

Topological Gravity and Holography

based on arXiv.2307.0321 (PRD)

Dusan Dordevic

Faculty of Physics, University of Belgrade
ICTP, Black Holes, String Theory and Holography
Gong show



Chamseddine's topological gravity

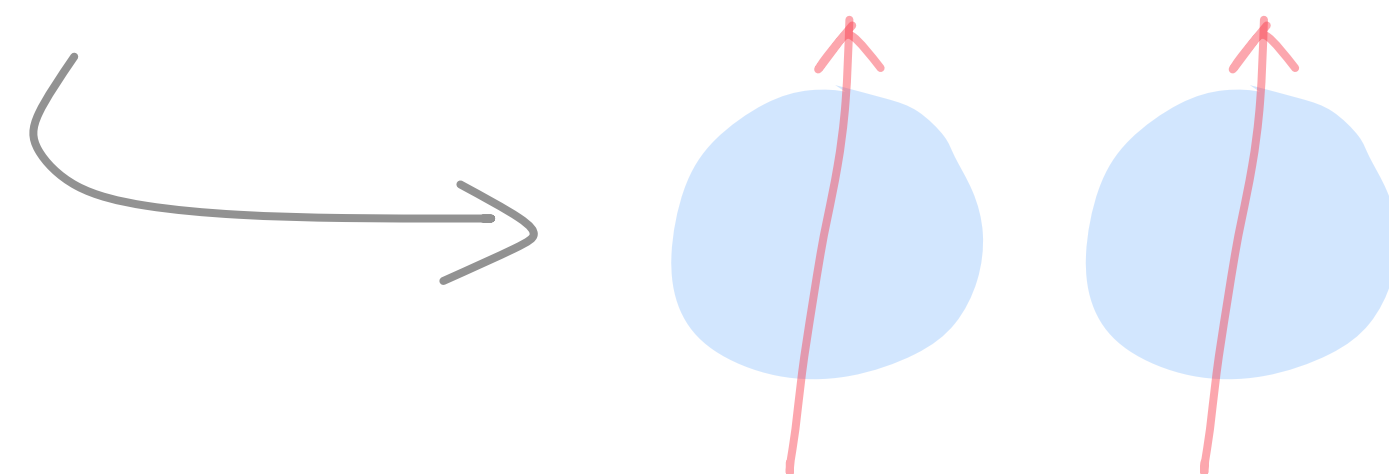
- In odd dimensions, Chern-Simons gravity [Miskovic, Olea, Theisen, Cvetkovic, Simic, Banados,...]

- In even dimensions, $\int \text{Tr } \phi F^n$ [DD, Gocanin]

- In four dimensions:

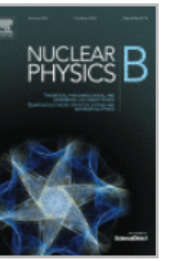
$$S = \int \varepsilon_{ABCD} \left[\varphi (R^{AB} + e^A e^B) (R^{CD} + e^C e^D) + 4\phi^A T^B (R^{CD} + e^C e^D) \right]$$

- Why do we care?



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Topological gravity and supergravity in various dimensions

A.H. Chamseddine *

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Holography on Riemann-Cartan spacetime

