Introduction to Ads/CFT for Nuclear physicists

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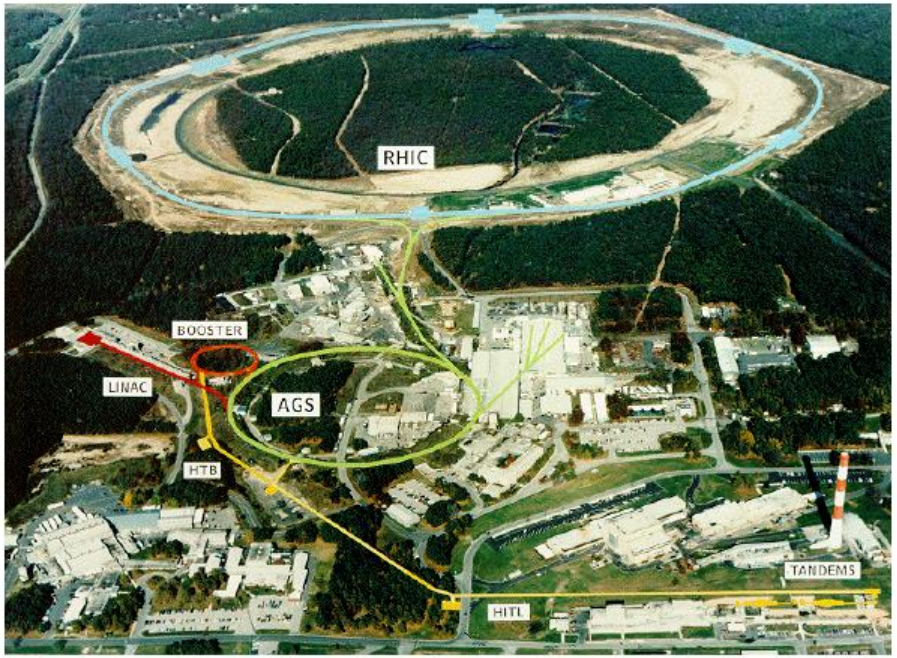


Contents

1. Why AdS/CFT?
2. holographic QCD and RG Flow.
3. Finite Temperature and Confinement 1
4. History: from QCD string to D-brane
5. How AdS Emerges
6. AdS/CFT and its basic structure
7. Chemical potential
8. Finite Temperature and Confinement 2
9. What we can do with it.

1. Why AdS/CFT for Nuclear Physics?

- Shear viscosity /entropy density

  experiment: <0.1

  for pQCD: $\eta / s = \frac{1}{g^4 \ln g} >> 1$

  for String Theory : 1/4π =0.09

- The method string theory used is AdS/CFT

Plan of the session:

