

C=1 MATRIX

↑

MATRIX MODELS

OF

2D COSMOLOGY

↓

'POOR MAN'S COSMOLOGY'
(NO DYNAMICAL GRAVITY,
MINIMAL "MATTER" CONTENT)

WITH A. STROMINGER
HEP-TH/0309138

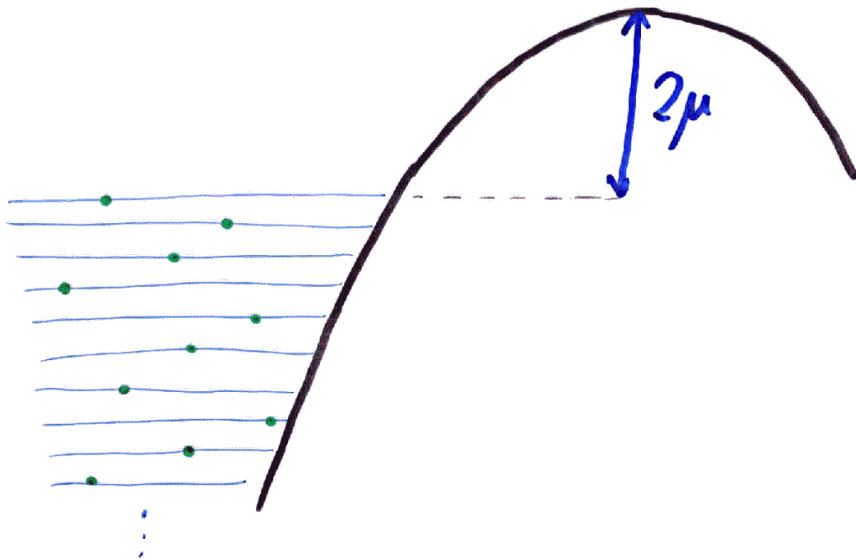
- TIME DEPENDENT STRING THEORY STILL IN ITS INFANCY
- REQUIRES NONPERTURBATIVE ANALYSIS WITHOUT SUSY (e.g. dS)
- 2D STRING AS A TOY MODEL
∴ NONPERTURBATIVELY DEFINED!

C=1 MATRIX MODEL (FERMION PICTURE)

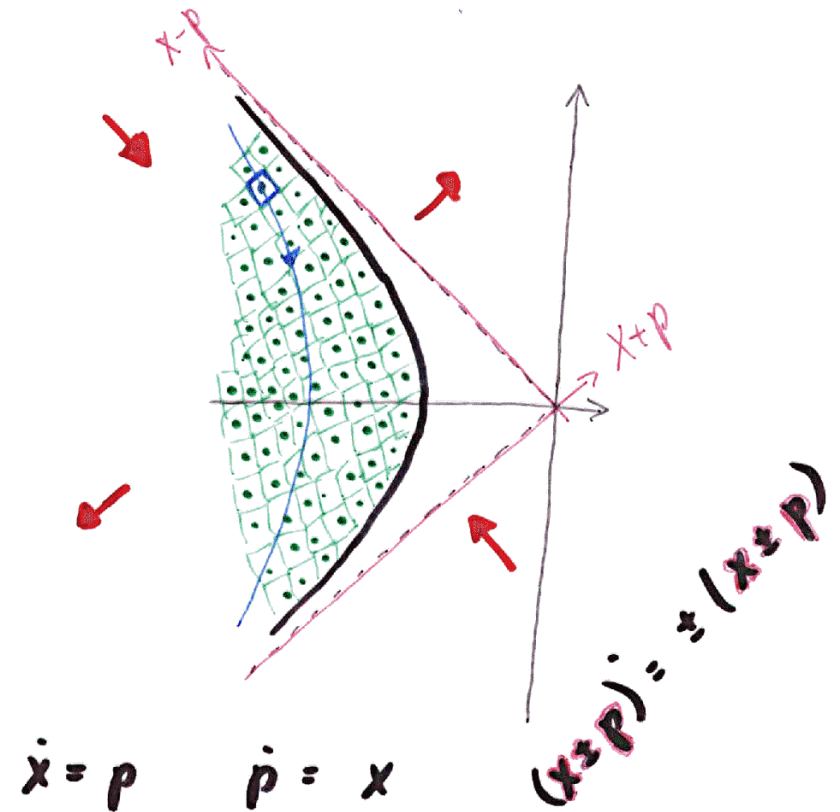
$\Phi_{N \times N} \rightarrow N$ EIGENVALUES λ_i

