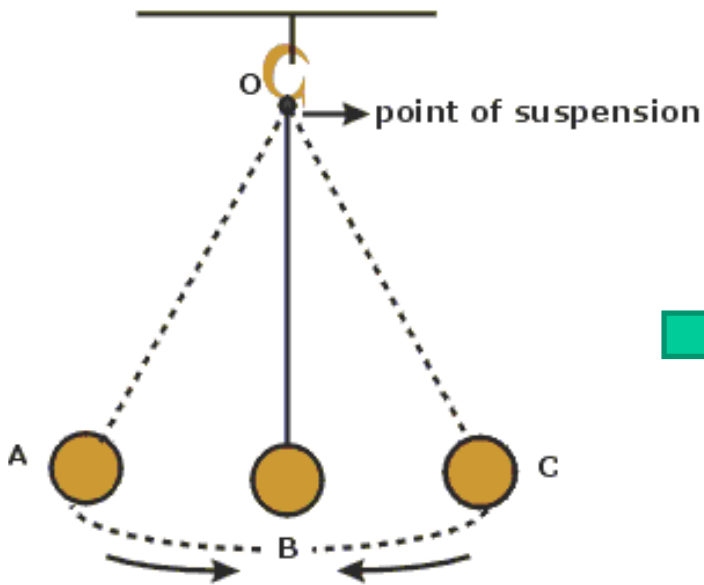


PH427

are *periodic* oscillations ubiquitous
or merely just a paradigm?

Paradigm: Periodic Systems

Instructor: Matt Graham



Winter 2016



*smaller goal: full mathematical
description of physically &
electronically coupled systems*

BIG GOAL: *show how
symmetry, oscillations and
quantum mechanics really
describe “everyday stuff”
i.e. quantum mechanics you can
get paid to do!!*

35% → problem sets (3)

15% → pick a “solid state physics”
journal article, give a 10 min. talk

50% → final exam (M of exam week)

Roadmap

DAYS 1- 7:

- Coupled pendulum, railroad cars, atoms, etc.
- From atoms to crystals \rightarrow extend coupling to infinity and define a dispersion relation for an atomic system

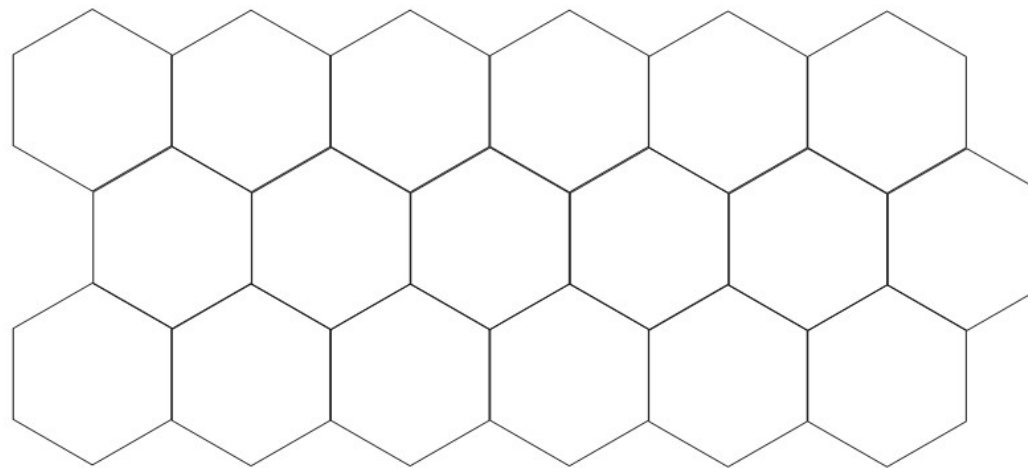
DAYS 7- 15:

