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Quantum phase transitions in a spin bus system YUN-PIL SHIM, Department of Physics, University of Wisconsin-Madison, SANGCHUL OH, XUEDONG HU, Department of Physics, University at Buffalo, State University of New York, MARK FRIESEN, Department of Physics, University of Wisconsin-Madison — A spin chain can be used as a quantum data bus to enable long distance interactions and to create multi-qubit entanglement between spin qubits. The operation of the spin bus strongly depends on its ground state properties. When the ground state changes abruptly, quantum phase transitions (QPTs) occur and affect the bus operation. Here, we describe the theory of QPTs induced by an external magnetic field in a Heisenberg spin chain which acts as a spin bus. We study the non-analytic behavior of the entanglement between qubits connected to the spin bus and its scaling properties near a quantum critical point. In some cases, we find the entangling properties actually *grow* with the length of the chain. We also analyze the magnetically induced anisotropy and disorder effects on the effective interactions between qubits.

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