EACH EIGENVALUE DESCRIBED
BY A FERMION (FREE)

$$H = \frac{1}{2} (p^2 - x^2)$$



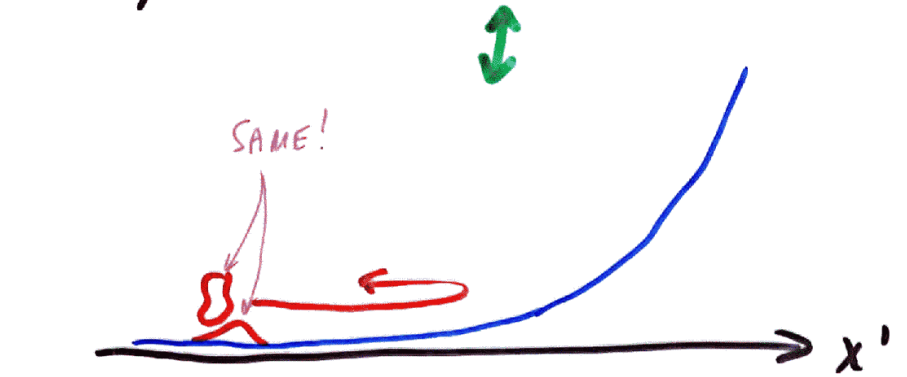
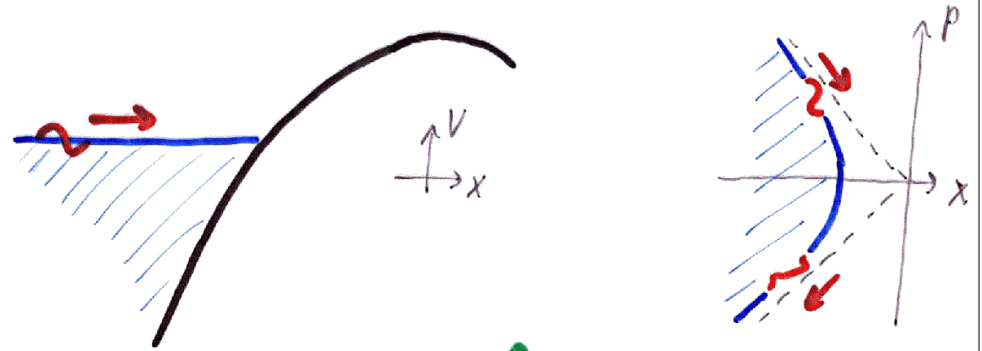
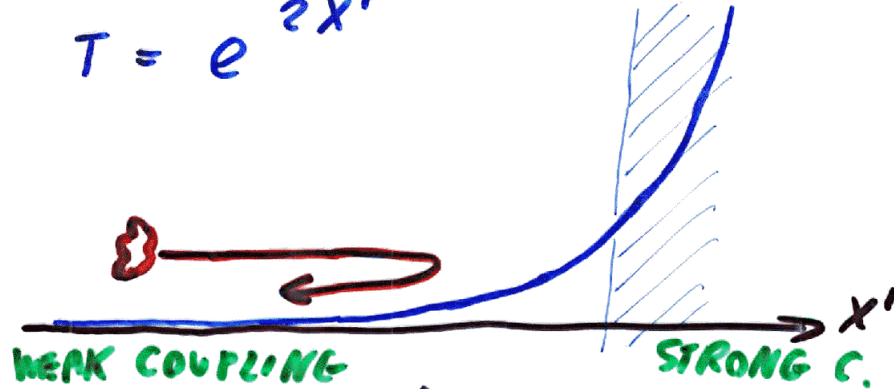
SEMICLASSICAL APPROX. IN PHASE SPACE



2d LIOUVILLE STRING

$\Phi(x^0, x^1)$ $T(x^0, x^1)$
 DILATION "TACHYON"

$\Phi = 2x^1 \rightsquigarrow g_s \propto e^\Phi$
 $T = e^{2x^1}$



OR SAME!
 SHAPE OF FERMI SURFACE
 (COLLECTIVE FERMION COORD.)

