_{tr}, Q^-_{tr} \} \quad \stackrel{N_{\text{max}} \to \infty}{\longrightarrow} \quad \{ Q^-_{tr}, Q^-_{tr} \} \)
\[ \frac{M^2 L^2}{\kappa^2 N_c} \]

Some field theory?

\[ g = \frac{g' \sqrt{NL}}{4 \pi^{3/2}} \]

\[ g' (\text{Mass } 1 + 1) \]

\[ \text{massless } 1 + 1 \]

laor
We can set some of the fields to zero and $Q \neq 0$.
This defines a set of 7 models.

Note: $A^2 = \psi^2 = 0 \Rightarrow$ Kutasov model
Super-symmetry with only adjoint fermion
-this was studied in great detail-

Our 7 models have the following content:

\[
\begin{array}{c|ccc}
A & 4 & 5 & 43 \\
\hline
\lambda & 1 & 2 & 3 \\
A^2 & X & X & 4 \\
\lambda A^2 & 5 & 6 & 7 \\
\end{array}
\]
Figure 9: $A\lambda\psi$ model: (a) Mass spectrum at $h = 1$ in units of $(g')^2N/\pi$ as function of $1/k$. (b) Lowest nonzero mass at $K = 4$ as function of coupling $h$. 