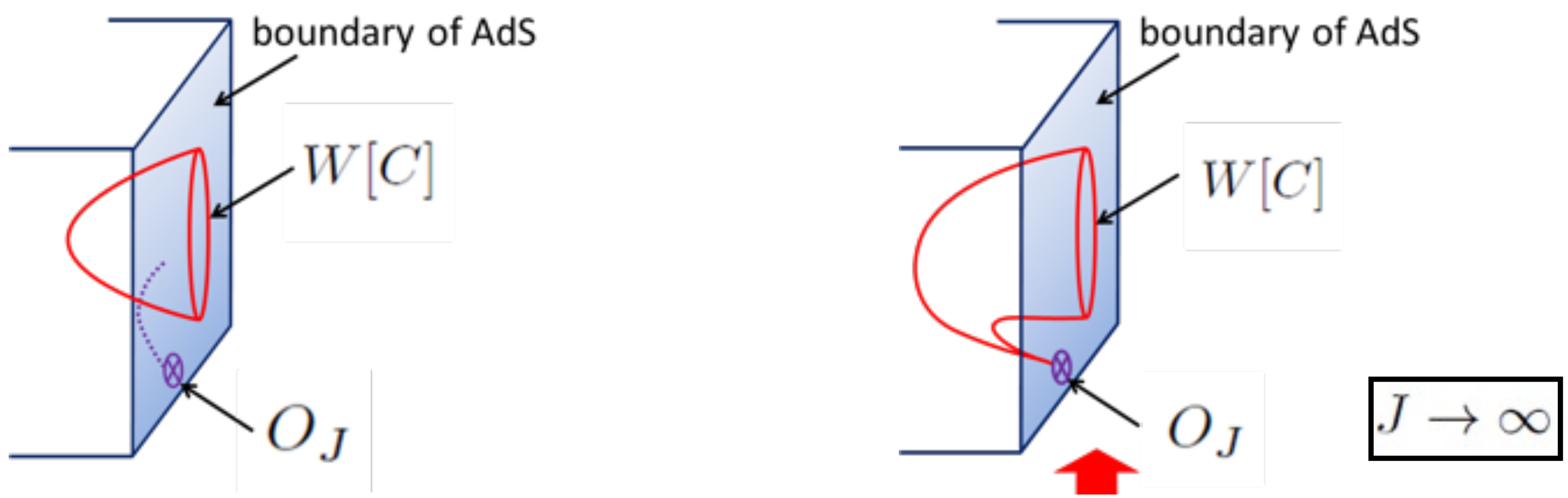
On gravity dual for a correlation function of a Wilson loop and a chiral primary operator

Phys. Rev. D86 (2012) 106004

Takayuki Enari, in collaboration with Akitsugu Miwa
College of Science and Technology, Nihon University

We consider the duality between $\mathcal{N}=4$ super Yang-Mills and type IIB superstring and focus on Wilson loops.

Fig. String world-sheet corresponding to $\langle W[C] O_J \rangle$



We find a gravity solution corresponding to a correlation function of a 1/4 BPS Wilson loop and a chiral primary operator with a large R-charge.

- Moreover, we find another gravity solution which becomes complex in a certain section. We study its interpretation in gauge theory side.

A new look at instantons and large-N limit

Masazumi Honda (KEK&YITP)

(w/ T.Azeyanagi, M.Hanada, Y. Matsuo and S.Shiba, today on arXiv)

't Hooft limit $\lambda = g^2 N = \text{fixed}, \ N \rightarrow \infty$

Well known: drastically simplifies theories in `perturbative` sector

$$(\text{Instanton correction}) \sim e^{-\frac{8\pi^2}{g^2}} = e^{-\frac{8\pi^2 N}{\lambda}}$$

Exponentially suppressed!

Less known: Do such simplifications occur also in instanton sector??

→ **A. Yes!!**

We demonstrate this by studying orbifold equivalence in instanton sector

→ enables us to find instanton partition functions in low/non-SUSY theories like Nekrasov partition functions.

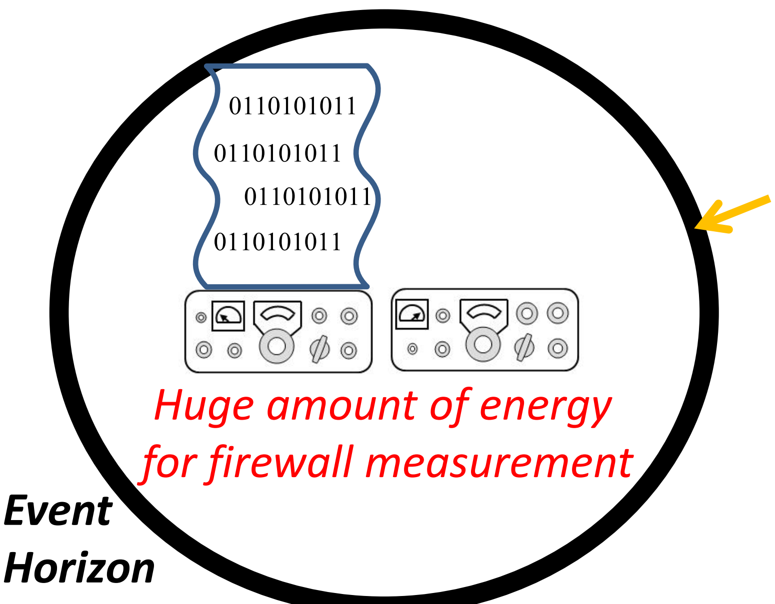
The title is changed:

Black Hole Firewalls Require Huge Energy of Measurement

Masahiro Hotta (Tohoku Univ.)

in collaboration with **Jiro Matsumoto (Tohoku Univ.)** and **Ken Funo (Univ. of Tokyo), arXiv:1306.5057**

The unitary moving mirror model is one of the best quantum systems for checking the reasoning of the firewall paradox in quantum black holes. The reasoning of AMPS (2012) inevitably raises a firewall paradox in the model. We resolve this paradox from the viewpoint of the energy cost of quantum measurements. No firewall with a deadly, huge energy flux appears, as long as the energy for the measurement is much smaller than the ultraviolet cutoff scale. Emergence of firewalls requires singular measurements with an infinite energy cost. Generally, preparation of the divergent amount of energy in the measurement region may cause large back reaction to the spacetime and change drastically the problem itself. In this model, the entropic paradox does not arise and the monogamy relation of entanglement is maintained.



Black hole formed in the measurement region during the preparation of huge energy for the firewall measurement

The measurement device may be enclosed inside the horizon before it outputs results!

⇒ Firewall Information Censorship

Duality Constraints on String Theory

Hirotaka Irie (YITP)

a collaboration with

Chuan-Tsung Chan (THU) and Chi-Hsien Yeh (NCTS)

String Duality in Non-perturbative Completion

(T-duality / spectra p-q duality)

Perturbative (saddles) $F(P,Q)=0$ ⇔ $F(Q,P)=0$

Complete correspondence!

NP completion (⇔ Finite g/ Finite N)

Combination of saddles!

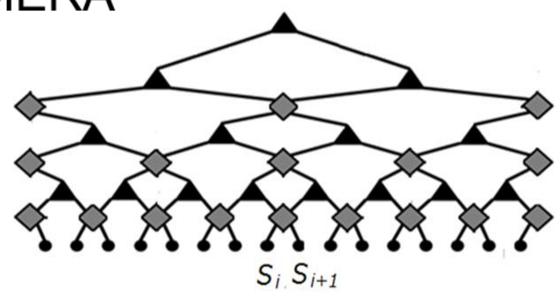
Tensor network and a black hole

Masafumi Ishihara (Tohoku University)
Collaborators: Hiroaki Matsueda (Sendai National college of Technology) and Yoichiro Hashizume (Tokyo University of Science)

Recently the relation between **Tensor Network** of wave function in quantum critical phase (**MERA**) and Anti de Sitter (AdS) space has been suggested. *(B.Swingle '2009)*