$x^1 \sim -\ln|x|$
 $T(x^0, x^1)$

POLCHINSKI
 91-94

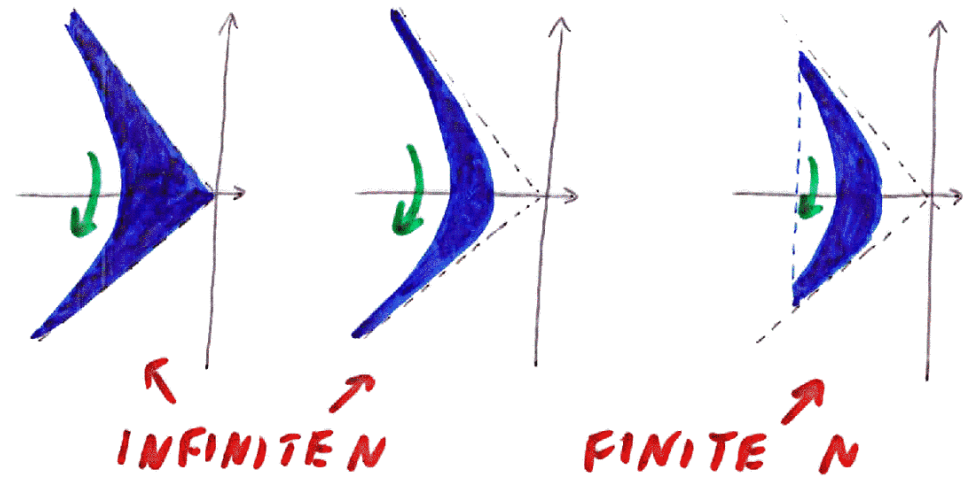
PHILOSOPHY :

ANY STATE OF THE
FERMION THEORY, WITH
ANY NUMBER OF FERMIONS,
SHOULD DEFINE A STRING
THEORY.

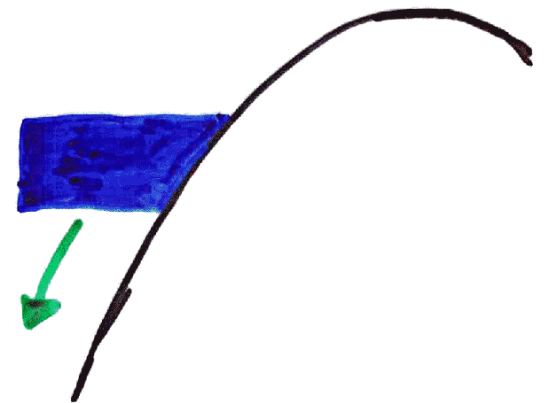
FINITE N STATE

FINITE COSMOLOGY (COMPACT X^1)

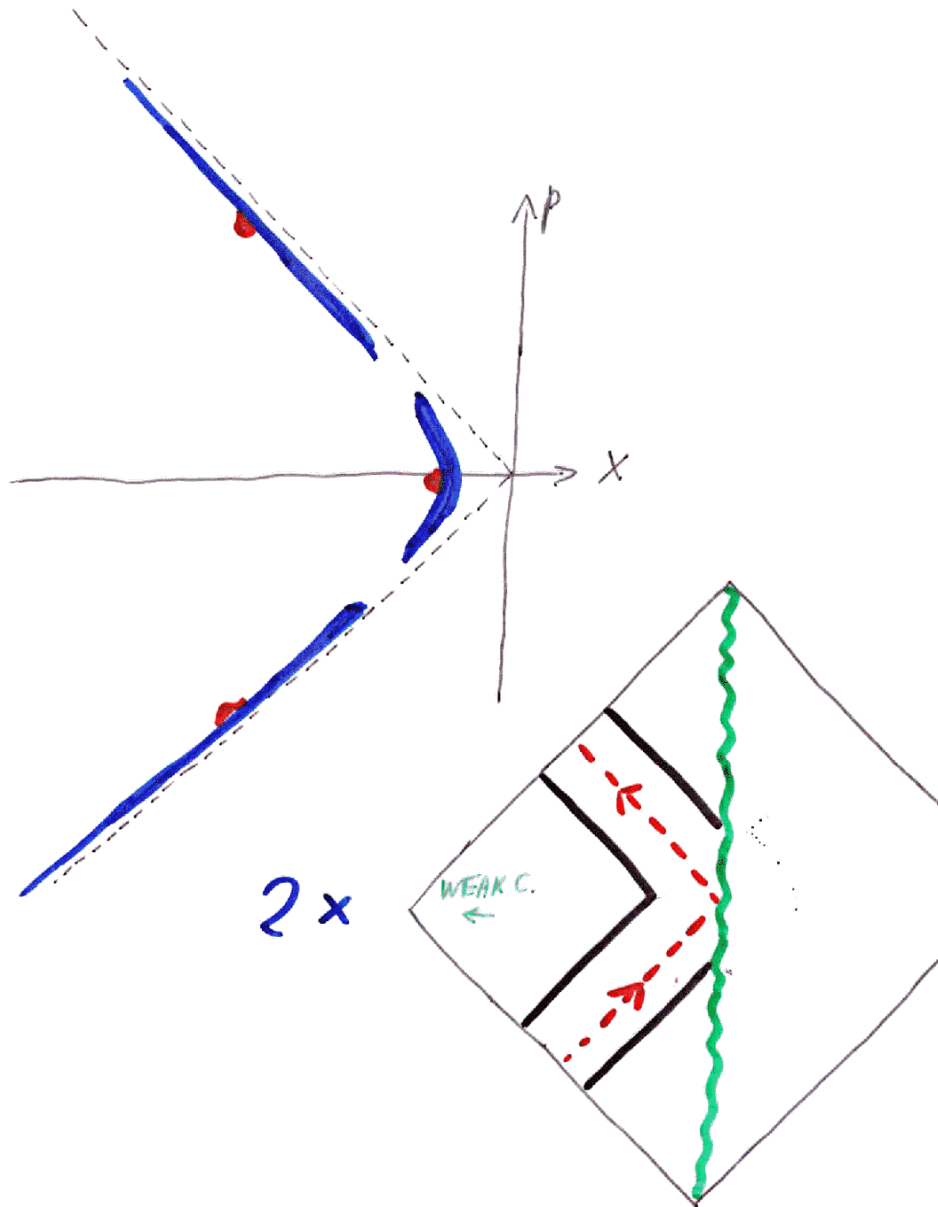
- e.g.
- FINITE COSMOLOGY
 - TACHYON CONDENSATION