SJS : basic concepts

Y. Kim: Bottom up

Y. Seo: Top down

K. Jo: Two point functions.

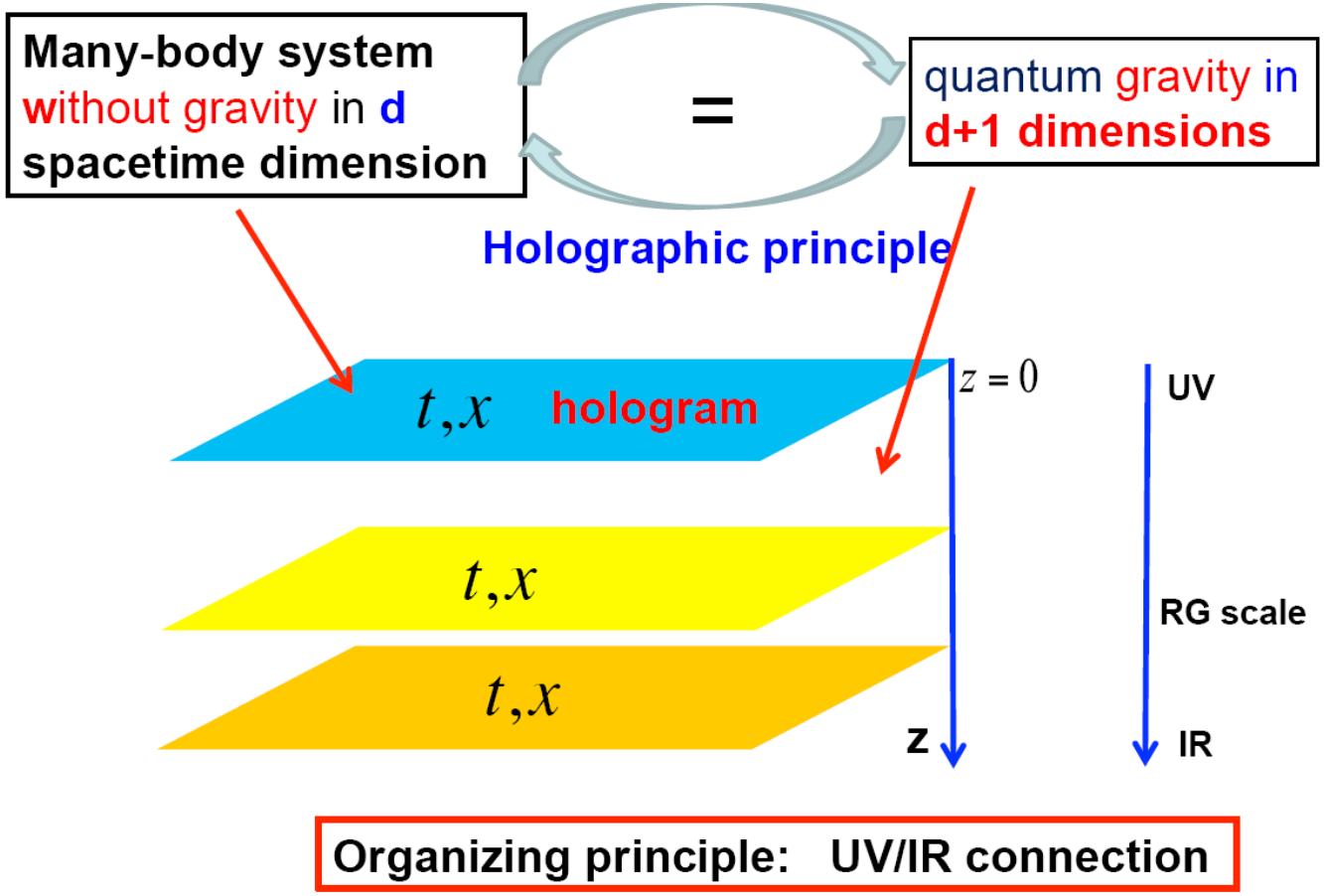
Aim of the talk is a communication:
what can we do together.

After I show a few pictures,

I will just answer your questions.

