

Lecture 20.

Lecture objectives.

- To introduce and detail the physics of waves propagating in periodic structures – (this is extremely important for crystals).
- To develop and write down equation of motion for the system of beads spaced on a stretched string.
- To solve this equation of motion and to then derive the dispersion relation for the system.
- To discuss the properties of this dispersion relation and to introduce the concept of the first Brillouin zone.

Post-lecture tasks.

- Estimate the cut-off frequency for a travelling wave on a beaded string with beads of mass 0.01 kg separated by a distance of 0.05 m, when the tension is 10 N.
- By how much does this cut-off frequency change if the both the mass and the bead separation are doubled?
- For a cut-off frequency of 100 Hz, a bead mass and separation of 200g and 1cm respectively, what would the tension in the string have to be?
- Explain why this system is actually a form of low-pass filter for wave frequencies.
- Sketch the dispersion curve for the system, including only the first Brillouin zone, and labeling all the relevant features.