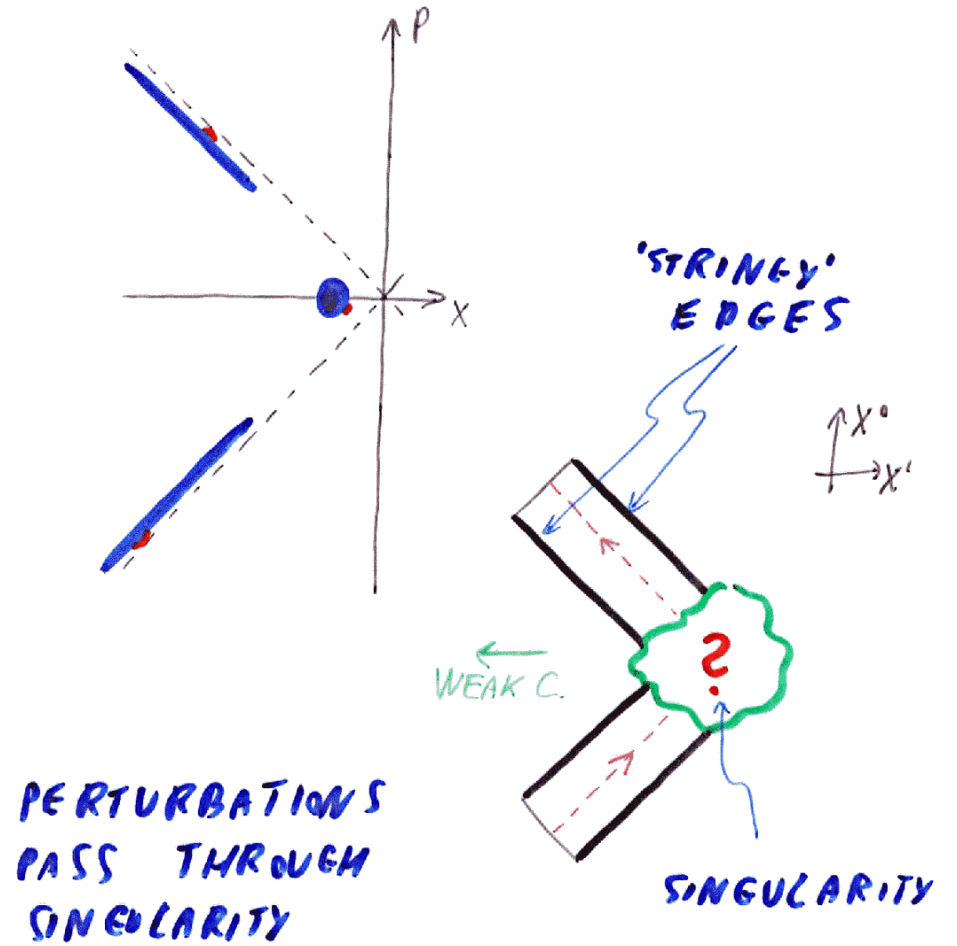
EVOLVES!