- Quantum wavelstates in periodic systems
- 10 minute journal presentations

Translational Symmetry and Noether's Theorem

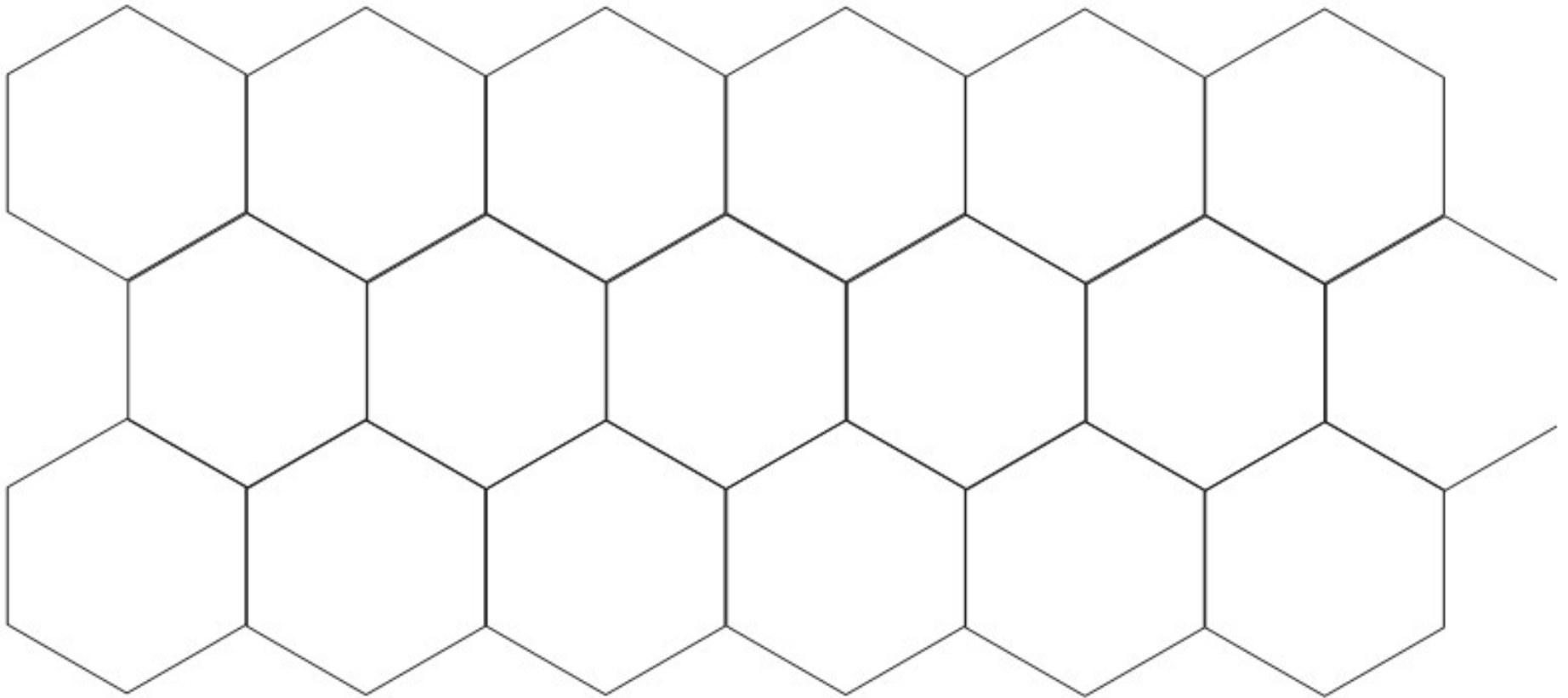
Any system with translational symmetry has an associated momentum conservation law.

→ An electron moving through a perfectly periodic crystal maintains its momentum like the electron was travelling through a vacuum



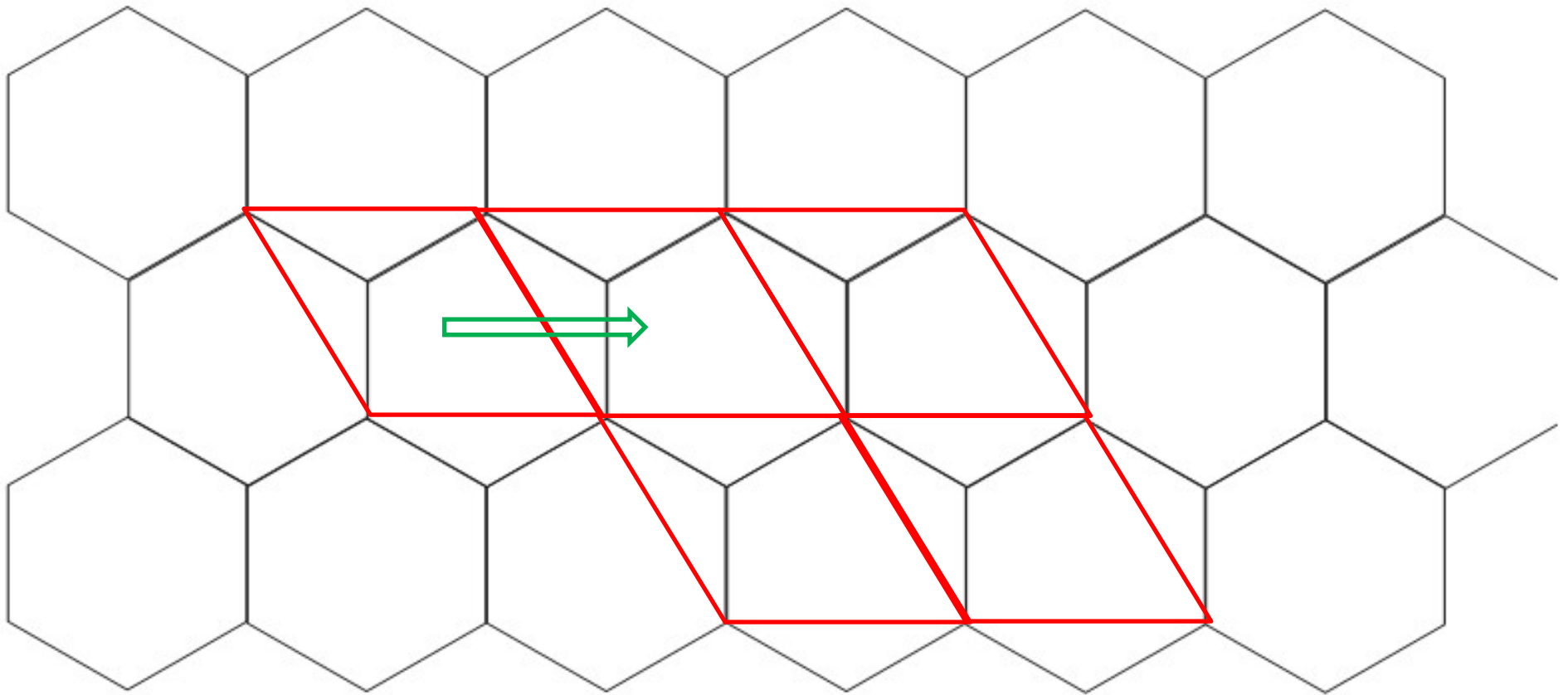
Graphene

Draw the “Unit Cell”



