Entanglement equilibrium for higher order gravity

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ABSTRACT

I will start with a quick review of the main approaches to the problem of deriving gravitational dynamics from entanglement/thermodynamic-based principles. My focus will be then on Jacobson's recent "entanglement equilibrium" proposal [1], which connects Einstein's equations to an equilibrium condition on the entanglement entropy of small spherical regions in vacuum. I will explain that this principle can be extended to the linearized equations of general higher-derivative corrections [2]. These corrections are naturally associated with the subleading divergences in the entanglement entropy, which take the form of a Wald entropy evaluated on the entangling surface. Variations of this Wald entropy are related to the field equations through a new identity for causal diamonds in maximally symmetric spacetimes. If the variations are taken holding fixed a geometric functional that we called the "generalized volume", the identity becomes an equivalence between the linearized constraints and the entanglement equilibrium condition. I will explain that the fully nonlinear higher curvature equations cannot be derived from the linearized equations applied to small balls, in contrast to the situation encountered in Einstein gravity. I will also discuss possible applications of our generalized volume (which generalizes the notion of volume to higher-derivative gravities in a similar way as Wald's entropy functional generalizes that of area), e.g., in the context of holographic complexity.

References

[1] T. Jacobson, Phys. Rev. Lett. **116** (2016) no.20, 201101 [arXiv:1505.04753 [gr-qc]].

[2] P. Bueno, V. S. Min, A. J. Speranza and M. R. Visser, Phys. Rev. D **95** (2017) no.4, 046003 [arXiv:1612.04374 [hep-th]].