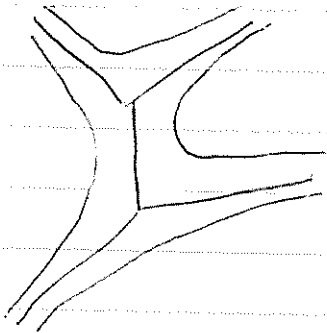



17 November 2006  
M. Friedman and  
E. Silverstein

## A Math / Physics Happening

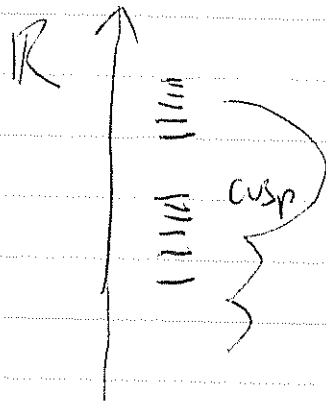
Old facts



Cusps  $\mathbb{Z}$   $\mathbb{H}$  

$\mathbb{H}$  has Euclidean (similarity) structure

hyp volumes are well ordered



$\sum_{\substack{\text{hyp 3-man.} \\ \text{inj rad} > \text{const}}} e^{-\text{vol}(M)} \rightarrow \text{diverges.}$

Maybe can fix

$$\sum e^{-\text{vol}(M)} (\log \text{vol}(M))^{1+\epsilon}$$

$n!$

Now know:

- 1.  $\pi_1$  (3-manifolds) logic evaporates
- 2. Simple homotopy type  $\Leftrightarrow$  diffeomorphism
- 3.  $\pi_1(M^3)$  is residually finite

Near complete

Space forms of "other 7"  
 polytocosm

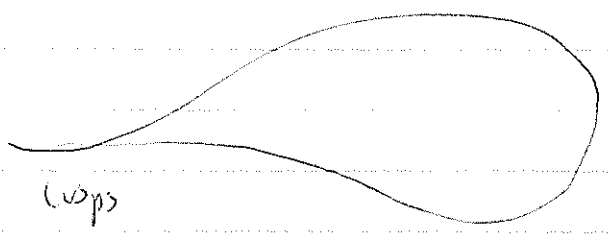
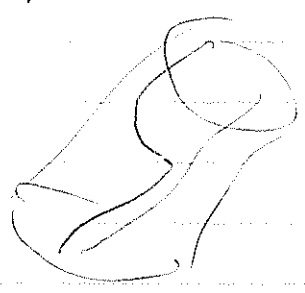
Lots known

Volumes of hyp 3-manifolds:  
 manifolds, unoriented manifolds, orbifold  
 cusped version

