Holography and Graphene

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Abstract (Oral contribution)

We present a 1+2 dimensional model holographically realized as the boundary theory of a four-dimensional gravity model for negative-curvature, Anti de Sitter spacetime. The appropriate boundary conditions chosen for the four-dimensional fields lead to an effective model for massive fermions living on a curved, graphene-like background [1].
In particular, the unconventional supersymmetry present in the boundary theory allows to introduce suitable internal degrees of freedom, which can provide an application of the model to the description of the charge carrier properties of graphene-like 2D materials at Dirac points **K** and **K'**. In this picture, the two valleys can be shown to correspond to the two independent sectors of the boundary description, connected by a parity transformation. The fermion masses entering the corresponding Dirac equations depend on the torsion parameters of the substrate in the three-dimensional model: the parity-even and odd components of the corresponding masses can then be identified with Semenoff and Haldane-type mass contributions, respectively [2,3].
The application of the derived model to the effective description of the electronic properties of graphene-like 2D materials provides a top-down approach to the study of the phenomenology of this physical system, as the effective three-dimensional theory, derived at the boundary and defining a Dirac fermion living in 1+2 dimensions, originates from a well-defined effective supergravity in the bulk.

REFERENCES

[1] A. Gallerati et al., JHEP **01** (2020) 084.
[2] G.W. Semenoff, Phys. Rev. Lett. 53 (1984) 2449.
[3] F.D.M. Haldane, Phys. Rev. Lett. 61 (1988) 2015.

FIGURES

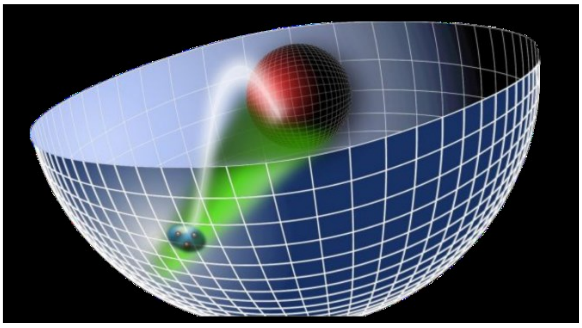

Figure 1: Holographic correspondence