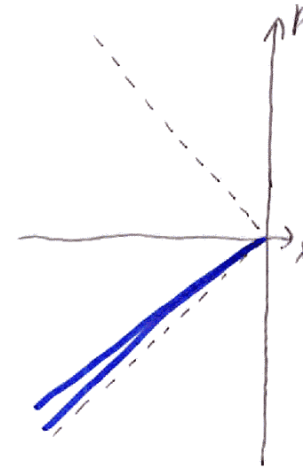
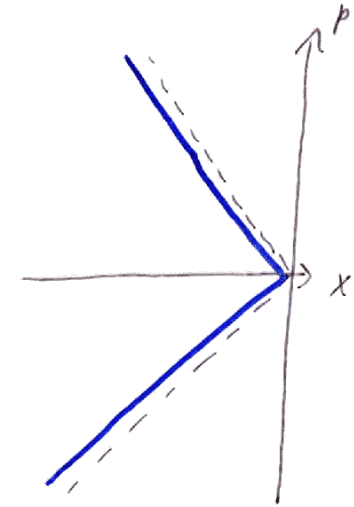
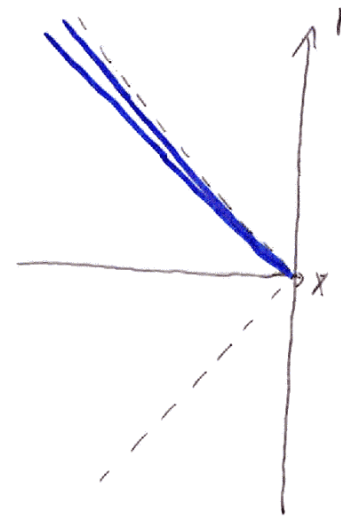
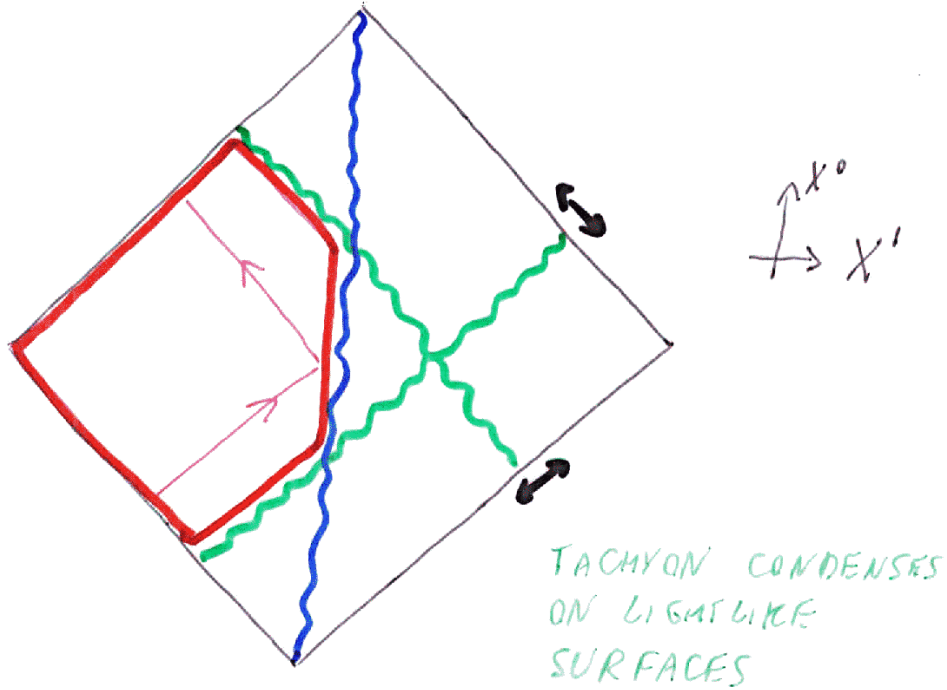
CRESCENT COSMOLOGY