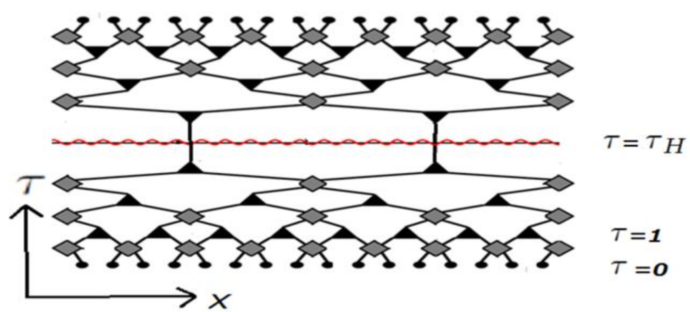
MERA

AdS space



We consider thermal MERA system and compare it with the AdS Black Hole

AdS Black Hole



Impurity effect in a holographic superconductor

Takaaki Ishii

(Seoul National Univ ⇒ **Univ of Crete**)

arXiv:1211.1798 with Sang-Jin Sin

We consider an s-wave holographic superconductor coupled to a massive vector field:

$$S = \int d^4x\sqrt{-g}\Big(-\frac{1}{4}F_{\mu\nu}F^{\mu\nu} - |\partial_\mu\Phi - iA_\mu\Phi|^2 - M^2\Phi^2$$
$$-\frac{1}{4}G_{\mu\nu}G^{\mu\nu} - \frac{m^2}{2}B_\mu B^\mu - \frac{c}{2}F_{\mu\nu}G^{\mu\nu}\Big)$$

Instanton String and M-wave in Multiple M5-brane System

Hiroshi Isono
(National Tsing-Hua University)
collaboration with Chong-Sun Chu (National Tsing-Hua University)

Start from a proposal for equations of motion of multiple M5

Give several evidence of the EoMs

The EoMs have classical solutions for BPS configurations

- **M2-M5 solutions**
- **M-wave on M5 solutions** ⟵ **our work**

Unification of IIA and IIB Supergravities

Imtak Jeon, KIAS

1011.1324, 1102.0419, 1105.6924, 1109.2035, 1112.0069, 1206.3478, **1206.3478**

Double Field Theory: O(D,D) T-duality manifest formulation of SUGRA, and beyond

[Siegel; Tseytlin; Hull, Zwiebach, Hohm]

✓ **Geometrization + Including Fermions, RR fields + SUSY**

→ **N=2 D=10 SDFT unifying IIA and IIB SUGRAs (to the full order in fermions).**

✓ **You may see how much SUGRA action is simplified.**

Welcome to my poster!

Noether current from surface term, Virasoro algebra and black hole entropy in bigravity

Taishi Katsuragawa (QG-lab. Nagoya Univ.)

based on work with Shin'ichi Nojiri
Phys. Rev. D 87, 104032 (2013) [arXiv:1304.3181]

Our work

- ☆ We consider black hole solutions in bigravity for a minimal model.
- ☆ We evaluate the black hole entropy.

$$S_{\text{bigravity}} = M_g^2 \int d^4x \sqrt{-g} R(g) + M_f^2 \int d^4x \sqrt{-f} R(f)$$
$$+2m_0^2 \, M_{\text{eff}}^2 \int d^4x \sqrt{-g} \left(3 - \mathrm{tr}\sqrt{g^{-1}f} + \det\sqrt{g^{-1}f}\right)$$

Results

- ☆ We find asymptotically flat solutions with $f_{\mu\nu} = g_{\mu\nu}$
- ☆ For Schwarzschild solution,
  we obtain a double portion of Bekenstein-Hawking entropy.

Classical integrable structure of Schrodinger sigma models

Io Kawaguchi (Kyoto Univ.)

Based on the collaborations with Takuya Matsumoto (Sydney Univ.) and Kentaroh Yoshida (Kyoto Univ.)

Integrable deformation of AdS/CFT

Deformation of string theory side (target space)

3D AdS spaces → 3D Schrodinger spacetime

$SL(2,R)_L \times SL(2,R)_R$ → **$SL(2,R)_L \times U(1)_R$**

Schrodinger sigma models

Two descriptions for its classical integrable structure

$SL(2,R)_L$ → **isotropic Lax pair** & **Yangian**

$U(1)_R$ → **anisotropic Lax pair** ↔ **isotropic Lax pair** → **Yangian**

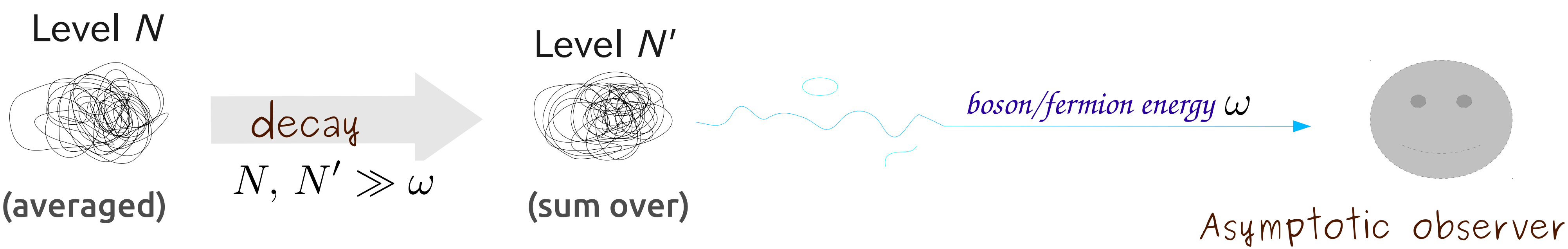
Non-local gauge transformation

Non-trivial realization

Emission Spectrum of Soft Massless States from heavy Superstring

Shoichi Kawamoto (Tunghai Univ.)

Semi-Inclusive heavy superstring decay



Emission rates

$$\Gamma \sim \frac{\omega^8 d\omega}{M^2}\frac{\sigma(\omega)}{e^{\beta_H \omega} \mp 1}$$

$\beta_H = \pi\sqrt{8\alpha'}$

Hagedorn temp.

Open from Open: $\sigma_{\text{boson}} = g^2\sqrt{N}\cdot 1$ (black)

$\sigma_{\text{fermion}} = g^2\sqrt{N}\cdot\omega^{-1}$

closed from Open/closed: $\sigma_{\mathbf{8}_v\otimes\mathbf{8}_v} = g^4 N\cdot\frac{\omega(e^{\beta_H\omega}-1)}{(e^{\beta_H\omega/2}-1)^2}$ (brane-like)

$\ldots$

PRD87 124001 with T. Matsuo (Anan NCT)

ABJ Wilson loops and Seiberg duality

Keita Nii (Nagoya University, Japan) with Sinji Hirano, Masaki Shigemori

1. Exact Calculation of Wilson loops in ABJ theory.

Localization technique → exact result for Wilson loop but tedious multi-integral → Our works: ▷ using lens space matrix model → simple formula tractable !!

2. Seiberg duality for ABJ Wilson loops.

$U(N_1)_k \times U(N_2)_{-k}$ ABJ theory ⇔ $U(2N_1 - N_2 + k)_k \times U(N_1)_{-k}$ ABJ theory

1/6 BPS Wilson loop

1/2 BPS Wilson loop

What are they mapped to? → We have its answer.

Please come to my poster and let's discuss.

5-dim Superconformal Index and global symmetry enhancements

Sung-Soo Kim
[with Hee-Cheol Kim, Kimyeong Lee]

- 5d SCFT with SU(2) gauge group and N_f flavors

- Global symmetry is enhanced :

$$SO(2N_f) \times U(1) \to E_{N_f+1}$$

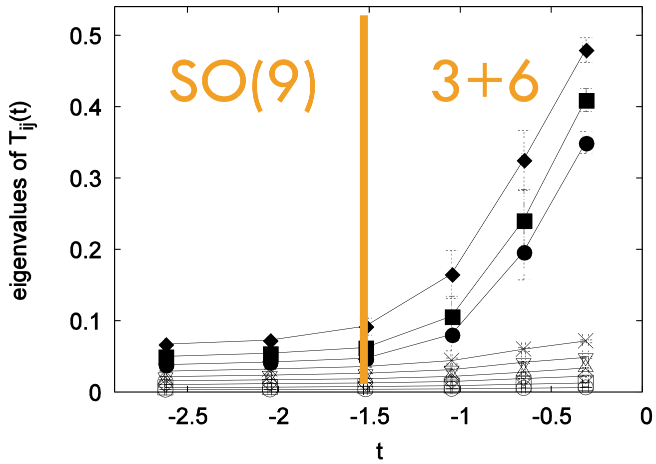
- Using the Superconformal index, we show the enhancement explicitly

$$\begin{aligned} I =& 1 + \left(1 + \chi_{\text{adj}}^{SO(2N_f)} + q\chi_{\text{s}}^{SO(2N_f)} + q^{-1}\chi_{\bar{\text{s}}}^{SO(2N_f)}\right)x^2 + \cdots \\ =& 1 + \chi_{\text{adj}}^{E_{N_f+1}} x^2 + \cdots \end{aligned}$$

Spontaneous breaking of rotational symmetry

Expanding 3D spaces

Monte Carlo study for cosmology



Noncommutative mechanism of SSB :
su(2) is preferred in a special limit.
3 gen = 3D spaces

