

# Integrability in 2D CFT Scale invariant

$SO(2, d)$  symmetry of  $CFT_d$  implies

$$\langle \bar{\phi}(x) \phi(x') \rangle = \frac{1}{|x-x'|^{\Delta_{\phi}}} \quad \begin{array}{l} \text{scaling dim} \\ \text{EV of "dilatation"} \end{array}$$

$$\langle \phi_1(x_1) \phi_2(x_2) \phi_3(x_3) \rangle = \frac{C_{123}}{\prod_{i,j} |x_i - x_j|^{\Delta_{ij}}} \quad \begin{array}{l} \text{3-point} \\ \text{couplings} \end{array}$$

In 2D CFT,  $so(2,2)$  algebra part of  $\infty$ -dim spectrum generating symmetry  
 $\leadsto$  Virasoro, Kac-Moody

$\Rightarrow$  strong constraints on  $\Delta_{\phi}, C_{123} \dots$

Q: ex.: herm. operator embedded into  $su(2)$

- Are BFKL EV  $\chi \leftrightarrow \Delta_{\phi}$  in 2D CFT?
- What is the spectrum generating sym?
- Constraints on  $\chi \leftrightarrow \Delta, V \leftrightarrow C \dots$ ?

no embedding BFKL  $\rightarrow$  2D CFT known ...

# AdS/CFT correspondence

gauge th. -  
string duality

Calculations in many d-dim CFTs (GT)

⇔ calc. in some string theory on  $AdS_{d+1}$

↑ same result, but different difficulty

metric near extremal black brane

$$ds^2 = \frac{r^2}{R^2} (-dt^2 + dx_i^2) + \frac{R^2}{r^2} dr^2 + \text{9-d dim.}$$

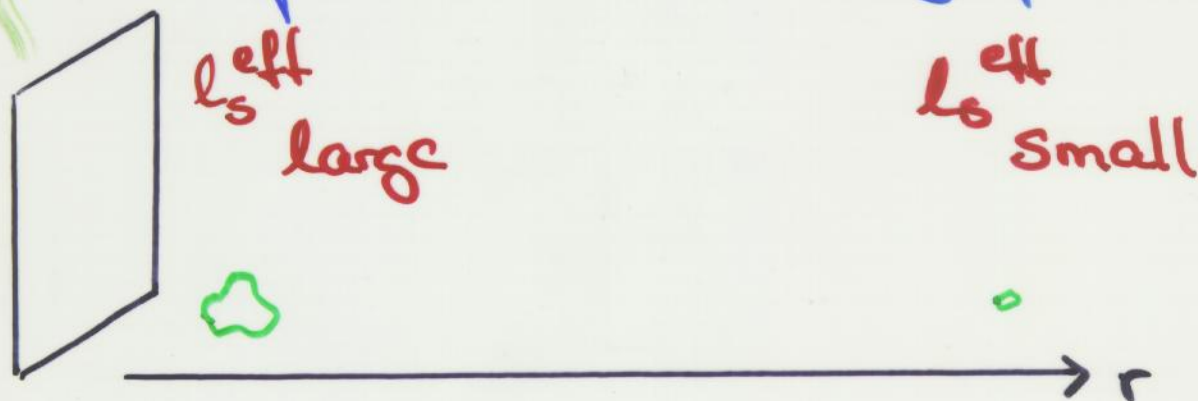
large red shift  
near  $r=0$

"  
 $x_0$

↑  
 $i=1, \dots, d-1$

"  
 $x_d$

String background contains extra non-compact dim → holographic des.!



⇒ String theory in AdS backgrounds:  
meson resonances & reasonable physics  
(vibrational modes) at high energies.



# AdS/CFT & high energy $N=4$ SYM

$N=4$  SYM  $\rightarrow$  strings on  $AdS_5 \times S^5$

$$S^{ST} \sim \int d\tau d\sigma G_{\mu\nu} (\partial_\sigma X^\mu \partial_\tau X^\nu - \partial_\tau X^\mu \partial_\sigma X^\nu)$$

dep. on  $X_r = X_5 \rightarrow$  non-linear!

believed to be integrable,  
but hard to integrate.....

Q: String theory dual of high E sector?

Integrate light-cone fields  $X^\pm = X^0 \pm X^1$   $\begin{matrix} AdS_5 \\ \downarrow \\ AdS_3 \end{matrix}$

- $AdS_3$  description of high E quantities?
  - develop methods for  $AdS_3$  calculations
  - construct spectrum gen.  $\begin{matrix} \text{Symmetries} \\ \uparrow \text{for high E sector.} \end{matrix}$
- $\uparrow$   
has been achieved for some  
simpler ST on  $AdS_3$  .....