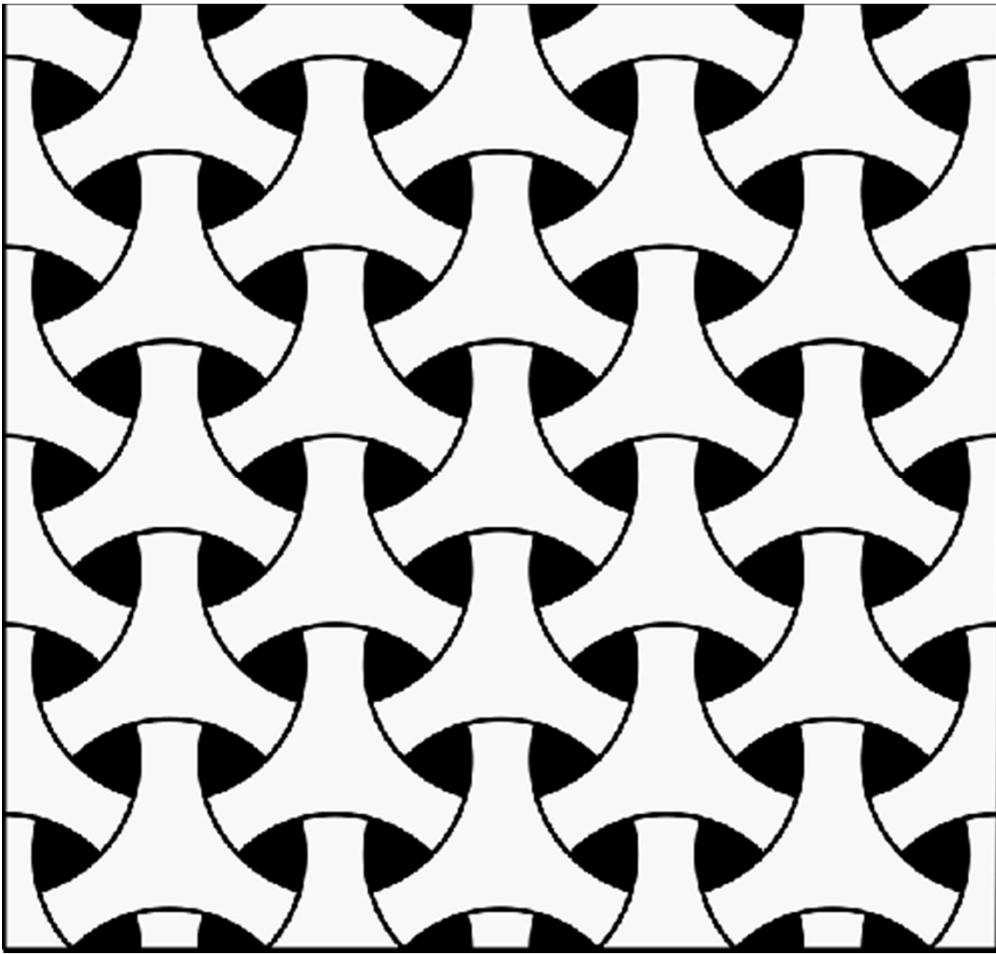
Graphene

Draw the “Unit Cell”