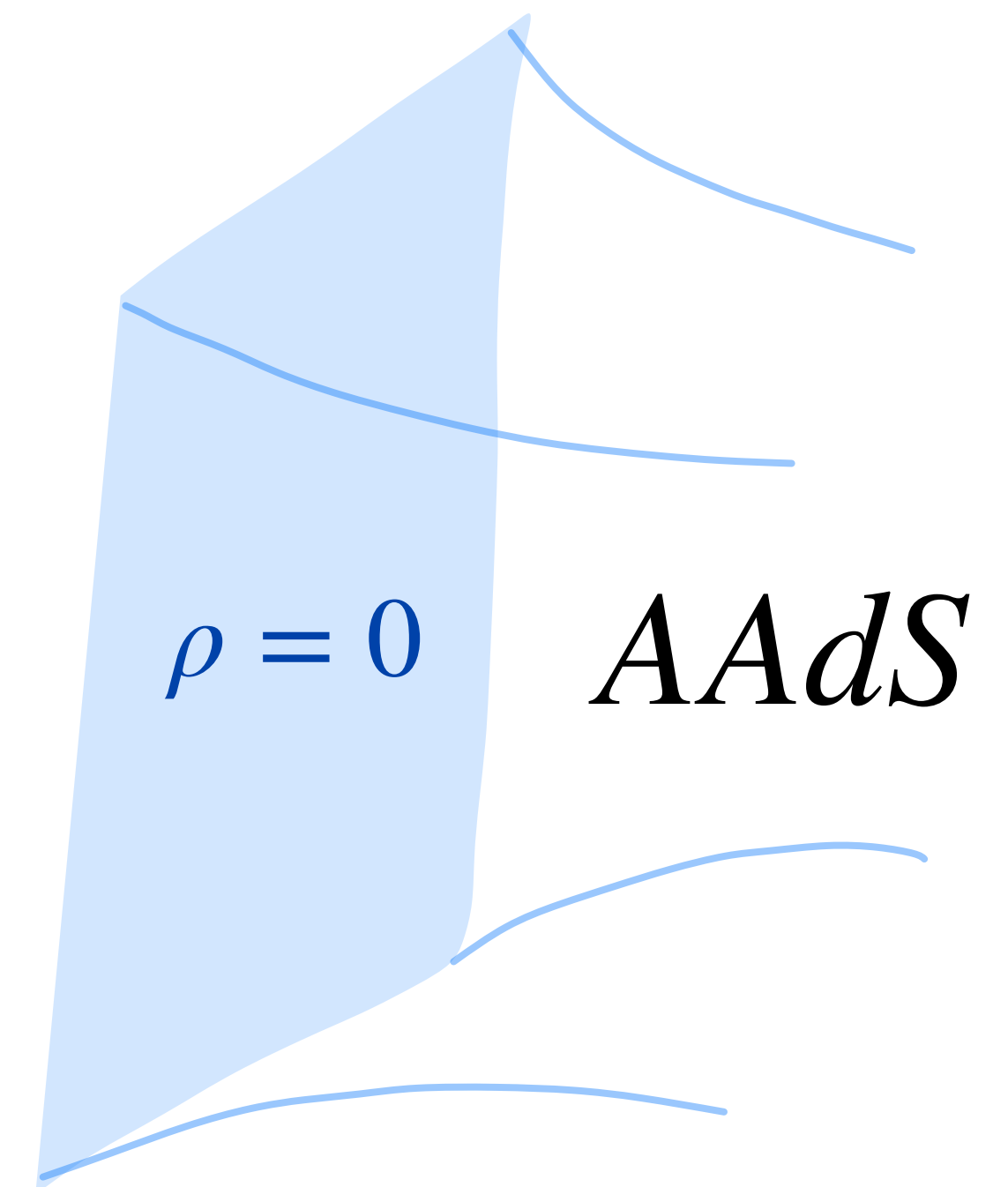
- Torsion: $T^a = de^a + \omega^a_b e^b$ [Leigh, Hoang, Petkou,...]

- Gauge theory of AdS gravity $A = \frac{1}{2} \omega^{AB} J_{AB} + e^A P_A$

- FG gauge for CTG: $\hat{e}^1 = -\frac{d\rho}{2\rho}$, $\hat{e}^a = \frac{1}{\sqrt{\rho}}(e^a + \rho k^a)$

