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Field theory representation of mixed gauge-gravity symmetry-protected topological invariants, group cohomology and beyond JUVEN WANG, Institute for Advanced Study, Princeton, ZHENG-CHENG GU, Perimeter Institute for Theoretical Physics, XIAO-GANG WEN, MIT — The challenge of identifying symmetry-protected topological states (SPTs) is due to their lack of symmetry-breaking order parameters and intrinsic topological orders. For this reason, it is impossible to formulate SPTs under Ginzburg-Landau theory or probe SPTs via fractionalized bulk excitations and topology-dependent ground state degeneracy. However, the partition functions from path integrals with various symmetry twists are universal SPT invariants, fully characterizing SPTs. In this work, we use gauge fields to represent those symmetry twists in closed spacetimes of any dimensionality and arbitrary topology. This allows us to express the SPT invariants in terms of continuum field theory. We show that SPT invariants of pure gauge actions describe the SPTs predicted by group cohomology, while the mixed gauge-gravity actions describe the beyond-group-cohomology SPTs, recently observed by Kapustin. We find new examples of mixed gauge-gravity actions for U(1) SPTs in 3+1D and 4+1D via the Stiefel-Whitney class and the gravitational Chern-Simons term. [Work based on Phys. Rev. Lett. 114, 031601 (2015) arXiv:1405.7689]

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