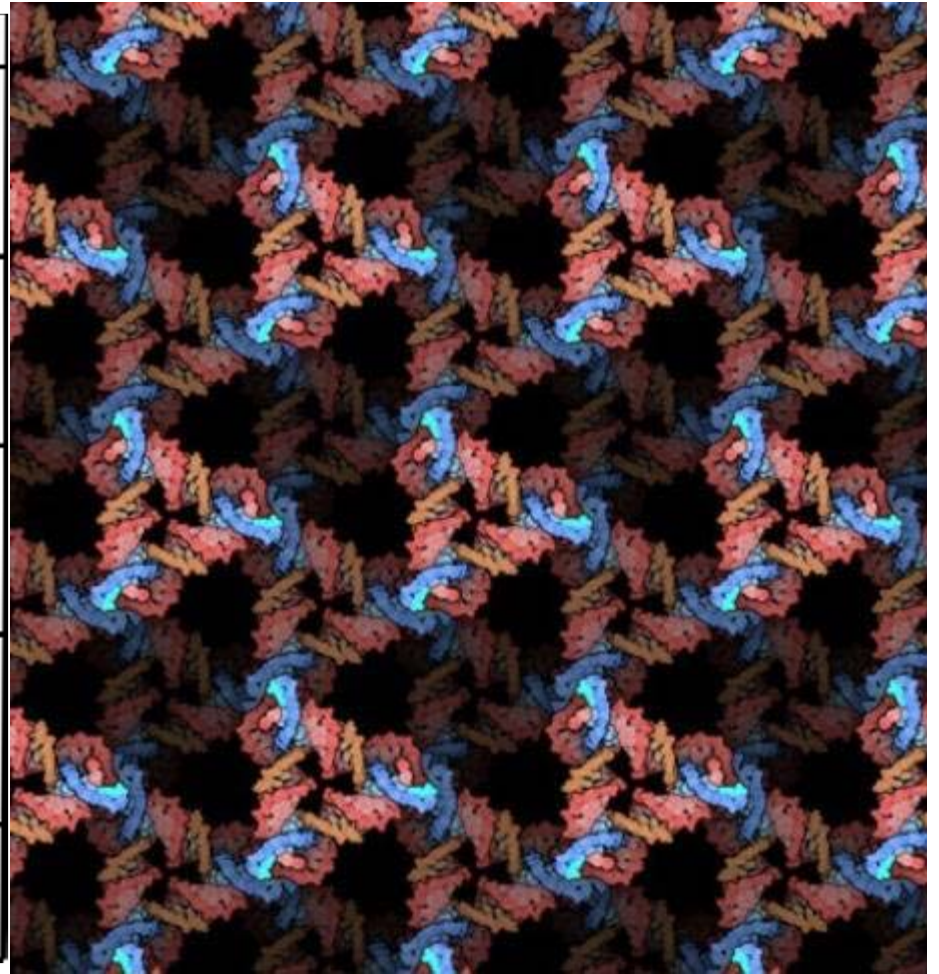


Graphene

Draw the “Unit Cell”