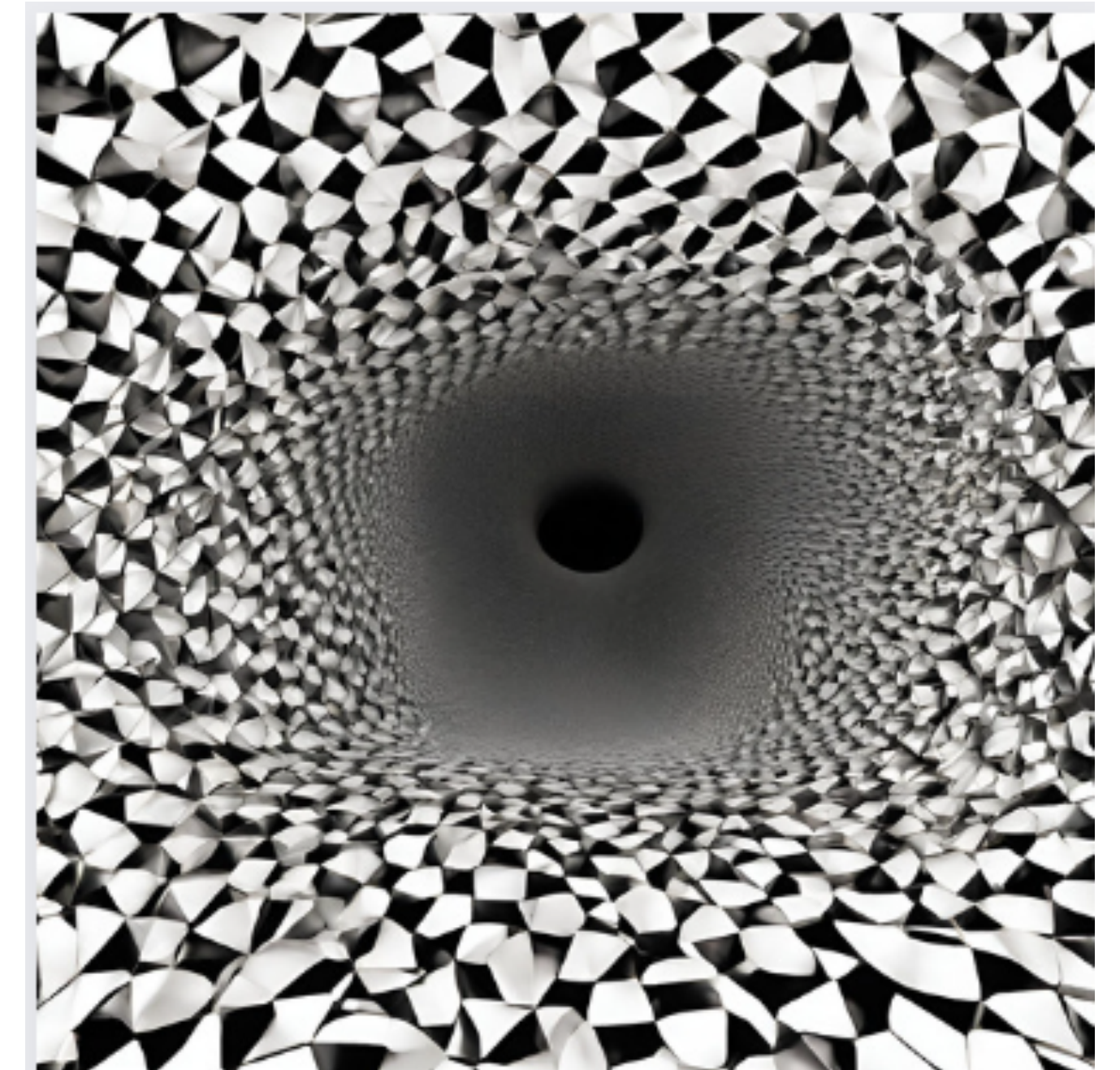
$$\hat{\omega}^{a1} = \frac{1}{\sqrt{\rho}}(e^a - k^a), \quad \hat{\omega}^{ab} = \omega^{ab} \quad \hat{\phi}^1 = \frac{1}{\sqrt{\rho}}(\varphi - \rho\psi), \quad \hat{\phi}^a = \phi^a$$

$$\hat{\phi} = \frac{1}{\sqrt{\rho}}(\varphi + \rho\psi),$$



Holography on Riemann-Cartan spacetime

- $\omega_{ab} \leftrightarrow$ spin current



[canva]

Spin current

- Idea: use holographic spin current to describe spin systems [Gallegos, Gursoy, Hashimoto, Kimura,...].
- In a theory dual to CTG gravity, this tensor is nontrivial.
- Checked: **Weyl anomaly** vanishes, reproduced entropy of **JT** gravity black hole!
$$e^a \langle \mathcal{T}_a \rangle + \varphi \langle \mathcal{O} \rangle = 0$$
- Important: variational principle in first-order gravity (with torsion): GHY like terms [Erdmenger, Heß, Matthaiakakis, Meyer,...].

Thank you for your attention!

Questions?