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Quantum criticality, kink confinement, and emergent symmetries in coupled Ising chains and ladders

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In this talk I cover the physics in three of the central quantum phase transitions in 1D. First, the transverse Ising model which is realized in CoNb₂O₆. While this is perhaps the simplest textbook case of a quantum phase transition, a remarkable emergence of E₈ symmetry arises close to the quantum critical point. This manifests itself in an octave of bound states. We observe these experimentally and in particular the interval of the first two resonances on this octave which are found to match the golden ratio 1.618... - just as predicted for the emergence of this extraordinary symmetry. I then plan to show with the example of the Heisenberg chain how we can probe the quantum critical volume experimentally and show the characteristic scaling behaviour in space and time. The third example is of a spin ladder CaCu₂O₃ which is near the long sought after Wess-Zumino-Novikov-Witten quantum critical point.