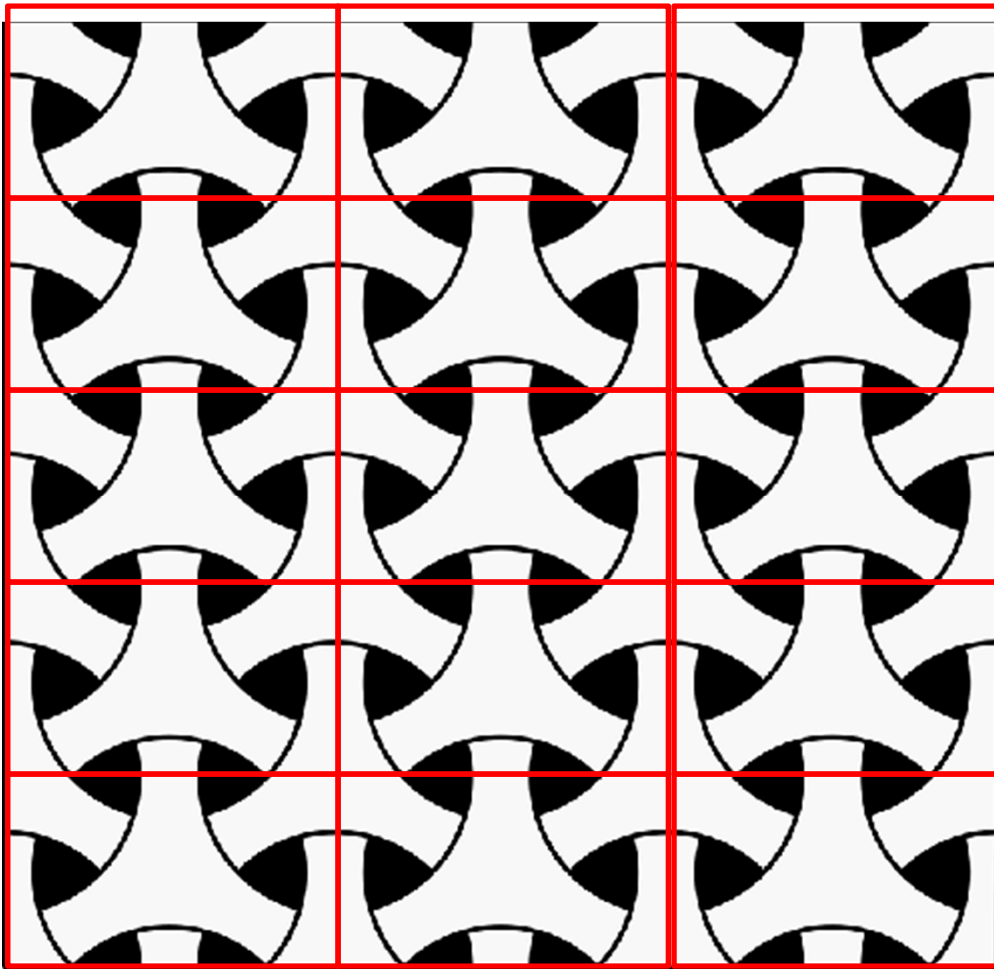


Celtic knot

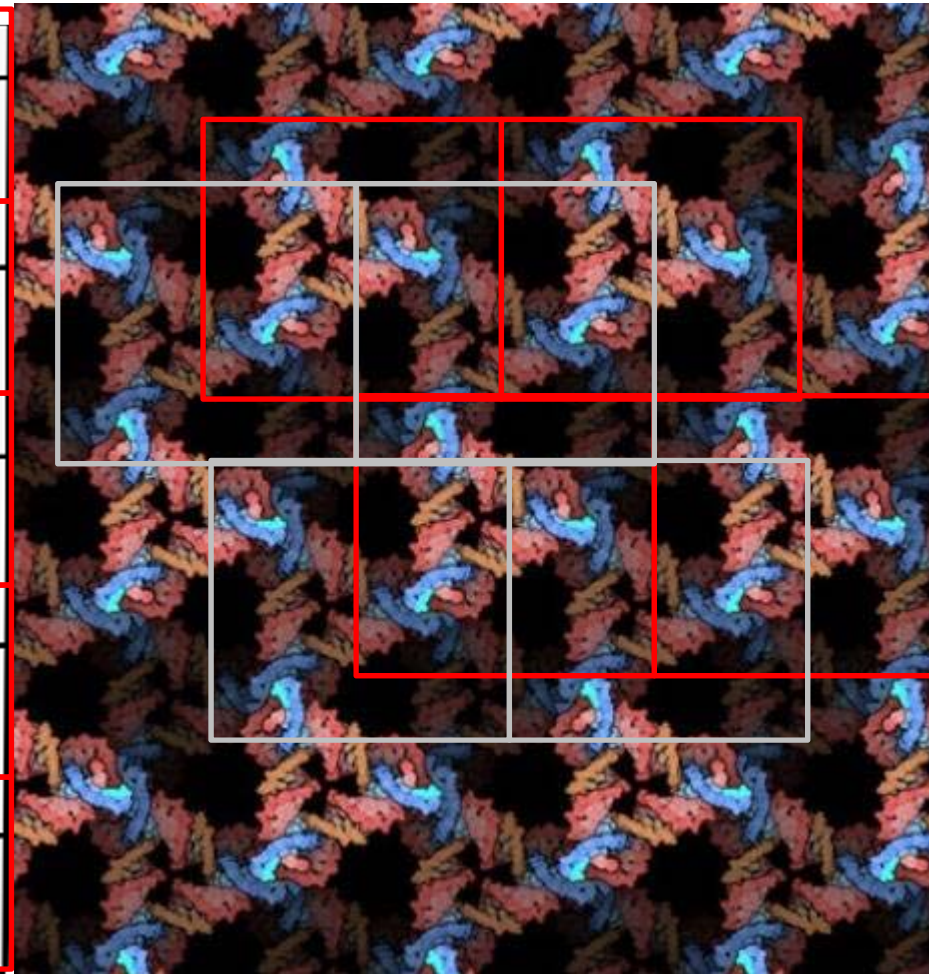


Protein/DNA

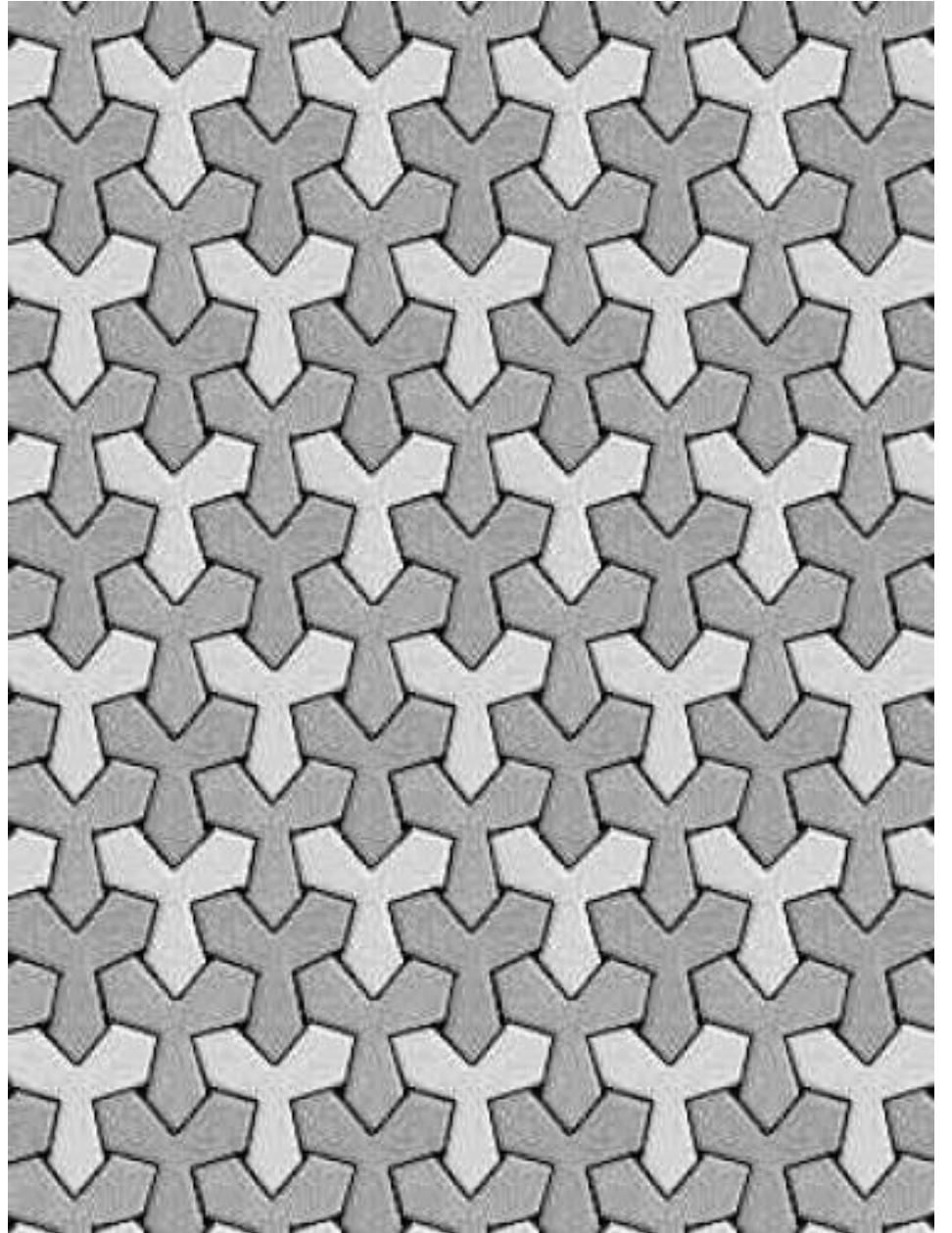
Draw the “Unit Cell”

