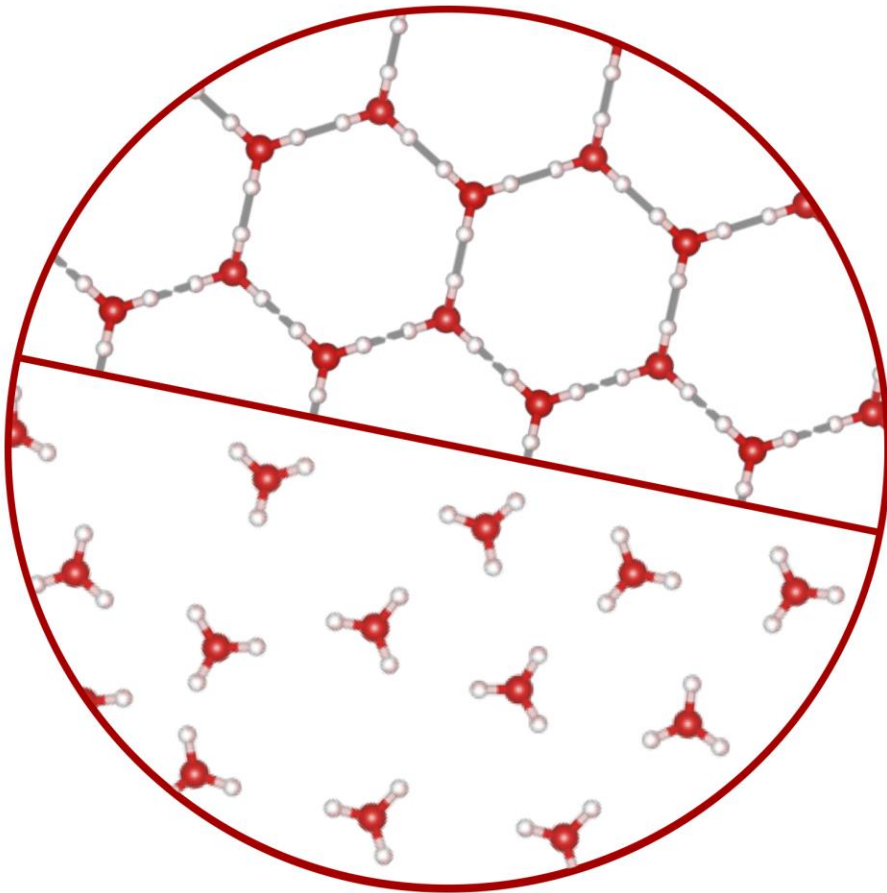


Advanced Topics in Condensed Matter

Lecture 5: Phonons (continuation)



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Acoustic phonons

1D lattice; 1 atom per unit cell

Longitudinal phonon ($\vec{f} \rightarrow 0$)



Longitudinal phonon ($\vec{f} > 0$)



Transverse phonon ($\vec{f} \rightarrow 0$)



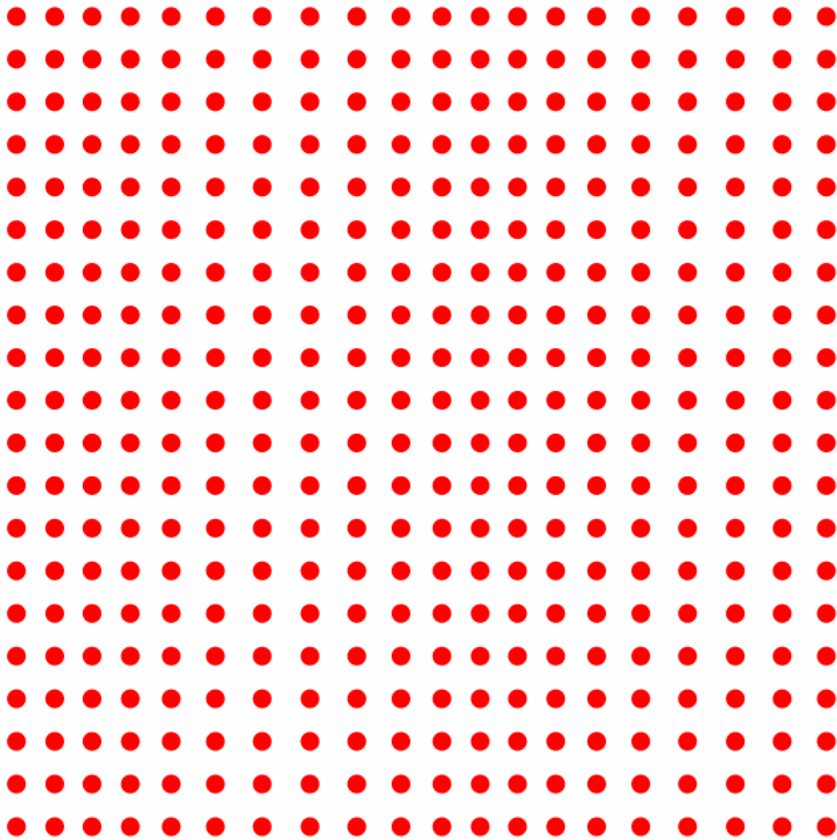
Transverse phonon ($\vec{f} > 0$)



