

# Symmetries of AdS

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Conformal symmetry group of Minkowski<sub>4</sub>:

$$\begin{array}{lcl} SO(2,4) & \supset & ISO(1,3) \quad \xrightarrow{\text{Poincaré}} \\ \text{15-dim} & & \text{10-dim} \\ & & \text{Dilations} \quad 1 \\ & & \text{Special conf} \quad 4 \end{array}$$

Dilations  $x \rightarrow x' = \lambda x$

Conformal:  $ds^2 = \eta_{\mu\nu} dx^\mu dx^\nu \rightarrow \Omega^2(x') \eta_{\mu\nu} dx'^\mu dx'^\nu$

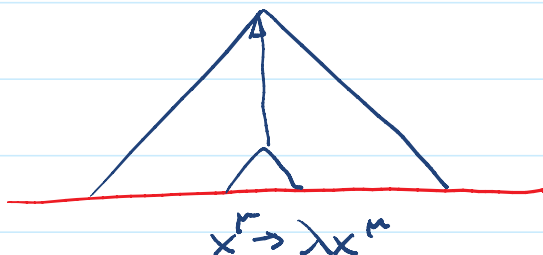
In  $d$  dimensions:  $SO(2, d)$

Isometries of  $AdS_n$ :  $SO(2, n-1)$

$AdS_{d+1}$  realizes geometrically (as isometries)

The conformal symmetry group of Minkowski<sub>d</sub>

Inward motion in  $AdS_{d+1}$  = dilatation in Mink<sub>d</sub>



$$ds^2 = \frac{dz^2 - dt^2 + dx_{d-1}^2}{z^2}$$

$$\left. \begin{array}{l} x^\mu \rightarrow \lambda x^\mu \\ z \rightarrow \lambda z \end{array} \right\} \text{AdS isometry}$$

## Area and volume in $AdS_{d+1}$

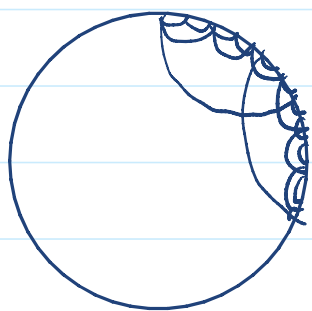
$$ds^2 = -(r^2+1)dt^2 + \frac{dr^2}{r^2+1} + r^2 d\Omega_{d-1}$$

volume inside a sphere of radius  $r=R \gg 1$

$$V \sim \int_0^R \frac{dr}{r} r^{d-1} \sim R^{d-1}$$

area of sphere  $A \propto R^{d-1}$

Volume of large spheres is concentrated near  
The boundary



Boundary values of fields in  $AdS_{d+1}$  behave as  
conformal field operators in  $d$  dimensions.

But This is a statement about any Theory defined  
in a fixed  $AdS$  background; no dynamical  
gravity is involved

The  $AdS/CFT$  correspondence is a deeper  
statement, in a sense The converse of The  
previous one:

$AdS_{d+1}/CFT_d$ : a quantum CFT in $d$ dimensions
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$AdS_{d+1}/CFT_d$  : a quantum CFT in  $d$  dimensions  
defines a quantum theory of  
gravity in  $d+1$  dimensions

The quantum theory of gravity may or not be independently defined. Our best result for this is string theory perturbatively defined in certain  $AdS \times M$  spacetimes

- Asymptotic structure:

Short distance structure of  $QFT_d \rightarrow$  Asymptotic behavior of gravity in  $AdS_{d+1}$

