

Physics 7653: Statistical Physics
<http://www.physics.cornell.edu/sethna/teaching/653/>
Material for Week 7
Exercises due Tuesday Oct. 17
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Pre-class Preparation

Thursday

Read: [Renormalization group and normal form theory](#), Archishman Raju, Colin B. Clement, Lorien X. Hayden, Jaron P. Kent-Dobias, Danilo B. Liarte, D. Zeb Rocklin, and James P. Sethna, <https://arxiv.org/abs/1706.00137> (submitted).

Superconductivity normal form. *In Exercise 12.21, we solved a RG flow equation describing the instability of a Fermi liquid, and found an explanation for the formula for the BCS transition temperature. Which bifurcation (tricritical, resonant, pitchfork, ...) does this correspond to? Does this paper suggest a correction to the BCS formula for the critical temperature dependence on the electron-electron attraction?*

(Submit electronically by 9:30 Wednesday evening.)

Tuesday

Cardy, sections 4.1 and 4.4.

Ising transitions meeting at the tricritical Ising model. You can view the Blume-Capel model of section 4.1 as having three spin types: white (+1), black (−1), and gray (0). It has three phase transition lines in the Ising universality class. Each is the boundary of an abrupt transition between two different phases. *Why do the Ising critical points form lines?* (Hint: how many parameters are there in the model?) *Why are there three lines of Ising critical points? Far from the tricritical point, what pairs of colors correspond to these three abrupt transitions? As one approaches the tricritical point, how will these color jumps change?*

(Submit electronically by 9:30 Monday evening.)

Exercises

- Cardy, exercise 3.7 (analytic corrections to scaling from RG inflow).
- Cardy, exercise 4.1 (tricritical Ising model).
- Cardy, exercise 4.3 (finite-size scaling for critical point in a strip.) Note that calculating properties of models in a strip is computationally very convenient to do with transfer matrices.