A universal fermionic analogue of the shear viscosity

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Motivation + Summary

Goal

- Try to find a universal holographic result similar to $\eta/s = 1/4\pi$ (Kovtun, Son, Starinets '04) from fermionic correlators.

Candidate

- spontaneous SUSY breaking by temperature
- supersound diffusion constant D_s in phonino pole

Result

- explicitly computed for black branes in AdS_{d+1}
- related it to a universal absorption cross section result:

$$\epsilon D_{3/2} = \frac{1}{4\pi G}\,\sigma_{1/2} \quad \leftrightarrow \quad \eta = \frac{1}{16\pi G}\,\sigma_0$$

Candidate?

- $T_{\mu\nu}$ in same multiplet as supersymmetry current S^{α}_{μ}
- Try to look at small ω and small $k \leftrightarrow$ "hydrodynamics" of supersymmetric field theory and look at the correlator

$$\langle [T_{\mu\nu}(x), T_{\rho\sigma}(0)] \rangle \rightarrow \langle \{ S^{\alpha}_{\mu}(x), \bar{S}^{\dot{\alpha}}_{\nu}(0) \} \rangle$$

(Policastro '08; Gauntlett, Sonner, Waldram '11; Kontoudi, Policastro '12)

$$T^{ij}_{\text{diss}} = -\eta \left(\delta^{ik}\delta^{jl} + \delta^{jk}\delta^{il} - \frac{2}{d-1}\delta^{ij}\delta^{kl} \right) \nabla^k u^l - \zeta \delta^{ij} (\nabla \cdot u)$$

$$S^{i}_{\text{diss}} = -D_{3/2} \left(\delta^{i}_{j} - \frac{1}{d-1}\gamma^{i}\gamma_{j} \right) \nabla^j S^0 - D_{1/2}\gamma^{i} \not{\nabla} S^0$$

- rearrangement of (Kovtun, Yaffe '03)

Holographic approach: gravitino

- Dual bulk field to the supersymmetry current on the boundary: gravitino ($\leftrightarrow$ supergravity dual) e.g. in AdS_{d+1}

$$S = \int d^{d+1}x\sqrt{-g}\bar{\Psi}_\mu \left(\Gamma^{\mu\nu\rho}D_\nu - m\Gamma^{\mu\rho}\right)\Psi_\rho \,,$$

- transverse gravitino Ψ^i has spin $1/2$ e.o.m.! $\leftrightarrow \Box h^y_x = 0$
- there exists a universal absorption cross section result for these (Das, Gibbons, Mathur '96); can relate to new Kubo formula for $D_{3/2}$

$$\boxed{\epsilon D_{3/2} = \frac{1}{4\pi G}\,\sigma_{\mathrm{abs},1/2}(0)} \quad \leftrightarrow \quad \eta = \frac{1}{16\pi G}\,\sigma_0$$

Conclusion / Outlook

Main results

- Connection to universal absorption cross section:

$$\epsilon D_{3/2} = \frac{1}{4\pi G}\,\sigma_{1/2} \quad \leftrightarrow \quad \eta = \frac{1}{16\pi G}\,\sigma_0$$

- Explicitly computed for non-dilatonic AdS_{d+1} black branes (two further independent computations in agreement)

Outlook

- Is there a quantity one should divide by?
- The transverse gravitino is generically not minimally coupled anymore for $\mu \neq 0$ (Pauli terms). Extension possible?