Metric space

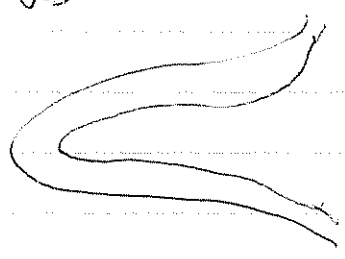


GH distance

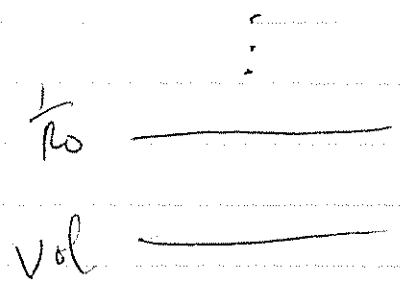


loops

$$ds^2 = dz^2 + e^{-z} ds_T^2$$



$$M_3 \times M_3$$

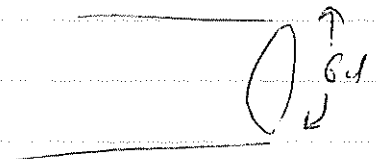


Vol, Coupling

$$\text{Vol} \leftrightarrow \rho = \rho(x_{4d})$$

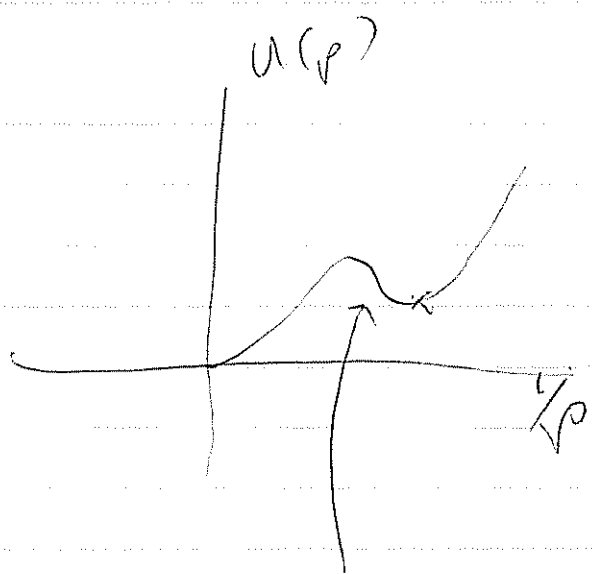
D=10

$$S_{10} = \int d^{10}x \sqrt{\det g} R$$

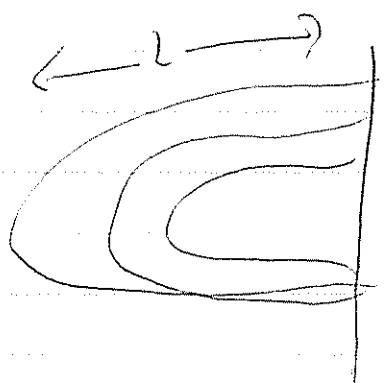


$$S_4 = \int d^4x \sqrt{\det g^{(4)}} \left( (2\rho)^2 - u(\rho) \right)$$

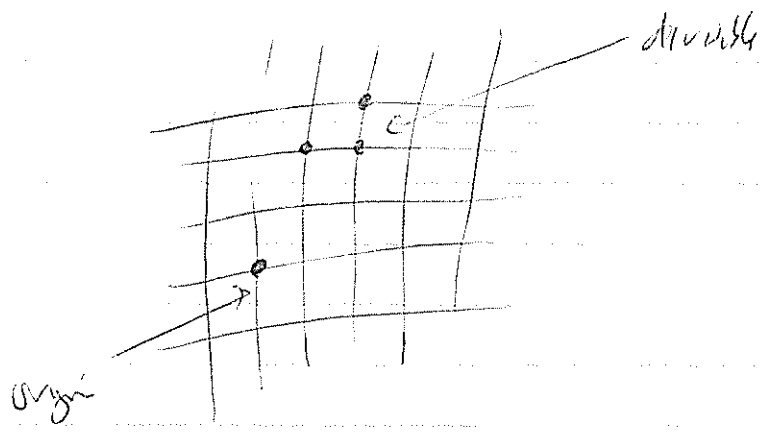
$\leftarrow 4d \rightarrow$



"orientifold"



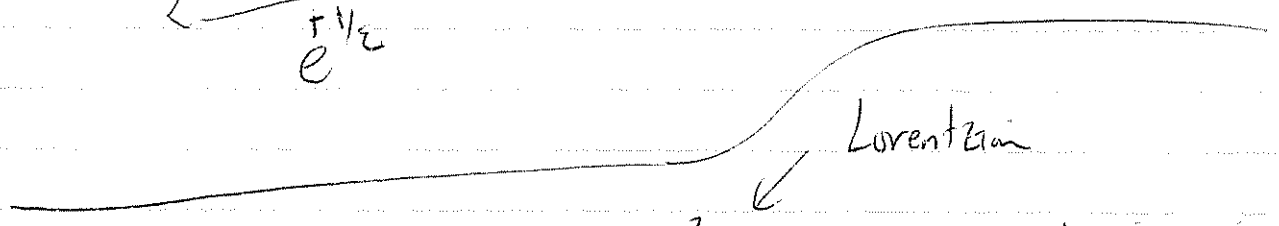
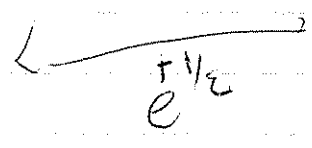
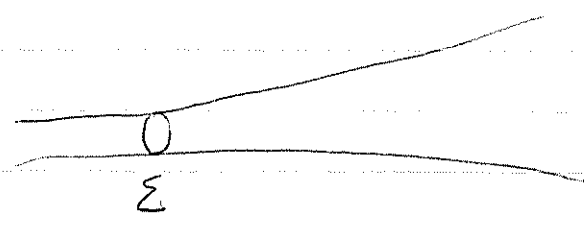
$$n(L) = ?$$



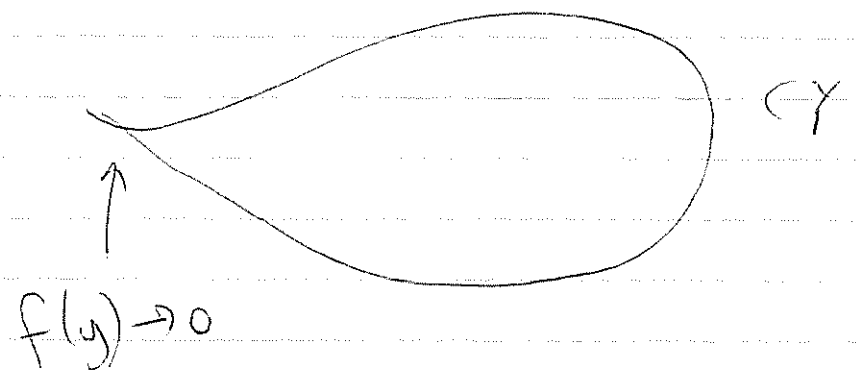
$(p, y)$

$$|p| + |y| = C$$

$$\text{depth} = C \text{ or } e^C$$

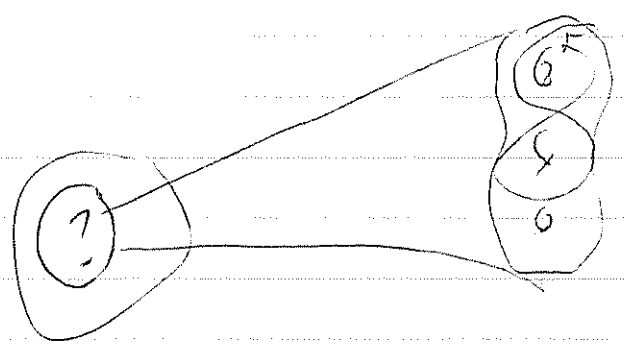


$$ds^2 = f(y) ds_{yd}^2 + g_{ij}(y) dy^i dy^j$$



Our 4d (3+1d)

$\nwarrow M_3$



$$n(L) \sim e^{L/L_0}$$

$t \rightarrow$

Riemann surface of genus  $h$

$T^{2h} =$  Jacobian

$T(x)$

$T^{2h}$

$\rightarrow$  Riemann surface