SANG-WOO KIM (KIAS)

LORENTZIAN IIB MATRIX MODEL

w/ Ito, NISHIMURA, TSUCHIYA

PRL 108:011601, PRD 86:027901, JHEP 1210:147 (2012), works in progress

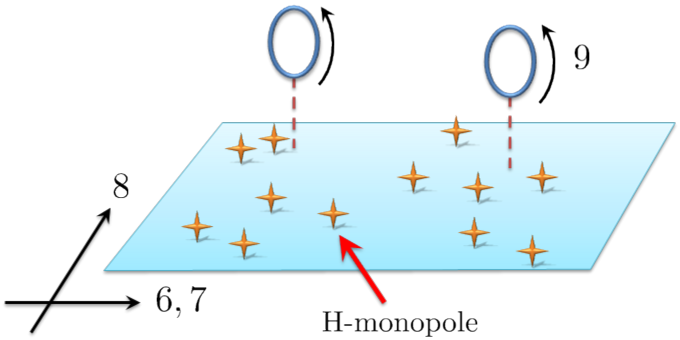
Classical solutions :
Valid for late time.
Many expanding commutative sol.
(power law, accelerating, etc)

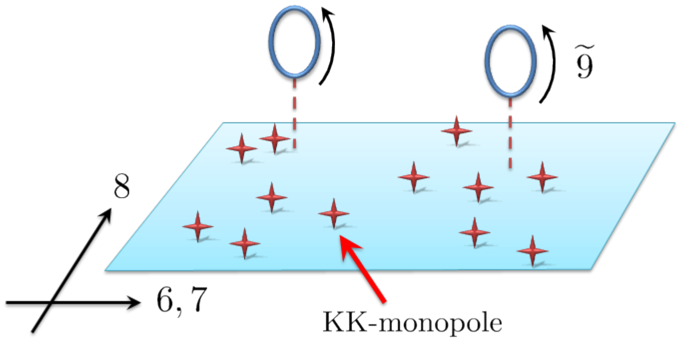
VDM model :
Quenched model w/ Vandermonde det to compensate absence of fermions.
Expands exponentially.

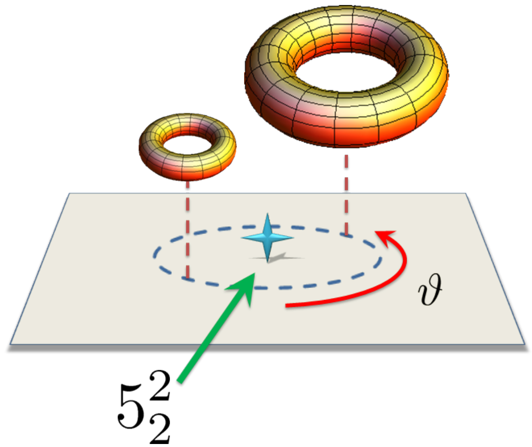
SPC model :
Exponential growth smoothly changes to power law expansion.
Suggests existence of new phase !

KIAS-YITP Joint Workshop at YITP (Poster Session: July 03, 2013)

Gauged Linear Sigma Model for Exotic Five-brane







Tetsuji KIMURA (Rikkyo University)

based on arXiv:1304.4061, arXiv:1305.4439

in collaboration with Shin SASAKI

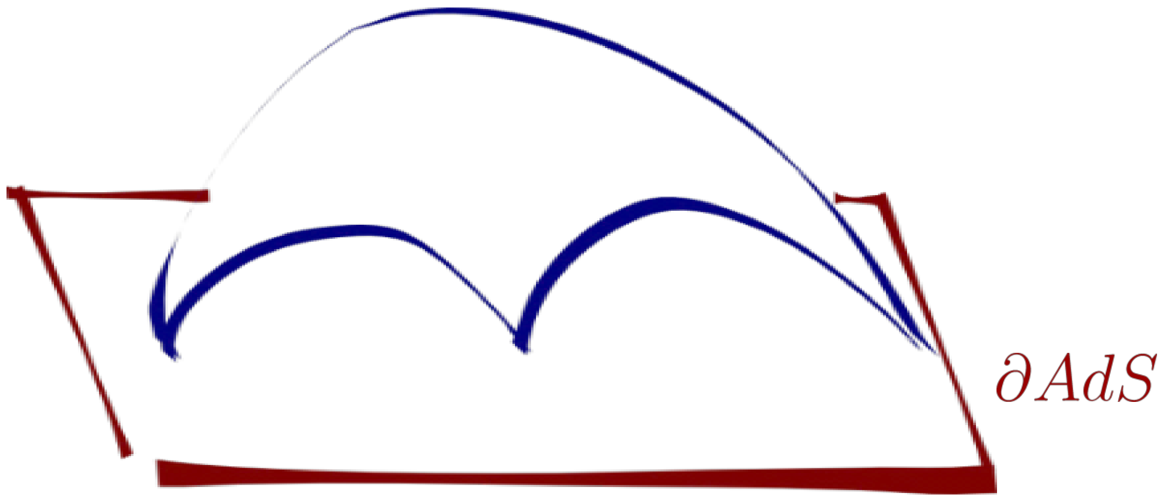
Holographic Three Point Functions for Strings in $AdS_2 \times S^3$

Shota Komatsu, University of Tokyo

- Long ("Heavy") BPS and Non-BPS 3-pnt functions in $\mathcal{N} = 4$ SYM

  SU(2)-sector at weak coupling: [Gromov, Escobedo, Sever, Vieira], [Kostov]

  Strong coupling:



(Area in $AdS_2 \times S^3$) + (Vertex operators)

[Janik, Wereszczynski] [Kazama, SK in progress]

For 3-BPS: $(\text{Area})_{AdS} + (\text{Area})_S = 0$.

Correct dependence on the coordinates and the R-charges from vertex ops.

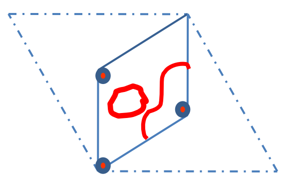
For details and discussions on non-BPS 3-pnts: Please see the poster.

Three Generation Models in Heterotic Asymmetric Orbifolds

Based on :hep-th1304.5621
+work in progress

Shogo Kuwakino (Chung Yuan Christian University)
Florian Beye (Nagoya University),
Tatsuo Kobayashi (Kyoto University)

Orbifold compactification of heterotic string theory



Asymmetric orbifold compactification

- Non-geometric compactification
- Models with a few moduli fields
- Many models (Generalization of orbifold)
- Systematic search for Standard model has not been investigated

Starting point for asymmetric orbifold

→ Narain compactification

- What kinds of Narain lattices can be starting point ?
- What kinds of gauge symmetries ?

Classification of lattices and gauge symmetries for Z3 asymmetric orbifold models

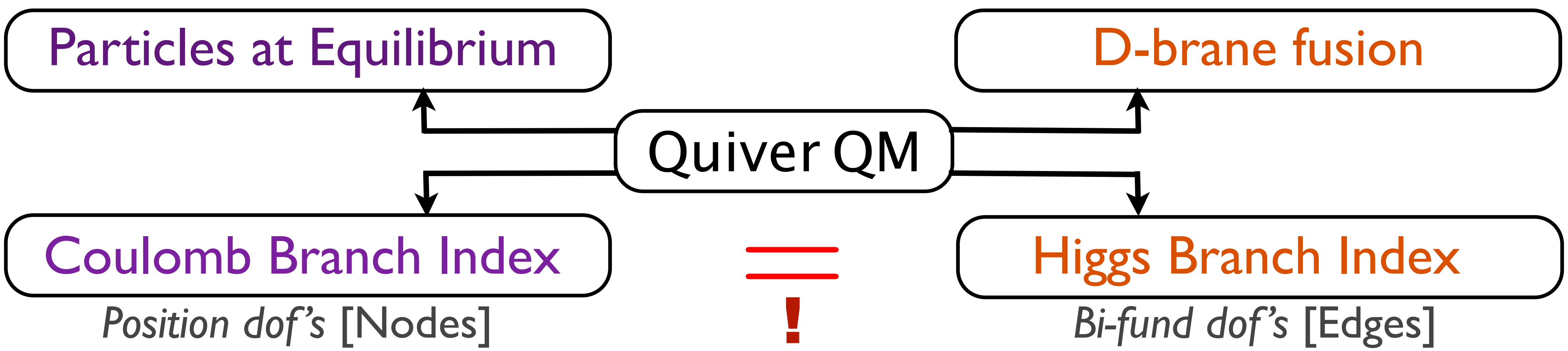
→ We find three-generation models with SM group

- with vector-like exotic fields
- A few exotic/singlet fields

Wall-Crossing and Quiver Invariants

1205.6511, 1207.0821 w/ P.Yi and Z.-L.Wang

- $\mathcal{N}$=2 Susy abelian gauge theories
  - BPS index (measure of short reps): jump across the wall
- BPS states as D-branes wrapping cycles
- Two pictures of the same BPS bound state of branes



- The two do not agree for quivers with a loop
  - Quiver invariants (measure of disagreement): do NOT jump across the wall

. . . . *An Example to be shown in the Poster!* . . . .