Geometrization of RG flow

- One way to view the AdS/CFT



Temperature

Finite temperature

boundary system at a finite temperature

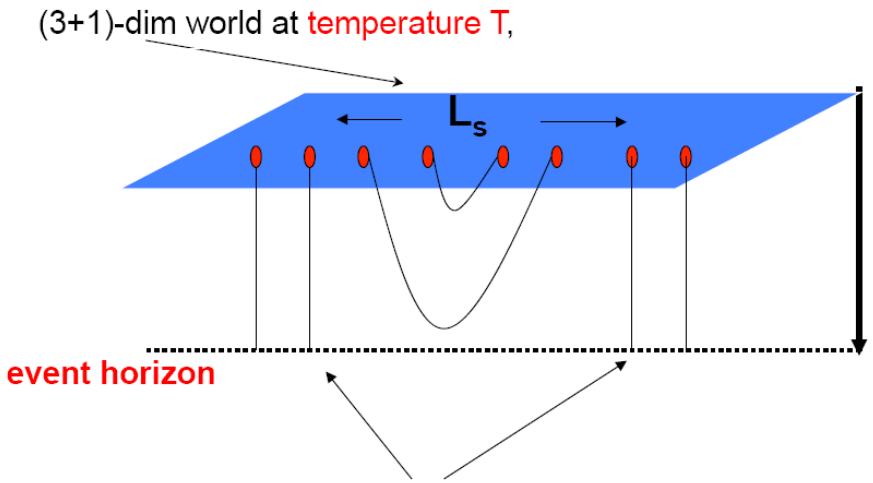
Black hole

Entropy, energy, Euclidean action of BH

Entropy, energy, free energy of YM theory

Confinement v.s deConfinement

Screening of quarks in a QGP

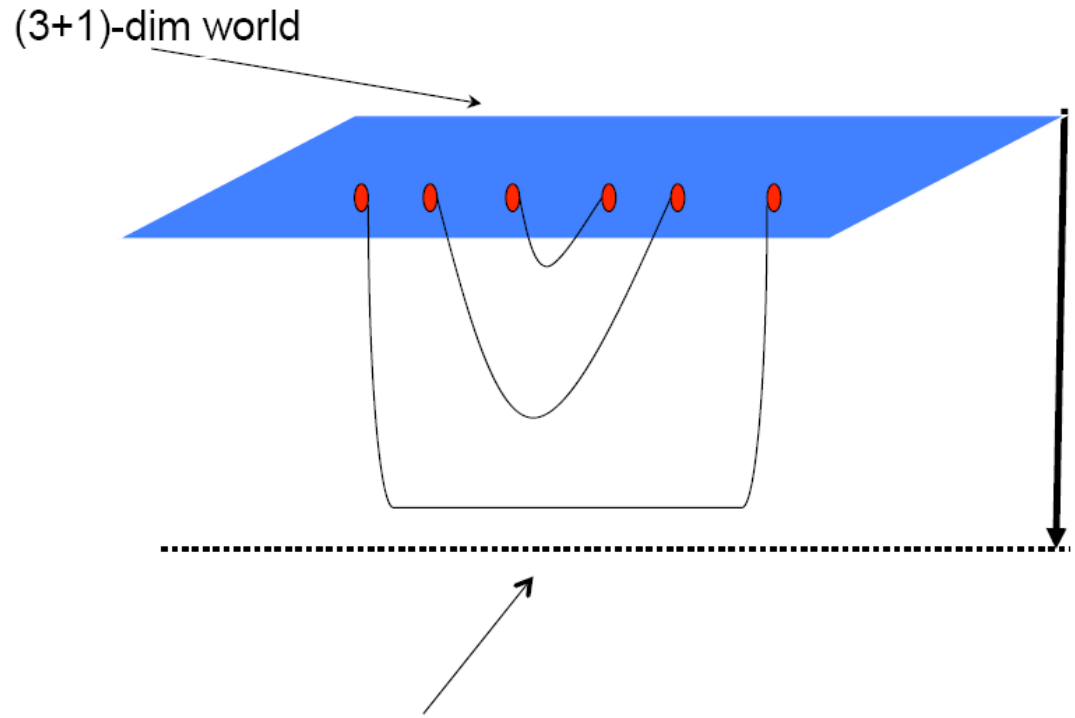


N=4 : $L_S = 0.277/T$, QCD (2 flavor): $L_S \sim 0.5/T$

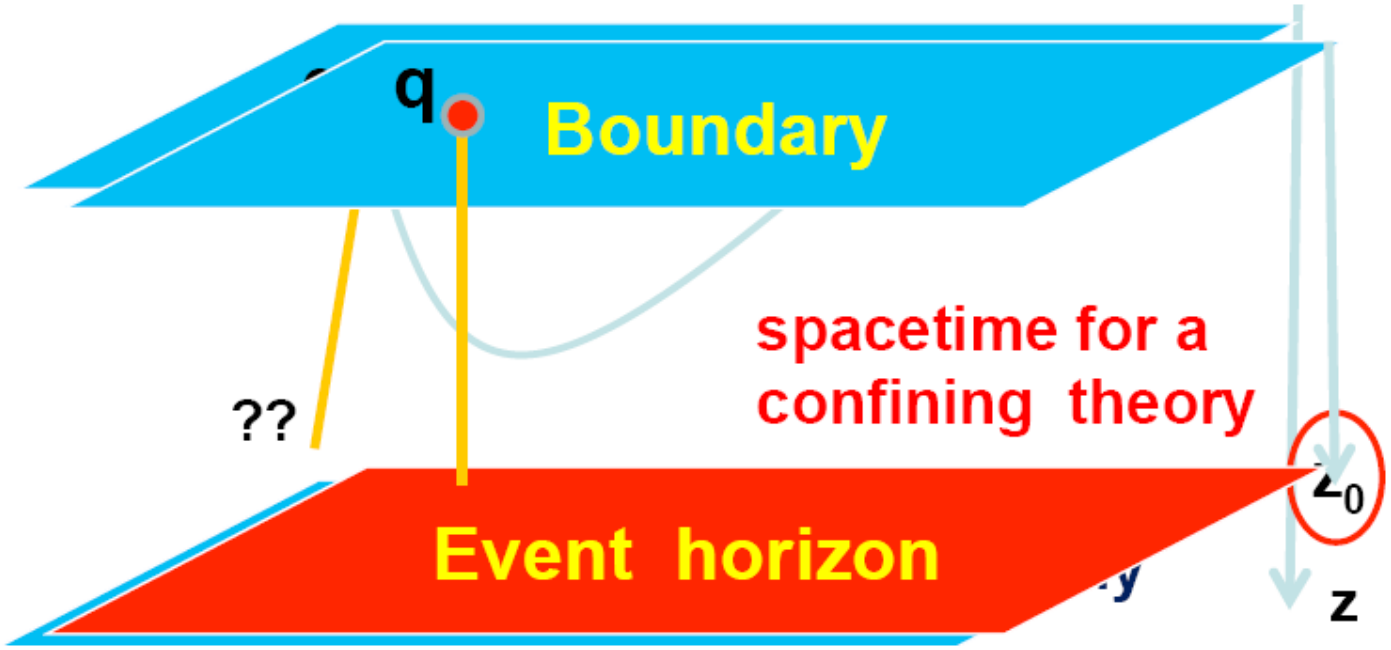
(lattice)

