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Understanding the entanglement entropy and spectra of 2D quantum systems through arrays of coupled 1D chains ANDREW JAMES, ROBERT KONIK, Brookhaven National Laboratory — We study the entanglement entropy and spectra of a coupled array of N one dimensional quantum Ising chains in their continuum limit. Employing a DMRG algorithm specifically adapted to the study of coupled, continuum systems, we are able to study large arrays of chains (up to N=200) both in their gapped phase and in the approach to criticality. Away from criticality the entanglement entropy obeys an area law. Close to criticality the entanglement entropy continues to obey the area law but possesses an additive piece scaling as $c_{eff}\log(N)/6$ with $c_{eff} \approx 1$. We also study the entanglement spectra of the coupled chains. Away from criticality in the disordered phase the low lying portion of the entanglement spectra appears similar to that of a single gapped quantum Ising chain. As the critical point is approached the entanglement gap closes. A finite size scaling analysis shows that the entanglement gap and the energy gap vanish at the same value of interchain coupling.

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