Effective Action for Dp-Brane in Large RR $(p-1)$-Form Background

Chen-Te Ma

Collaborator: Pei-Ming Ho

National Taiwan University

JHEP 1305, 056 (arXiv: 1302.6919 [hep-th])

July 3, 2013

D-brane Anomaly Inflow Revisited

Heeyeon Kim (Seoul National University)

Based on H. Kim, Piljin Yi (1201.0762)

- We studied a subtle issue of anomaly inflow mechanism.

- We showed the following :

① Inflow mechanism can be well applied to the self-dual D-branes.

② Topological coupling of D-branes can be written in more natural form.

- We also fixed the topological coupling for all types of Orientifold planes.

5D SYM and 2D q-Deformed YM

Nariaki Matsumiya (University of Tokyo)

6D $\mathcal{N} = (2, 0)$ on $S^3 \times S^1 \times \Sigma$

[Gaiotto]

S^1 compactification

5D $\mathcal{N} = 2$ SYM on $S^3 \times \Sigma$

Our exact calculation

Dual

4D $\mathcal{N} = 2$ on $S^3 \times S^1$ ⟷ 2D q-YM on Σ

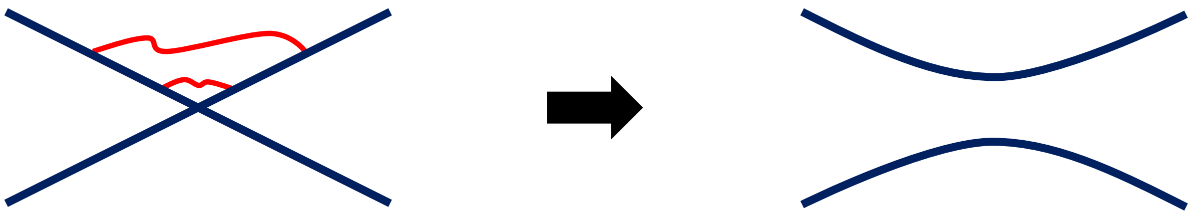
In this case, this 4D/2D duality is conjectured.The 4D theory is specified by the Riemann surface Σ.
On the other hand, how to derive the 2D theory from the 6D theory?
We discussed this derivation.

On brane recombination in the ABJM model

Akitsugu Miwa [CST, Nihon University] in collaboration with Takayuki Enari and Tomohisa Takimi

The D-brane recombination is caused by localized tachyonic modes:

[K.Hashimoto-S.Nagaoka JHEP0306(2003)034]



F1: Energy $\sim T_{F1} \times$ length → localized

Our question: How about the membrane ?

M2: Energy $\sim T_{M2} \times$ area → ??? localized ???

Thermodynamics of black M-branes from SCFTs

Ref) arXiv:1305.0789 with Shotaro Shiba

Takeshi Morita (KEK)

◆ Free Energies of Black D & M-branes from SUGRA

N branes

Dp-brane

$$F_{Dp} \sim N^2 T^{\frac{2(7-p)}{5-p}} \lambda^{-\frac{3-p}{5-p}}$$

M2-brane (ABJM)

$$F_{ABJM} \sim \underline{N^{\frac{3}{2}}} \sqrt{k} T^3$$

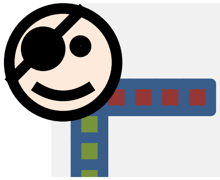
M5-brane

$$F_{M5} \sim \underline{N^3} T^6$$

What is the microscopic origin of these exotic N dependences of M-branes?

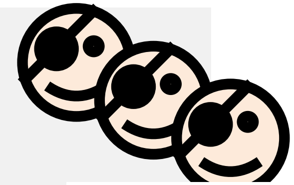
We successfully reproduce these free energies from ABJM theory and 6d SCFT through a simple estimation.

- SUSY plays a essential role to explain these N dependences.
- Dynamics of Dp and M-branes are similar, although the N dependences are different.



Captain Hook

ABJM Matrix Model
- Partition Function & Wilson Loop -



The Pirates

ABJM Matrix Model

$$\frac{1}{(N!)^2}\int\prod_i\frac{d\mu_i}{2\pi}\prod_k\frac{d\nu_k}{2\pi}e^{-(\sum\mu_i^2-\sum\nu_k^2)/2g_s}$$
$$\times\frac{\prod_{i<j}\left(2\sinh\frac{\mu_i-\mu_j}{2}\right)^2\prod_{k<l}\left(2\sinh\frac{\nu_k-\nu_l}{2}\right)^2}{\prod_{i,k}\left(2\cosh\frac{\mu_i-\nu_k}{2}\right)^2}$$

M-theory?
Membranes? $N^{3/2}$?
NonPert.Effects?

Grand Potential

$e^{J(\mu)} = \sum_{N=0}^{\infty} e^{\mu N} \langle 1 \rangle_N$

Partition Function [HMO, Hatsuda-Marino-M-Okuyama]

$J(\mu)=J^{\rm pert}(\mu)+J^{\rm WS}(\mu^{\rm eff})+J^{\rm MB}(\mu^{\rm eff})$

$J^{\rm pert}(\mu)=C\mu^3/3+B\mu+A$

$J^{\rm WS}(\mu^{\rm eff})=F_{\rm top}(T_1^{\rm eff},T_2^{\rm eff},\lambda)$

$J^{\rm MB}(\mu^{\rm eff})=(2\pi i)^{-1}\partial_\lambda[\lambda F_{\rm NS}(T_1^{\rm eff}/\lambda,T_2^{\rm eff}/\lambda,1/\lambda)]$

GC Wilson Loop

$W(\mu) = e^{-J(\mu)} \sum_{N=0}^{\infty} e^{\mu N} \langle W \rangle_N$

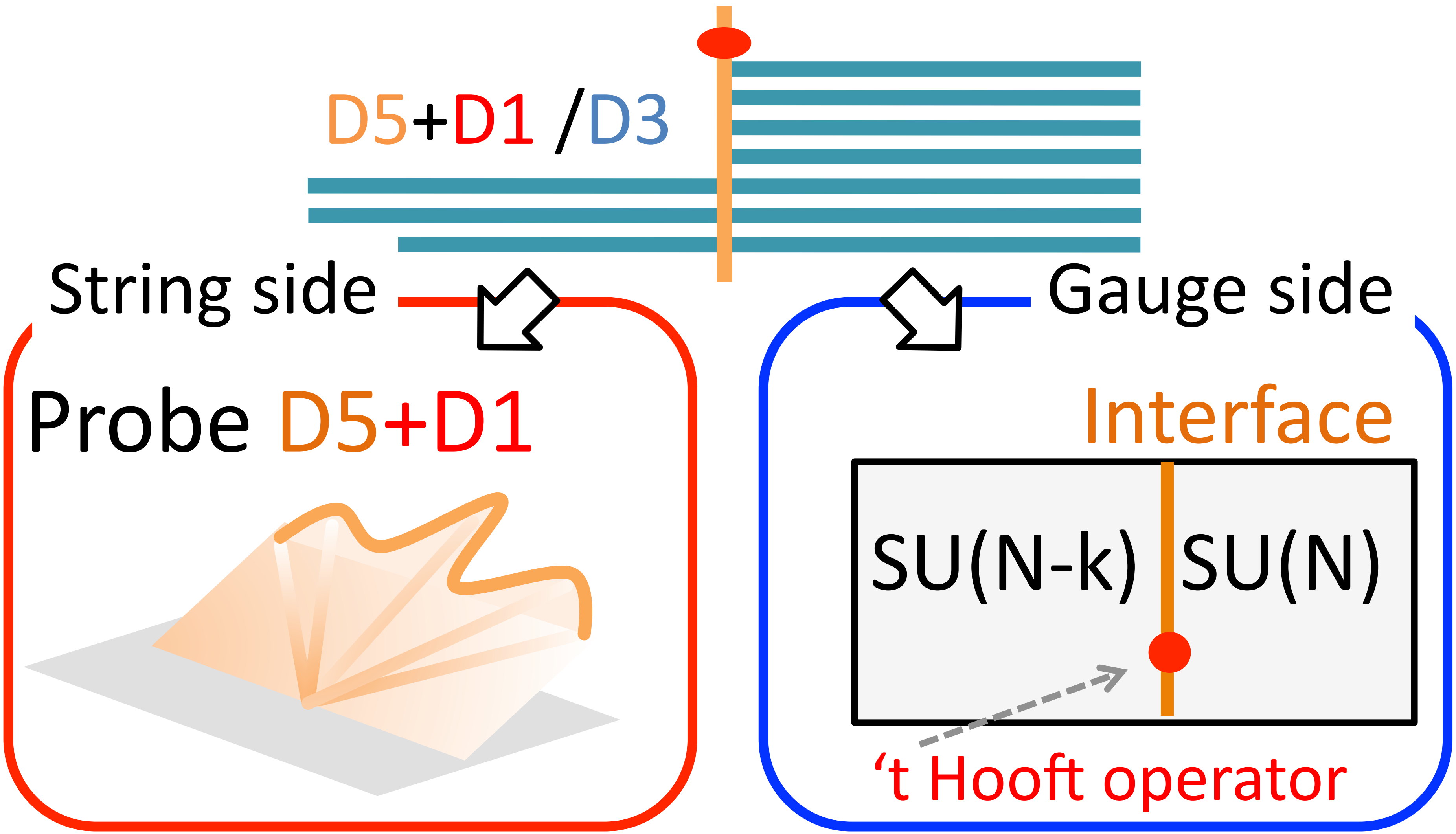
Wilson Loop [Hatsuda-Honda-M-Okuyama]