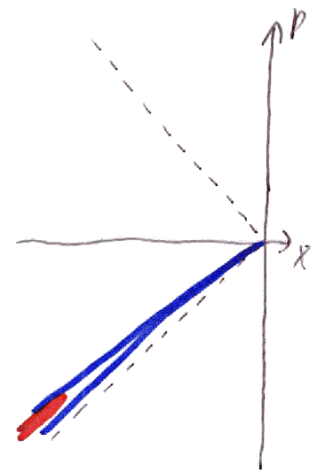
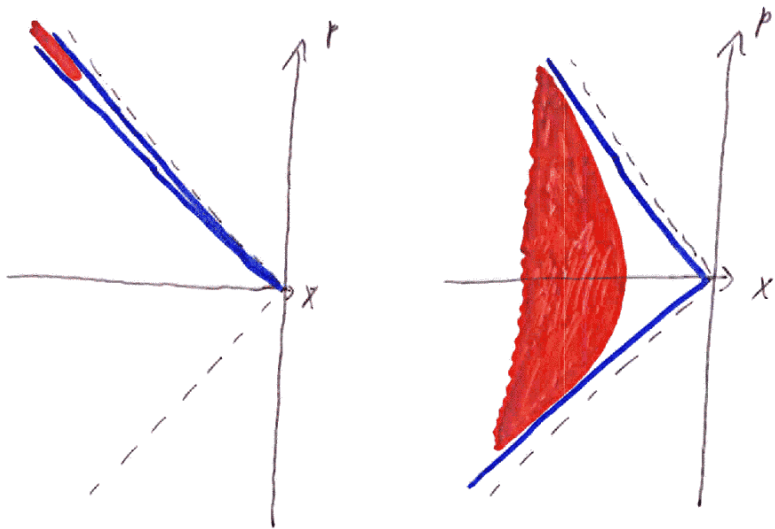


GENERIC DROPLET COSMOLOGY



$$T \sim \mu e^{2x'} + \lambda_+ e^{x'+x^0} + \lambda_- e^{x'-x^0}$$

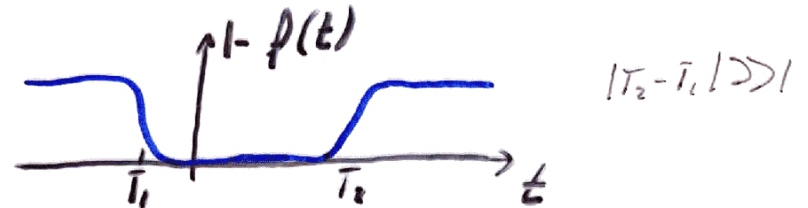




$$\begin{aligned}
 & (\sinh(t-T_1)x - \cosh(t-T_1)p) x \\
 & (\sinh(t-T_2)x - \cosh(t-T_2)p) x \\
 & = -\frac{1}{2g_s} \cosh(T_2 - T_1) \\
 & T_1 < T_2
 \end{aligned}$$

$$T = -\hat{\mu} \phi e^{2\phi} + \kappa (1 - f(x^0))$$

$$f(t) = \frac{\sinh(T_2 - T_1)}{2 \cosh(t - T_1) \cosh(t - T_2)}$$



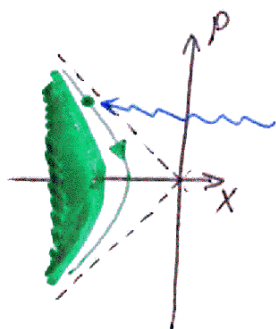
SMALL $T(\phi, x^0)$:

$$T \approx -\hat{\mu} \phi e^{2\phi} + \kappa \left(e^{2(x^0 - T_2)} + e^{-2(x^0 - T_1)} \right)$$

SPACE-LIKE TACHYON CONDENSATION
(PHASE TRANSITION?)

OPEN - CLOSED STRING DUALITY (CONNECTION TO D-BRANES)

$\Phi_{N \times N}$ = OPEN STRING TACHYON



SINGLE (UNSTABLE)
D0-BRANE

DROPLET = STACK OF N BRANES
(dS-CFT)

TACHYON CONDENSATION =
DECAY OF ALL BRANES

- VARIOUS 2D TIME-DEPENDENT SCENARIOS HAVE A NON PERTURBATIVE DEFINITION IN THE $c=1$ MATRIX MODEL. (E.G. RESOLUTION OF BOUNCE SINGULARITIES)
- A LARGE CLASS OF STATES IN $c=1$ MATRIX MODEL (INCLUDING FINITE N) SHOULD BE INTERPRETED AS VARIOUS STRING THEORIES.