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Entanglement Entropy and Spectra of the One-dimensional Kugel-Khomskii Model REX LUNDGREN, VICTOR CHUA, GREGORY FIETE, University of Texas at Austin — We study the quantum entanglement of the spin and orbital degrees of freedom in the one-dimensional Kugel-Khomskii model, which includes both gapless and gapped phases, using analytical techniques and exact diagonalization with up to 16 sites. We compute the entanglement entropy, and the entanglement spectra using a variety of partitions or "cuts" of the Hilbert space, including two distinct real-space cuts and a momentum-space cut. Our results show the Kugel-Khomski model possesses a number of new features not previously encountered in studies of the entanglement spectra. Notably, we find robust gaps in the entanglement spectra for both gapped and gapless phases with the orbital partition, and show these are not connected to each other. We observe the counting of the low-lying entanglement eigenvalues shows that the "virtual edge" picture which equates the low-energy Hamiltonian of a virtual edge, here one gapless leg of a two-leg ladder, to the "low-energy" entanglement Hamiltonian breaks down for this model, even though the equivalence has been shown to hold for similar cut in a large class of closely related models.

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