$W(\mu)= F^{\rm open}(\mu^{\rm eff})$

Membrane Instanton・Pole Cancellation・Refined Topological Strings

Bubbling Probe D5-brane

Koichi Nagasaki (Osaka Univ.)



Non-equilibrium phase transitions from AdS/CFT

Shin Nakamura (Nagoya U.)

Why non-equilibrium? : a good place to apply AdS/CFT

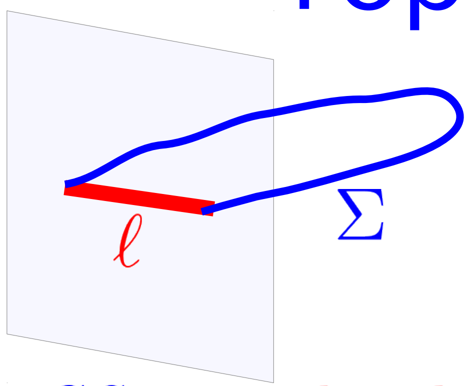
- Frontier in modern physics, closely connected our daily life.
- Statistical physics after the coarse graining: the difference between the holographic setup and that in nature can be less important.

A discovery of new phase transitions and a new critical point in non-equilibrium steady states,

found under the presence of constant flow of current in a holographic setup (published in PRL): please come to see.

[S.N. PRL 109 (2012) 120602]

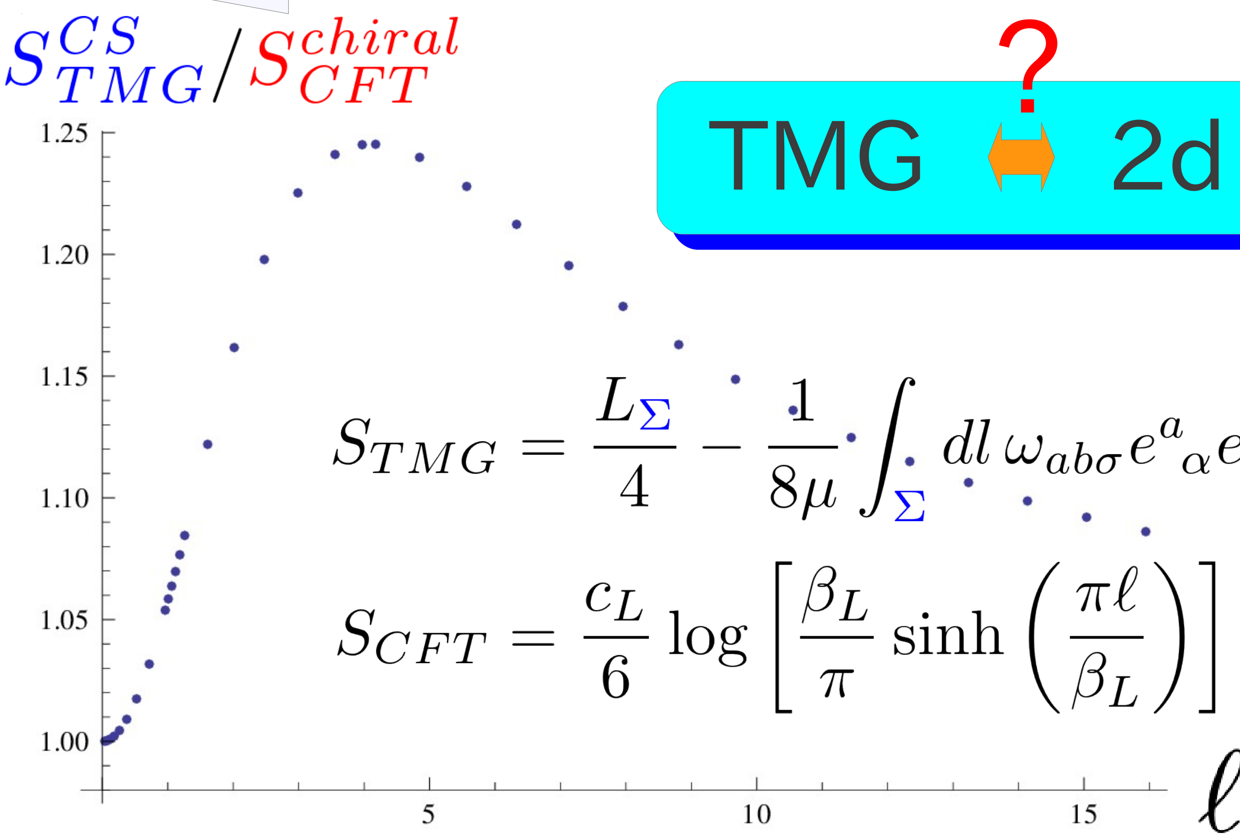
Holographic Entanglement Entropy in Topologically Massive Gravity



Noriaki Ogawa (KIAS)

w/ Tomonori Ugajin (YITP)

TMG ⇔? 2d $c_L \neq c_R$ CFT



$$S_{TMG} = \frac{L_\Sigma}{4} - \frac{1}{8\mu}\int_\Sigma dl\, \omega_{ab\sigma} e^a{}_\alpha e^b{}_\beta \epsilon^{\mu\nu\sigma} N^\alpha{}_\mu N^\beta{}_\nu$$

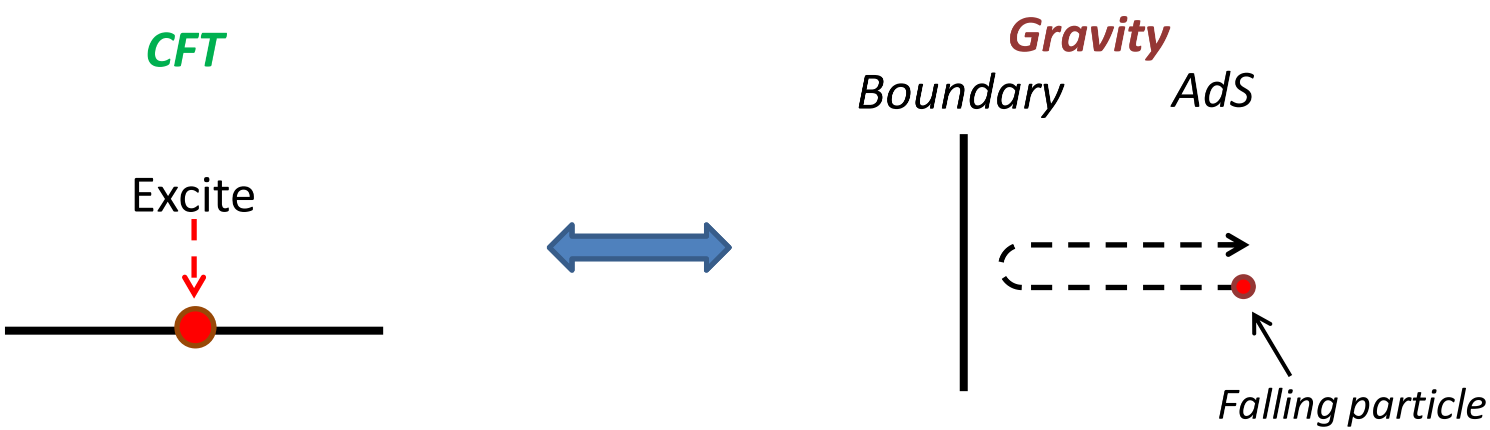
$$S_{CFT} = \frac{c_L}{6}\log\left[\frac{\beta_L}{\pi}\sinh\left(\frac{\pi\ell}{\beta_L}\right)\right] + \frac{c_R}{6}\log\left[\frac{\beta_R}{\pi}\sinh\left(\frac{\pi\ell}{\beta_R}\right)\right]$$