Confinement v.s deConfinement

Confinement



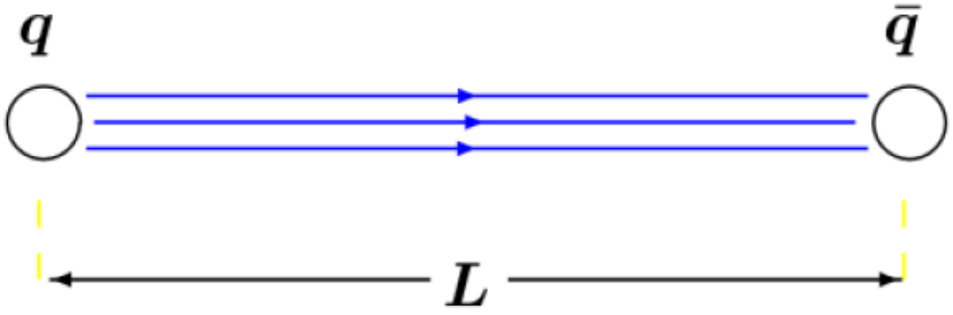
Confinement v.s deConfinement



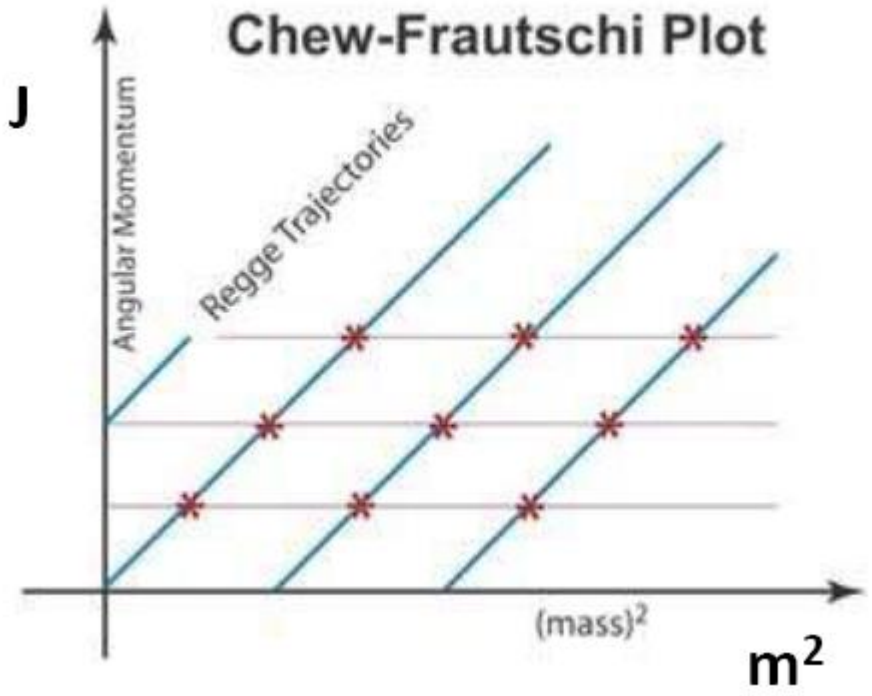
History:
from QCD string to D-brane

- Confinement → Flux string
- QCD string

Confining theory: Linear potencial: $E \propto L$



. QCD string was good for Regge strajectory



Open string theory

$$m^2 = (J-1)/\alpha'$$

$$\alpha' \sim 1(GeV)^{-2}$$

Spin 1 is a massless spectrum ➔ photon , gluon?

History

- Bad for parton behavior
- So QCD string is good for low E and bad for the high energy.
- Negative beta function of QCD implied Asymptotic freedom.
- QCD string was dead in 1973.

Closed string 1974

- Found graviton in Closed string
- $$m^2 = (J + \tilde{J} - 2)/4\alpha'$$

- Paradigm shift : alpha' is changed from 1GeV to Plank scale.

D-brane

- Dirichlett boundary condition
- D-brane = black p-brane with charge. (Polchinski) Dp,
- Its vibration = open string modes

closed string in warped geometry.

If lambda>>1, gs<<1

Gravity description is valid.

… too much constraint. Let go to board.

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What can we do with it.

- Phase transition, equation of state.
- Two point function
  → Transports. Spectral fct
  Viscosity conductivity heat cd
- Elliptic flow(time dependence)
- Dissipation and energy loss. (dragging)
- Meson/Baryon spectrum
- Symmetry energy
- Lepto and Photo emission rate …….

Conclusion

- Almost everything can be calculated in terms of ads/cft.
- Model dependence and deviation from the real qcd is not controlled yet.
- Can we bypass qcd
  hqcd v.s exp?