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Black Hole Interiors and Modular Inclusions

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We argue that the traversable wormhole induced by a double-trace deformation of the thermofield double state can be understood as a modular inclusion of the algebras of operators. The effect of this deformation is the creation of a new region of spacetime deep in the bulk, corresponding to a non-trivial center between the left and right algebras. This set-up provides a precise framework for investigating how black hole interiors are encoded in the CFT. In particular, we use modular theory to demonstrate that state dependence is an inevitable feature of any attempt to represent operators behind the horizon. Building on this geometrical structure, we propose that modular inclusions may provide a more precise means of investigating the nascent relationship between entanglement and geometry in the context of the emergent spacetime paradigm.

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