Holographic Local Quenches and Entanglement Density

Masahiro Nozaki (YITP)

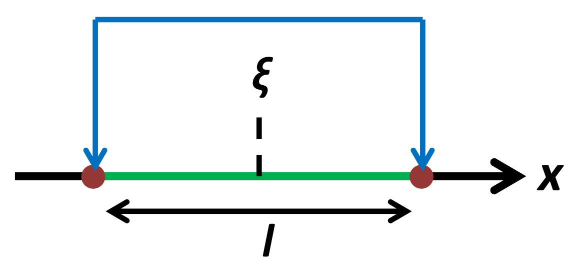
W/ Tokiro Numasawa, Tadashi Takayanagi, on JHEP 1305 (2013) 080 (arXiv:1302.5703 [hep-th]).

- We propose ***a new holographic model*** of the local quench:



- We introduce a new quantity "***Entanglement Density*** $n(l,\xi,t)$ " which measures the two body entanglement between two points:

$$n(l,\xi,t) =$$



Supersymmetric Plebański-Demiański solution

Masato Nozawa (KEK), coworker: Dietmar Klemm (Milano Univ.)
based on JHEP 1305 (2013) 123, Poster # 33

Supersymmetric solutions in supergravities

$$\delta\psi_\mu \sim \hat{\nabla}_\mu \epsilon = 0 \qquad \text{:Killing spinor}$$

- utilizing bilinears of Killing spinors, systematic classifications of BPS geometries have been developed recently

⟶ metric & flux obey simpler set of equations than Einstein's eqs.

- in gauged supergravities, reduced system obeys a ***nonlinear*** set of eqs.

  - we found the most general BPS solutions with Petriv-type D (Plebanski-Demianski metric) in 4D $\mathcal{N}$=2 minimal gauged supergravity

  - Wick rotation gives a gravitational instanton which admits an integrable almost complex structure

Squashed cones and surface contributions to entanglement entropy
Dmitri Fursaev, Alexander Patrushev and Sergey Solodukhin
$\mathcal{M}_n$ from n replicas,locally $\mathcal{C}_n \times \Sigma$. No $O(2)$ isometry. Regularized metric for a cylindrical entangling surface

$$ds^2 = r^2 d\tau^2 + f_n(r,b)dr^2 + (a + r^n c^{1-n}\cos\tau)^2 d\varphi^2 + dz^2$$

$$\int_{\tilde{\mathcal{M}}_n} \mathcal{R}^2 \to n\int_{\mathcal{M}} \mathcal{R}^2 + 4\pi(1-n)\int_\Sigma \left(\mathcal{R}_{proj} - \alpha_1 k^2 - \alpha_2 \,\mathrm{Tr}\, k^2\right) + ...$$

Euler and Weyl terms reproduce logarithmic contributions to entanglement entropy for 4 D CFT theory without holographic calculations.
Holographic formula for the bulk gravity with quadratic terms

$$S(\Sigma) = \frac{A(\tilde{\Sigma})}{4G_{(5)}} + 4\pi\int_{\tilde{\Sigma}} \sqrt{\gamma}d^3y \left[2aR + b\left(R_{ii} - \frac{1}{2}k^2\right) + 2c(R_{ijij} - \mathrm{Tr}k^2)\right]$$

Ryu-Takayanagi $a = b = c = 0$. Gauss-Bonnet $a = 2\lambda$, $b = -4\lambda$, $c = \lambda$: $S(\Sigma) = \frac{A(\tilde{\Sigma})}{4G_{(5)}} + 8\pi\lambda\int_{\tilde{\Sigma}} \sqrt{\gamma}d^3y\ \hat{R}$
Off-shell ? vs On-shell A. Lewkowycz and J. Maldacena
Generalized entropy

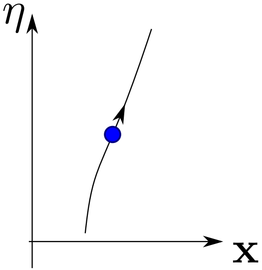
Systematic construction of non-BPS black holes in $N = 2$ supergravity

Jan Perz
Istituto Nazionale di Fisica Nucleare, Turin

Master equation for the Unruh-DeWitt detector and the universal relaxation time in de Sitter space

Yuho Sakatani (Maskawa Institute, Kyoto Sangyo U.)
in collaboration with **Masafumi Fukuma** and **Sotaro Sugishita** (Kyoto U.)
[arXiv:1305.0256 [hep-th]]

Unruh-DeWitt detector
interacting with
a scalar field $\phi(x)$
in de Sitter space



If the scalar field is in the Bunch-Davies vac. $|0_{\rm BD}\rangle$, a stationary detector is known to respond as if it is in a thermal bath with temperature

$$T_{\rm dS} = \frac{1}{2\pi\ell}\,.$$

Our result

If the scalar field is in the instantaneous ground state at a finite past, $\eta = \eta_0$, $|0_{\eta_0}\rangle$, the density matrix of an Unruh-DeWitt detector exhibits a relaxation to the thermal distribution with the universal relaxation time, $\tau_{\rm relax} = \ell/2\,.$

2D CDT IS 2D HORAVA-LIFSHITZ QUANTUM GRAVITY

Yuki Sato (KEK)

work with J. Ambjørn, L. Glaser and Y. Watabiki, Phys. Lett. B **722** (2013) 172.

Small scale structure
regularized by CDT

Large scale structure
described by field theory

2d projectable Horava-Lifshitz:

$$S_{\rm HL} = \int dt\, dx\, N\gamma \left[(1-\lambda)K^2 - 2\Lambda\right]$$

where $N = N(t) \qquad \Lambda > 0 \quad \lambda < 1$

→ CDT and Horava-Lifshitz are in the same universality class in 2D!!

Quark-Antiquark Potential in Holographic Schwinger Effect

arXiv:1304.7917 & 1306.5512

Yoshiki Sato(Kyoto univ.)

in collaboration with Kentaroh Yoshida(Kyoto univ.)

- We consider the Schwinger effects in Coulomb phase and confining phase by using holographic setups.
- We find the critical electric field above which there is no potential barrier and the system becomes unstable catastrophically.
- In a confining phase, we also find that no Schwinger effect occurs when the electric field is smaller than the confining string tension.

Exact results of theories with SU(2|4) symm. and the gauge/gravity correspondence

Shinji Shimasaki (Kyoto U.)

- Theories with SU(2|4) symmetry (16 SUSY)

  N=4 SYM on $R \times S^3/Z_k$, N=8 SYM on $R \times S^2$, plane wave matrix model

- Apply the localization to these theories

→
- ➢ the gauge/gravity correspondence (IIA bubbling geometry)
- ➢ IIA little string theory on $R \times S^5$ from the plane wave matrix model

Gauge Symmetry Breaking in a Non-Supersymmetric D-brane Model

Shutaro Kobayashi (together with Noriaki Kitazawa)

I want to describe the beyond SM using D-branes.

Two important results in LHC experiment based on the research:
- discovered Higgs(-like) particle with the mass, 125-126(GeV).
- MSSM is difficult to think about beyond SM.

As bottom-up approach,
- Regge slope or String scale tune to describe the Higgs mass.
- want to describe the non-supersymmetric model beyond SM.

Construct a toy model using four D3-branes and three anti-D7-branes.
- describe a non-supersymmetric U(2)xU(1)xU(1)xU(3) gauge theory, after an appropriate Z_3 projection

Main topics of the research
- obtain the non-trivial four point potential due to Superstring world-sheet theory.
- investigate the geometrical aspect of D3-branes after gauge symmetry breaking.

Spontaneous Generation of Angular Momentum in Holographic Theories

- We present a holographic mechanism for spontaneous generation of angular momentum and edge current in the presence of bulk Chern-Simons interactions $\vartheta R \wedge R$ or $\vartheta F \wedge F$.
- Systems with nonzero bulk scalar hair generally acquire angular momentum, scalar profile need not be nontrivial.
- Large class of models where both angular momentum density and Hall viscosity are nonzero, but no obvious relation between the two.
- Based on arXiv:1212.3666 (H. Liu, H. Ooguri, B. S., N. Yunes) and arXiv:13xx.xxxx (H. Liu, H. Ooguri, B. S.).