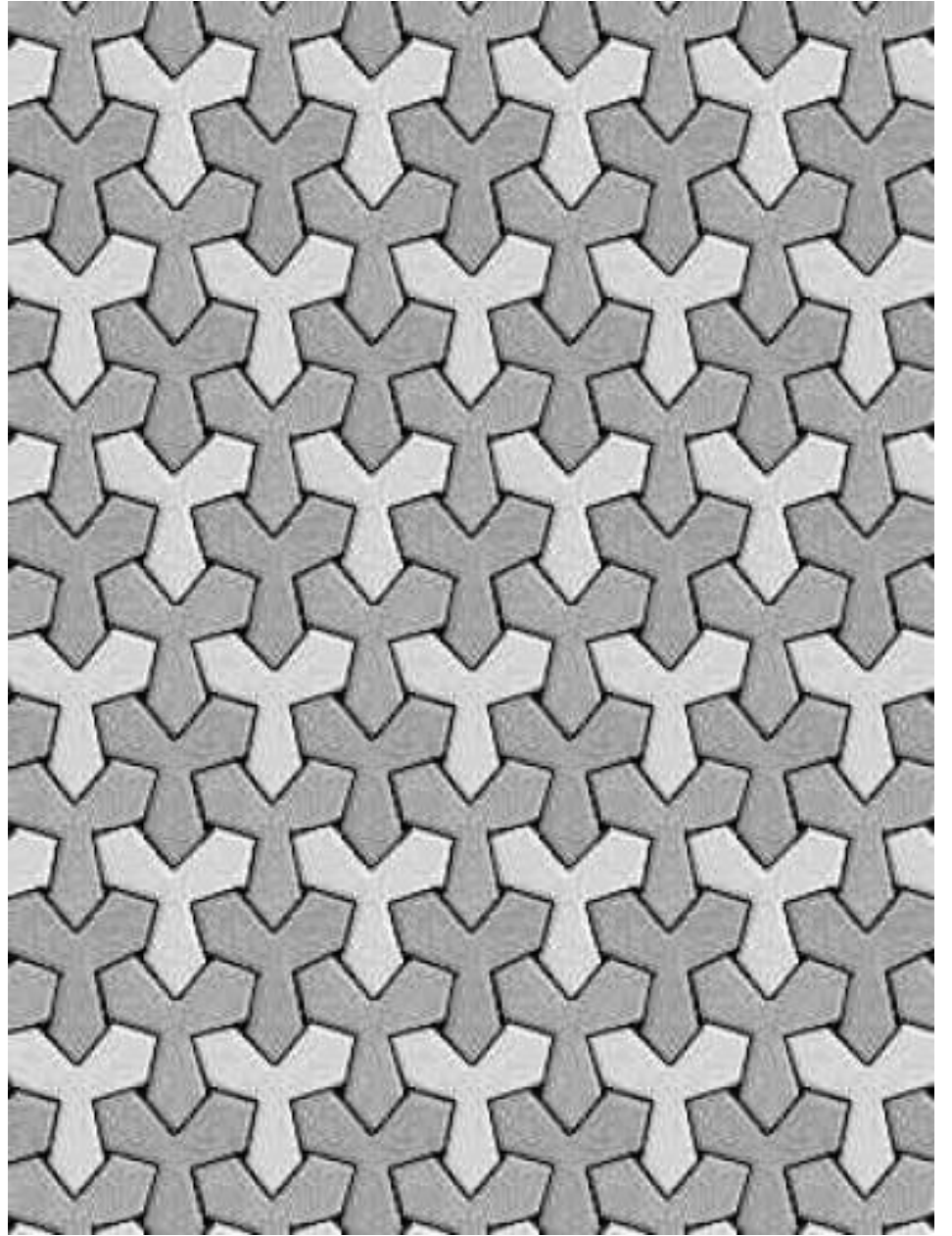
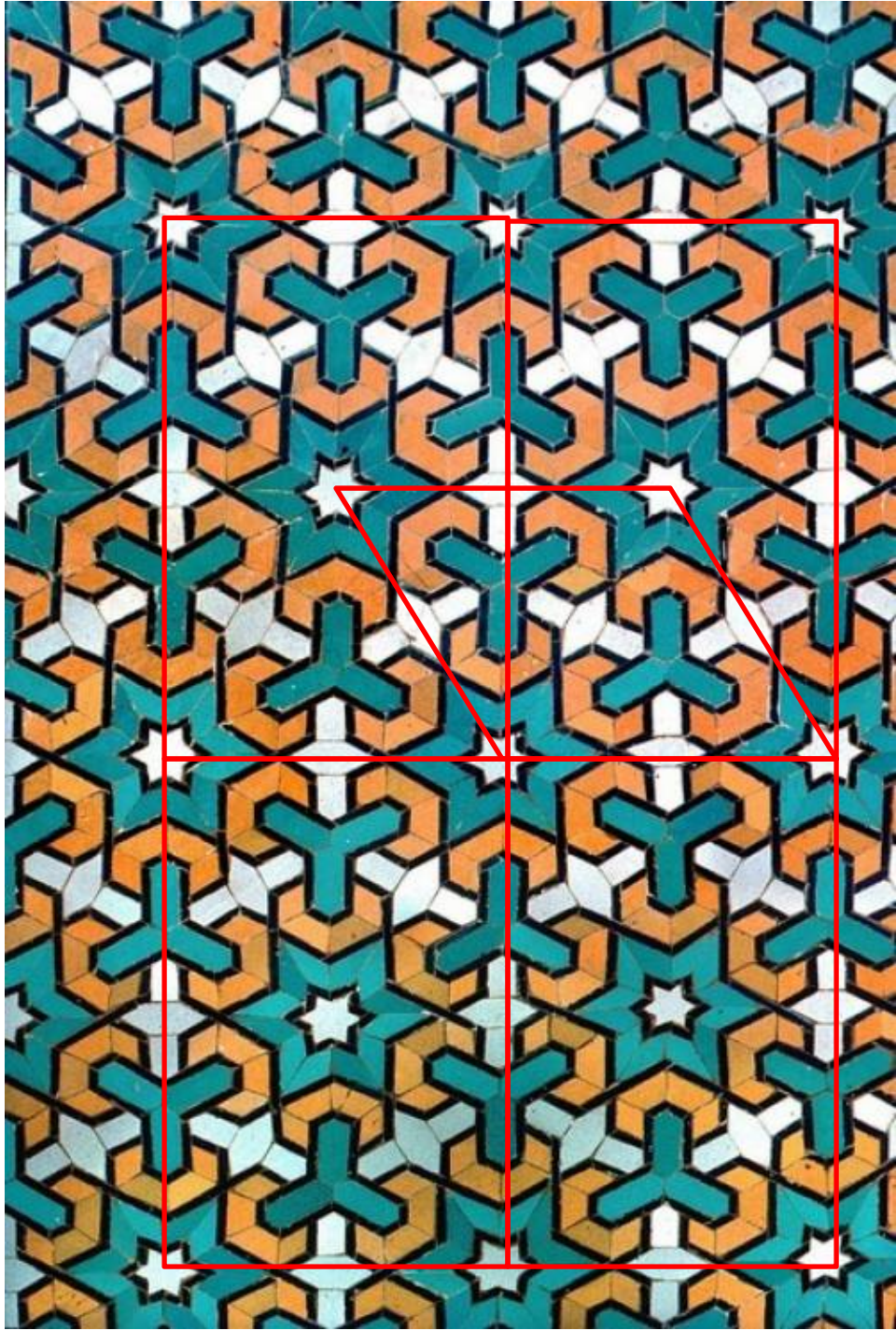