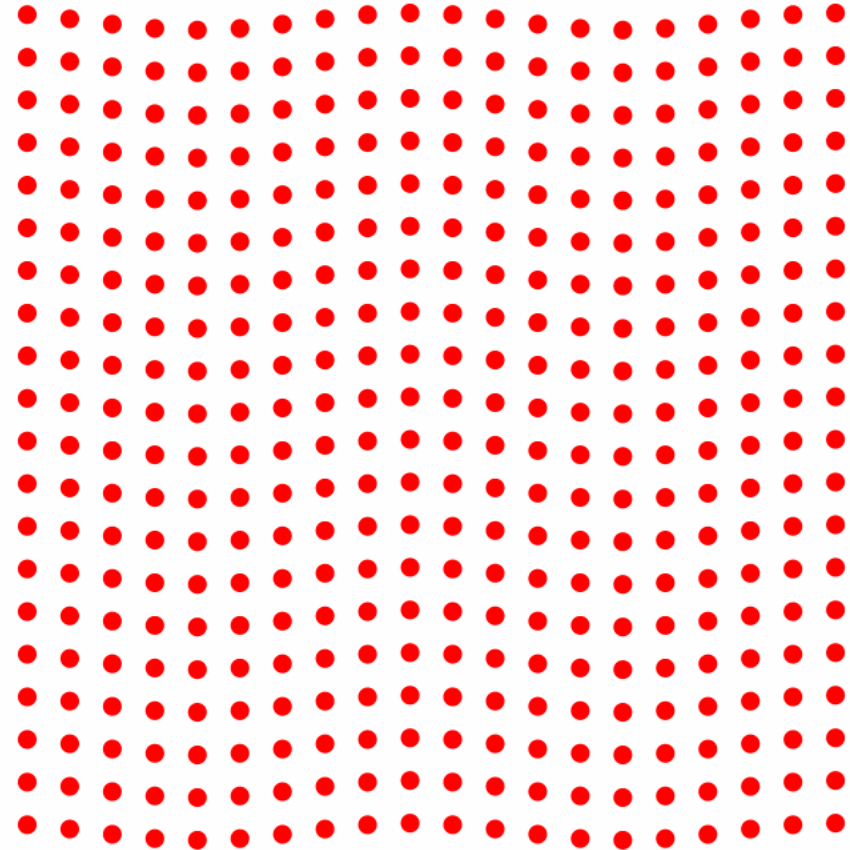
Acoustic phonons

2D lattice; 1 atom per unit cell

Longitudinal phonon ($\vec{f} \parallel \vec{e}_x$)



