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Entropy Accumulation, Divergent Gruneisen Ratio, and Crossover Energy Scales near Quantum Critical Points JIANDA WU, Rice University, LIJUN ZHU, LANL, QIMIAO SI, Rice University — A quantum critical point (QCP) arises at the point of second order phase transition at zero temperature. General scaling arguments have been used to show that a thermodynamic ratio – the Gruneisen ratio of thermal expansion to specific heat – diverges at QCPs [1], and this divergence has been experimentally observed in heavy fermion metals [2]. An important consequence of this divergence is that entropy will be maximized in the quantum critical regime, and this has recently been directly observed in an elegant experiment on the field-induced QCP in Sr3Ru2O7 [3]. Here, we further address the relationship between the accumulation of entropy, the divergence as a function of both temperature (T) and control parameter (r) in the Gruneisen ratio, and the crossover energy scales in the T-r phase diagram. We consider these in some detail in the simplest examples of QCPs: the transverse-field Ising chain, and the transitions into itinerant magnets. We report the result of microscopic calculations of the entropy as a function of the control parameter r in both models. We show that, for the transverse-field Ising chain, there is an unusual contrast between the T- and r- dependence of the Gruneisen ratio.[1] L. Zhu et al, PRL 91, 066404 (2003);[2] P.Gegenwart et al, Nature Phys. 4, 186 (2008);[3] A.W. Rost et al, Science 325, 1360 (2009).

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