Summary: In this work, we extend the 2d topological gravity model of [D. Marolf and H. Maxfield, J. High Energy Phys. 2020, No. 8, Paper No. 44, 72 p. (2020; Zbl 1454.83042)] to have as its bulk action any open/closed TQFT obeying Atiyah’s axioms. The holographic duals of these topological gravity models are ensembles of 1d topological theories with random dimension. Specifically, we find that the TQFT Hilbert space splits into sectors, between which correlators of boundary observables factorize, and that the corresponding sectors of the boundary theory have dimensions independently chosen from different Poisson distributions. As a special case, we study in detail the gravity model built from the bulk action of 2d Dijkgraaf-Witten theory, with or without end-of-the-world branes, and for arbitrary finite group \( G \). The dual of this Dijkgraaf-Witten gravity model can be interpreted as a 1d topological theory whose Hilbert space is a random representation of \( G \) and whose aforementioned sectors are labeled by the irreducible representations of \( G \). These holographic interpretations of our gravity models require projecting out negative-norm states from the baby universe Hilbert space, which in [loc. cit.] was achieved by the (only seemingly) ad hoc solution of adding a nonlocal boundary term to the bulk action. In order to place their solution in the completely local framework of a TQFT with defects, we couple the boundaries of the gravity model to an auxiliary 2d TQFT in a non-gravitational (i.e. fixed topology) region. In this framework, the difficulty of negative-norm states can be remedied in a local way by the introduction of a defect line between the gravitational and non-gravitational regions. The gravity model is then holographically dual to an ensemble of boundary conditions in an open/closed TQFT without gravity.

MSC:
- 83C80 Analogues of general relativity in lower dimensions
- 83C45 Quantization of the gravitational field
- 81T45 Topological field theories in quantum mechanics
- 81R05 Finite-dimensional groups and algebras motivated by physics and their representations
- 83E05 Geometrodynamics and the holographic principle

Keywords:
AdS-CFT correspondence; models of quantum gravity; topological field theories

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