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Emergent dual space-time geometry for free fermions CHING HUA LEE, XIAO-LIANG QI, Stanford Univ — The theme of holography has attracted great interest among high energy and condensed matter physicists alike. It involves describing a 'boundary' system in terms of a 'bulk' system in a space one dimension higher, with the emergent direction representing energy scale. We propose a simple exact holographic mapping for lattice systems based on wavelet bases, which naturally entail an emergent dimension representing scale. The system in the new basis is identified as the bulk, whose correlation functions can be interpreted as that of a massive field in curved spacetime. Despite the simplicity of our approach, we obtain in the long-wavelength limit geometries that are consistent with those expected from the Ryu-Takanayagi formula, i.e. AdS space for critical zero-temperature systems, a paradigmatic example of the AdS-CFT correspondence. At nonzero temperature, we obtain the BTZ and Lifshitz black holes for linear and nonlinear critical band touchings respectively, as we analytically verify up to the subleading logarithmic correction. Our results remain true in any number of dimensions, under generic local wavelet bases.

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