On propagators in de Sitter space

Sotaro Sugishita (Kyoto univ.) arXiv:1301.7352

Collaborators : M. Fukuma (Kyoto univ.) & Y. Sakatani (MISC)

In a general curved spacetime, we do not have a natural choice for the vacuum of the quantum field.

In this work, taking the vacuum of a free scalar field
to be the instantaneous ground state of the Hamiltonian
at each moment,
we develop a method to calculate propagators for a scalar field in a nonstationary spacetime.
We apply the method to de Sitter space and obtain de Sitter invariant propagators.

Phase structures of Chern-Simons matter theories on $S^2 \times S^1$

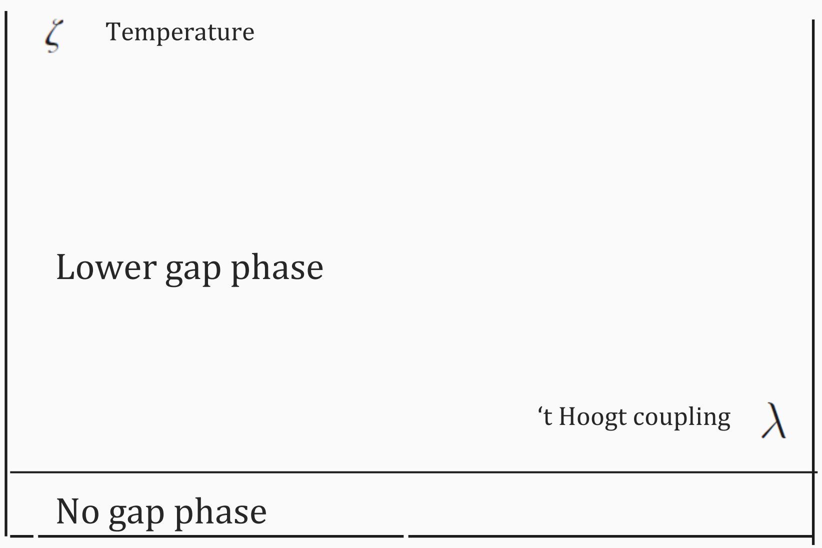
Tomohisa Takimi (TIFR)

[Jain, Minwalla, Sharma, T.T, Wadia, Yokoyama 1301.6169]
[T.T 1304.3725]

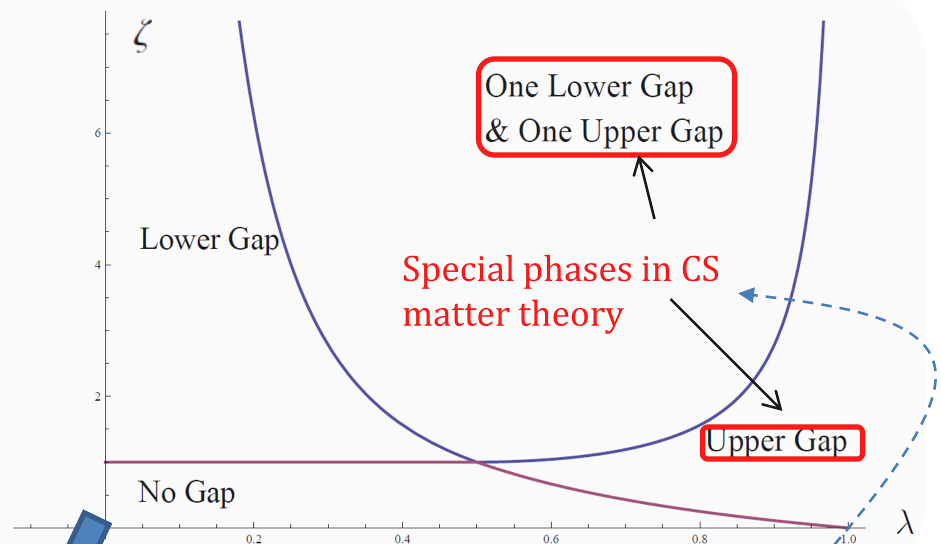
Non-SUSY AdS/CFT

Information of Vasiliev's theory, QG ? ← **Phase structure of CS matter theory**

Different from the phase structures in usual YM theories on Sphere



Usual YM theory



CS matter theory

Interesting information of QG ?

Due to the monopole configuration & non-propagating gauge field s in CS.

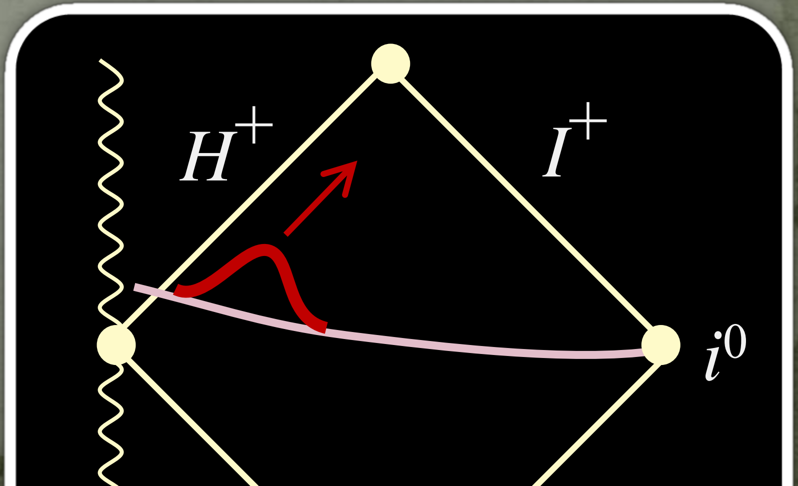
Horizon instability of an extreme Reissner-Nordström BH

Norihiro Tanahashi (Kavli IPMU)
with J. Lucietti, K. Murata, H. S. Reall

- 4D Black holes ⇦ Classically Stable (mostly)
- *Extreme* BH:
  - ✓ $\kappa = 0$ ⇨ New phenomena on the horizon

↳ Instability on Extreme Horizons

[Aretakis 2011, 2012]



An entropy formula for higher spin black holes via conical singularities (Tomonori Ugajin YITP)

Based on work with Per Kraus arXiv:1302.1583

Higher spin black holes : black holes in higher spin theory in 3d (with higher spin charge).

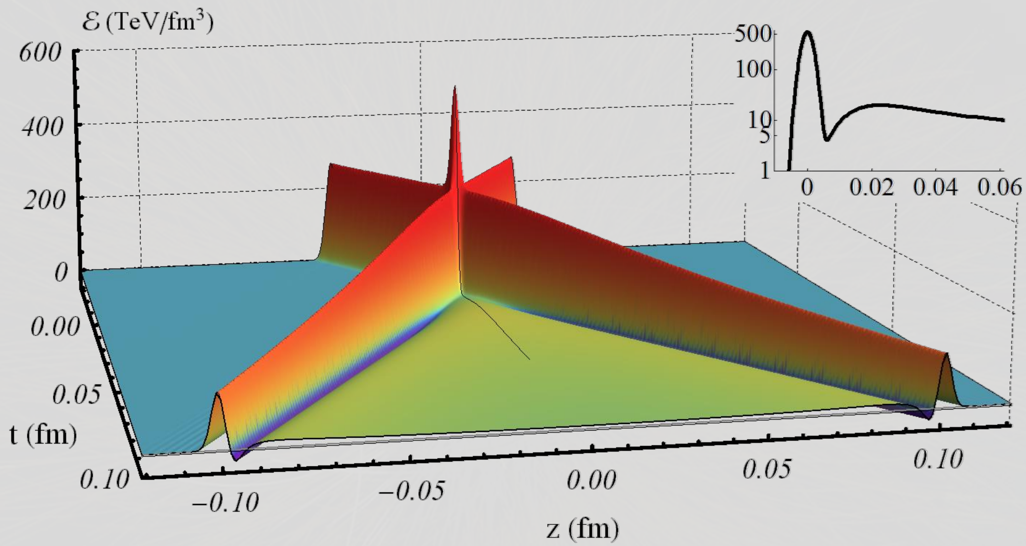
Due to gauge symmetries of higher spin fields, a event horizon is gauge dependent concept . Wald like formula for higher spin black holes?

We find an entropy formula for general static higher spin black holes by employing conical singularity approach.