Celtic knot

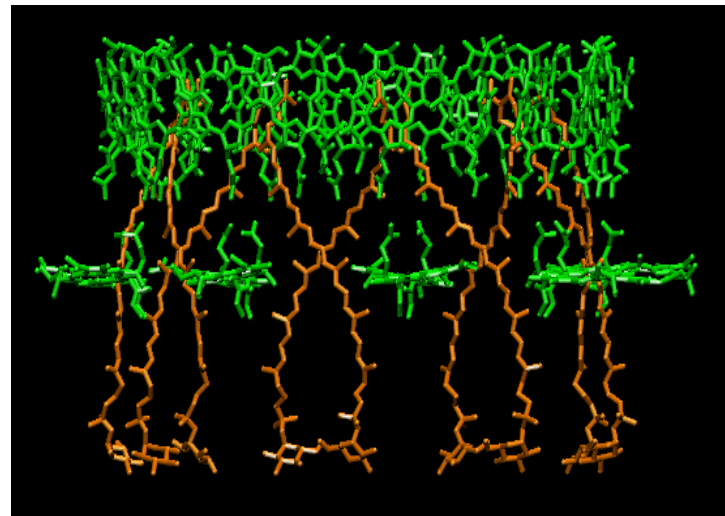
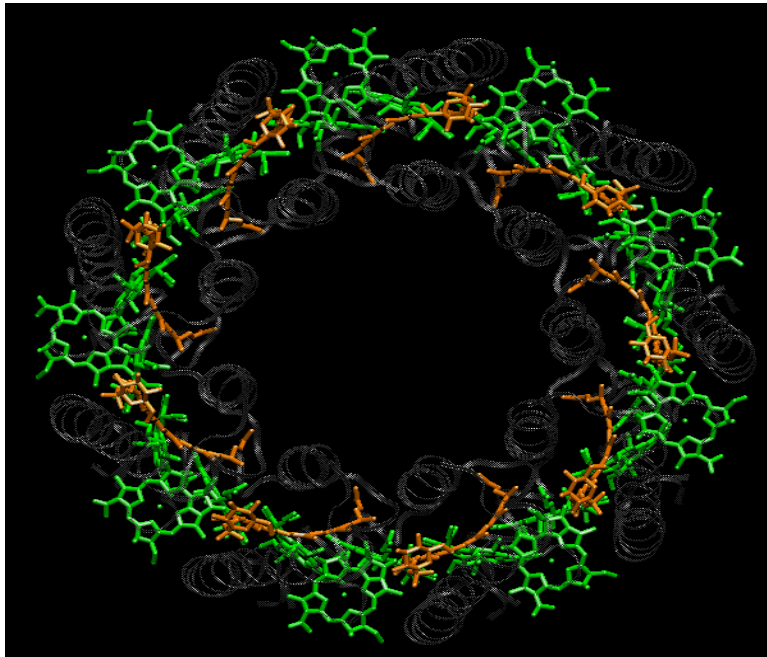


