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Bulk-boundary correspondence in (3+1)-dimensional topological phases APOORV TIWARI, XIAO CHEN, SHINSEI RYU, University of illinois, Urbana Champaign — We discuss (2+1)-dimensional gapless surface theories of bulk (3+1)-dimensional topological phases, such as the BF theory at level K, and its generalization. In particular, we put these theories on a flat (2+1) dimensional torus T^3 parameterized by its modular parameters, and compute the partition functions obeying various twisted boundary conditions. We show the partition functions are transformed into each other under $SL(3, Z)$ modular transformations, and furthermore establish the bulk-boundary correspondence in (3+1) dimensions by matching the modular $\mathcal{S}$ and $\mathcal{T}$? matrices computed from the boundary field theories with those computed in the bulk. We also propose the three-loop braiding statistics can be studied by constructing the modular $\mathcal{S}$ and $\mathcal{T}$? matrices from an appropriate boundary field theory.

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