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Entanglement Spectra of Gapped One-dimensional Field Theories and Symmetry-Protected Topological Phases GIL YOUNG CHO, Department of Physics, Korea Advanced Institute of Science and Technology, KEN SHIOZAKI, Department of Physics, University of Illinois at Urbana-Champaign, ANDREAS LUDWIG, Department of Physics, University of California, Santa Barbara,, SHINSEI RYU, Department of Physics, University of Illinois at Urbana-Champaign

— We discuss the entanglement spectrum(ES) of (1+1)d gapped Lorentz invariant field theories in the vicinity of a conformal field theory (CFT). In particular, for a gapped theory obtained by perturbing a CFT in infinite space by relevant perturbations, we show that the low-lying ES for the half-line is equal to the physical spectrum of the gapless CFT defined on a finite interval of length $L = \log(\xi/a)$, which is the spectrum of a boundary CFT. Here ξ is the correlation length, a a microscopic lattice scale, and our result applies in the "scaling limit" where $\xi \gg a$. A similar property has been known to hold for Baxter's Corner Transfer Matrices of a class of very special, namely integrable lattice models, for the entire ES and independent of the scaling limit. In contrast, our result applies to completely general gapped Lorentz invariant theories in the scaling limit, without the requirement of integrability, for the low-lying ES. As a consequence, while on a finite interval of length $2R$ the physical spectrum of the gapped theory is known to undergo a dramatic reorganization as $2R$ crosses ξ, the bipartite ES remains unchanged up to an overall scale. We apply these to (1+1)d symmetry-protected topological phases and symmetry-protected degeneracy of ES.

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