From full stopping to transparency

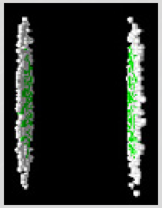
Colliding shocks in AdS

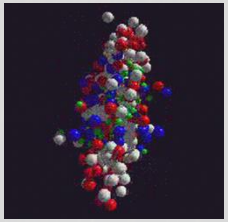
Wilke van der Schee, PhD student, Utrecht

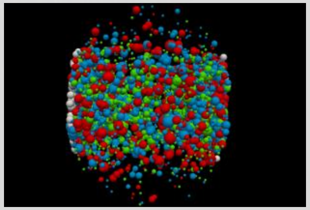


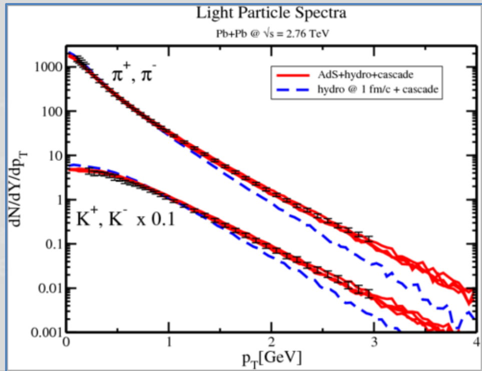
Work with Michal Heller, David Mateos, Jorge Casalderrey

Paul Romatschke and Scott Pratt









"almost like a real collision"

Bulk Physics and Descendants

Zhao-Long Wang (KIAS)

- An alternative proposal for the bulk local operator in AdS
  - $\langle \mathcal{O}(z,x)\mathcal{O}(x') \rangle = K(z,x;x')$
  - Construct $\mathcal{O}(z,x)$ by the descendant of the primary $\mathcal{O}(x)$?
  - The answer is given by the normalizable mode

$$\mathcal{O}(z,x) = \frac{1}{2\Delta - d}\, {}_0F_1\left(;\Delta - \frac{d}{2} + 1; -\frac{z^2}{4}\Box\right)\mathcal{O}(x)$$

- Consistency check

$$\Big\langle \mathcal{O}(z,x)\,\mathcal{O}(z',x') \Big\rangle = \text{The standard bulk} - \text{bulk propagator}$$

- Field theory arguments
  - Zero-th order field renormalization at energy scale $\mu = 1/z$

$$\mathcal{O}(\mu,x) = \sum Z_n(\mu,\Lambda)\Box^n \mathcal{O}_b(x)$$

  - Conformal transformation of $\mathcal{O}(\mu,x)$ should also include the transformation of μ.
  - Conformal invariance implies the solution of bulk EOM.

Analytical study of two-band holographic superconductor

Wen-Yu Wen

Department of Physics, Chung Yuan Christian University, Taiwan

In collaborated w/ Jackson Wu and Shang-Yu Wu

Model

$$e^{-1}\mathcal{L} = R - \frac{6}{L^2} - \frac{1}{4}F^2 - |(\partial + igA)\Psi_1|^2 - |(\partial - igA)\Psi_2|^2 - V(\Psi_1, \Psi_2),$$

$$\text{with} \quad V(\Psi_1, \Psi_2) = m_1^2|\Psi_1|^2 + m_2^2|\Psi_2|^2 + \frac{\eta}{2}(\Psi_1\Psi_2^* + \Psi_2\Psi_1^*).$$

Near Tc

$$\Phi = \lambda r_+(1-z),$$

$$\Psi_i = \frac{<\mathcal{O}_i>}{\sqrt{2}r_+^{\Delta_i}} z^{\Delta_i} F^i(z),$$

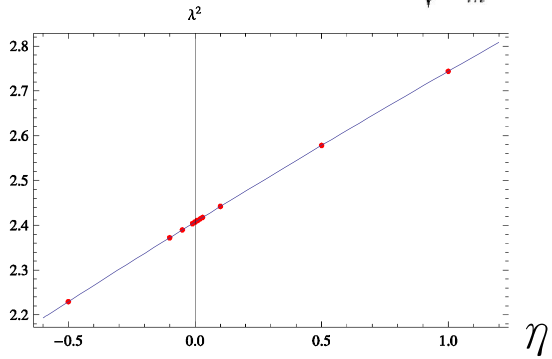
Trial function

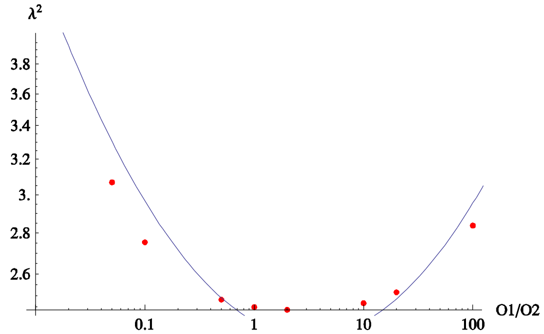
$$F_i = 1 - \alpha_i z^2.$$

$$<\mathcal{O}_1> = (1 - \frac{T}{T_c})^{1/2}\gamma_1 T_c^{\Delta_1}(1 - \frac{1}{2}(\frac{\gamma_1}{\gamma_2})^2 T_c^{2(\Delta_1-\Delta_2)}\frac{<\mathcal{O}_2>^2}{<\mathcal{O}_1>^2}),$$

$$<\mathcal{O}_2> = (1 - \frac{T}{T_c})^{1/2}\gamma_2 T_c^{\Delta_2}(1 - \frac{1}{2}(\frac{\gamma_2}{\gamma_1})^2 T_c^{2(\Delta_2-\Delta_1)}\frac{<\mathcal{O}_1>^2}{<\mathcal{O}_2>^2}),$$

$$T_c = \frac{3}{4\pi}\sqrt{\frac{\rho}{\lambda_m}}$$





Work partially sponsored by
Taiwan's National Science Council

Quantization of Emergent Gravity

Hyun Seok Yang (CQUeST)

Duality from Quantization

► Any noncommutative (NC) space introduces a new kind of duality:

NC phase space ⟺ wave-particle duality

NC spacetime ⟺ gauge-gravity duality

► NC spacetime admits a novel form of equivalence principle for electromagnetic force

⟸ Darboux theorem or Moser lemma in symplectic geometry

► $U(1)$ gauge theory on $M \times \mathbb{R}^{2n}_{\theta} \equiv$

$U(N \to \infty)$ Yang-Mills theory on M

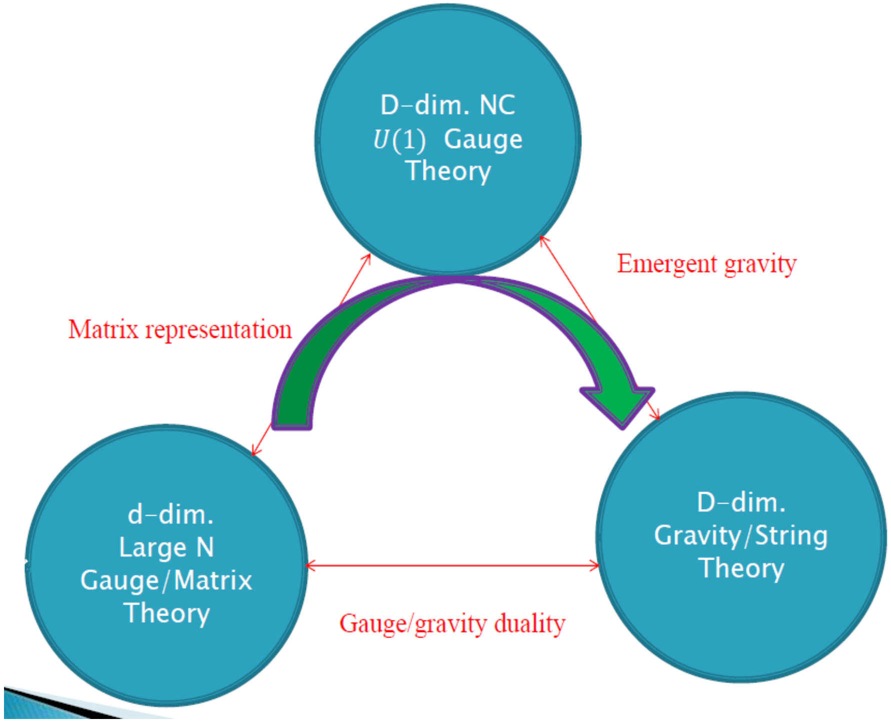
⟺ Large N duality

► Large N gauge theory or matrix model ≃

Background independent quantum gravity

► Spacetime as well as matters fields is equally emergent from a universal vacuum of quantum gravity

Emergent quantum gravity



$$D = d + 2n$$