Protein/DNA

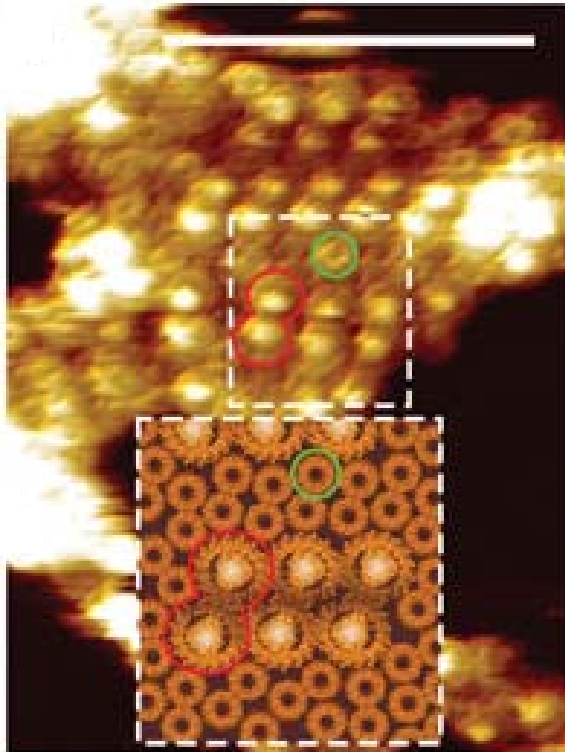




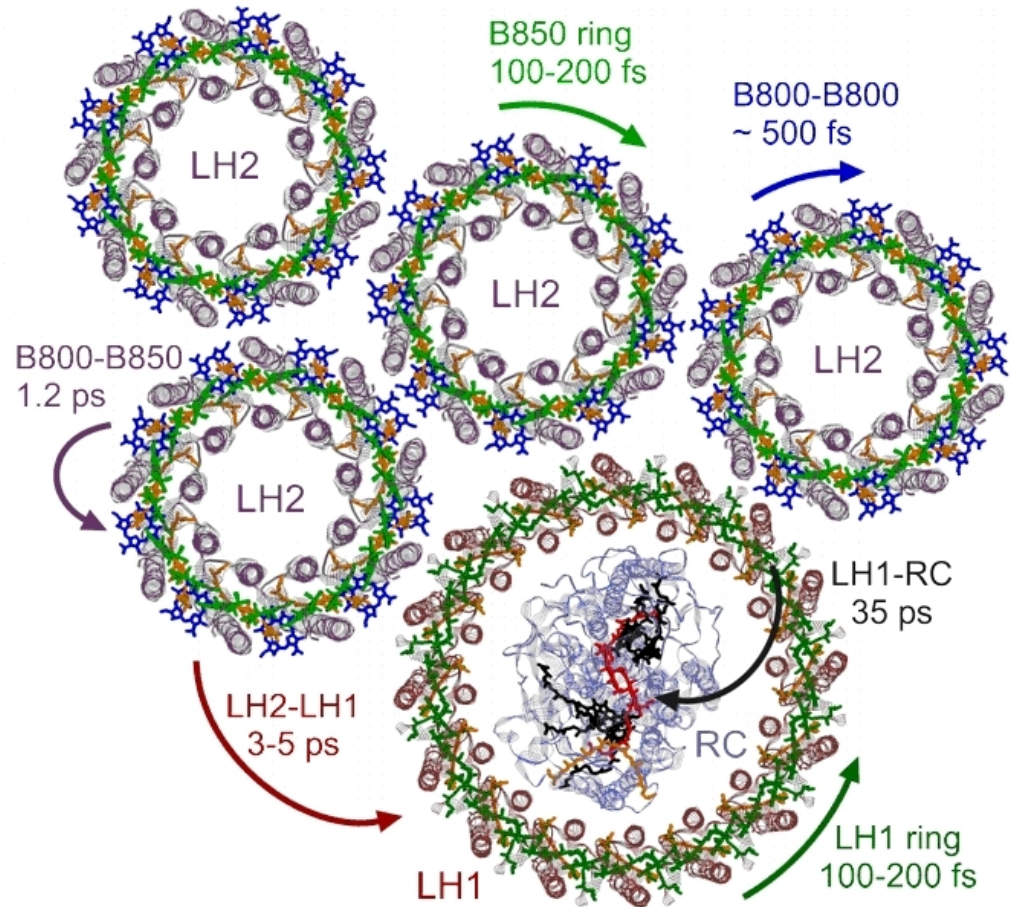
PERIODIC SYSTEM IN BIOLOGY: Light Harvesting Complex II



Bacterial Light Harvesting



Bahatyrova, et al.
Nature (2004) **430** 1058



Hu, et al.
J. Phys. Chem. B (1997) **101** 3854