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Quantum phase transitions between a class of symmetry protected topological states LOKMAN TSUI, Department of Physics, University of California, Berkeley, HONG-CHEN JIANG, Stanford Institute for Materials and Energy Sciences; SLAC National Accelerator Laboratory,, YUAN-MING LU, Department of Physics, The Ohio State University, DUNG-HAI LEE, Department of Physics, University of California, Berkeley; Materials Science Division, Lawrence Berkeley National Laboratories, — The subject of this paper is the phase transition between symmetry protected topological states (SPTs). We consider spatial dimension d and symmetry group G so that the cohomology group, $H^{d+1}(G, U(1))$, contains at least one Z_{2n} or Z factor. We show that the phase transition between the trivial SPT and the root states that generate the Z_{2n} or Z groups can be induced on the boundary of a d+1 dimensional $G \times Z_2^T$-symmetric SPT by a Z_2^T symmetry breaking field. Moreover we show these boundary phase transitions can be "transplanted" to d dimensions and realized in lattice models as a function of a tuning parameter. The price one pays is for the critical value of the tuning parameter there is an extra non-local (duality-like) symmetry. In the case where the phase transition is continuous, our theory predicts the presence of unusual (sometimes fractionalized) excitations corresponding to delocalized boundary excitations of the non-trivial SPT on one side of the transition. This theory also predicts other phase transition scenarios including first order transition and transition via an intermediate symmetry breaking phase.

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