

Material for Week 10

Physics 4488/6562: Statistical Mechanics

<https://sethna.lassp.cornell.edu/Teaching/562/>

Exercises due Wed. Apr 09

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- Chapter 10 is more challenging mathematically than the rest of the course, and the pre-class questions starting next Monday will be more challenging.
- Our in-class exercises on Wednesday will involve computer simulations. They should run on tablets and smart phones as well.
- Pre-class question Friday, only do part (a). We'll do the rest in class.
- The exercises with numbers N1.xxx are to be found in <https://sethna.lassp.cornell.edu/StatMech/SethnaExercises.pdf>
- This homework is due on Wed. Apr. 9 (due to spring break). Please do the pre-class questions for Monday and Wednesday before class, but turn them in with this problem set.

Monday

In-class question: 9.1 *Nematic defects*

In-class question: 9.11 *Pentagonal order parameter*

In-class question: 9.19 *Defect entanglement*

Wednesday

Read: No reading today

Pre-class question: 9.13 *Chiral wave equation*

In-class question: 9.18 *Defects in crystals*

In-class question: 9.19 *Defect entanglement*

Friday

Read: Chapter 10, Sec. 10.1 (Correlation functions: motivation)

Pre-class question: 10.10 *Human correlations*

In-class question: 10.10 *Human correlations*

Monday

Read: Chapter 10, Sec. 10.3 (Equal-time correlations in the ideal gas) and 10.4 (Onsager's regression hypothesis and time correlations)

Pre-class question: 10.12 *Liquid free energy*

Assigned exercise for everyone

9.16 *Can't lasso a basketball.* (Mathematics). Homotopy theory of (no) defects.

Special topic exercises (6562 do one; 4488 do 7 during 14 weeks)

9.17 *Fingerprints.* The tips of your fingers form a wonderful example of dislocations, disclinations, and smectic order.

9.7 *Superfluid order and vortices.* (Quantum, Condensed matter) There is a quantized vorticity (swirling motion) around defects in superfluids.

N1.17 *Nonabelian defects.* (Mathematics) An in-depth exploration of braiding and homotopy for nonabelian defects.

N1.26 *Correlation matching.* Test and exercise your understanding of correlation functions in real space and Fourier space. Match snapshots with their real and Fourier space correlation functions.

10.11 *Subway bench Monte Carlo.* Compute the correlations between subway riders. Turn our class exercise into a real statistical mechanics model.

N1.31 *Rubber band dynamics III: Free energy and statics.* Detailed balance, gradient descent, and algorithms for the rubber band. Links to the infinite-range Ising model. Hints at <https://sethna.lassp.cornell.edu/StatMech/EOPCHintsAndMaterials.html>