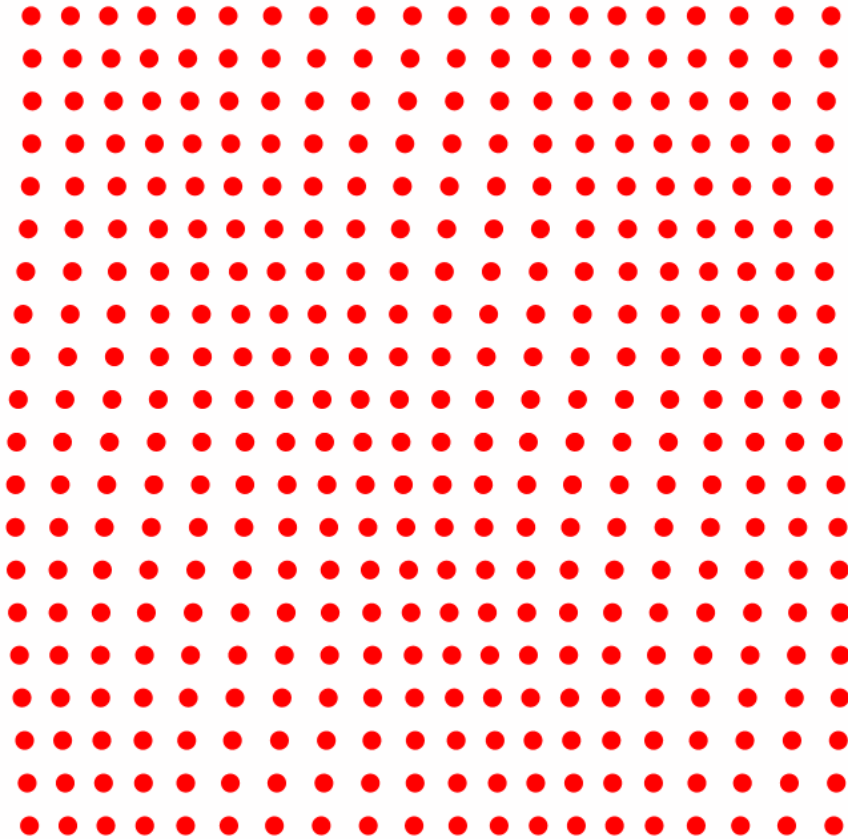
Transverse phonon ($\vec{f} \perp \vec{e}_x$)



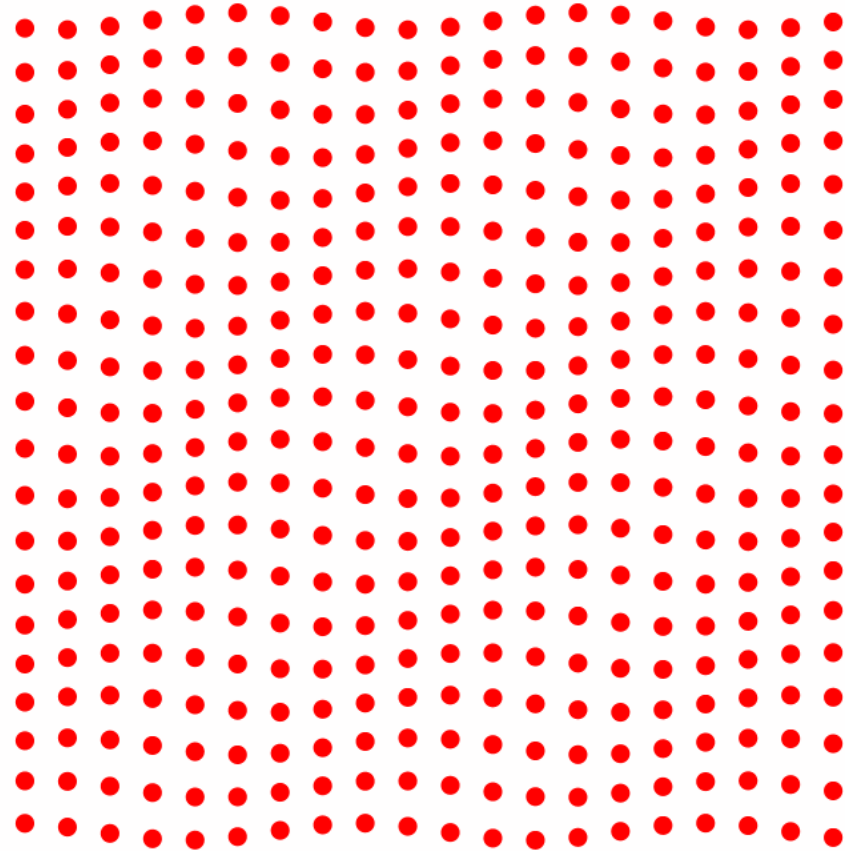
Acoustic phonons

2D lattice; 1 atom per unit cell

Hybrid phonon ($\vec{f} \nparallel \vec{e}_x$)



Hybrid phonon ($\vec{f} \nparallel \vec{e}_y$)



Optic phonons

1D lattice; 2 atom per unit cell

Acoustic phonons:

Longitudinal phonon



Transverse phonon



Optic phonons:

Longitudinal phonon



Transverse phonon

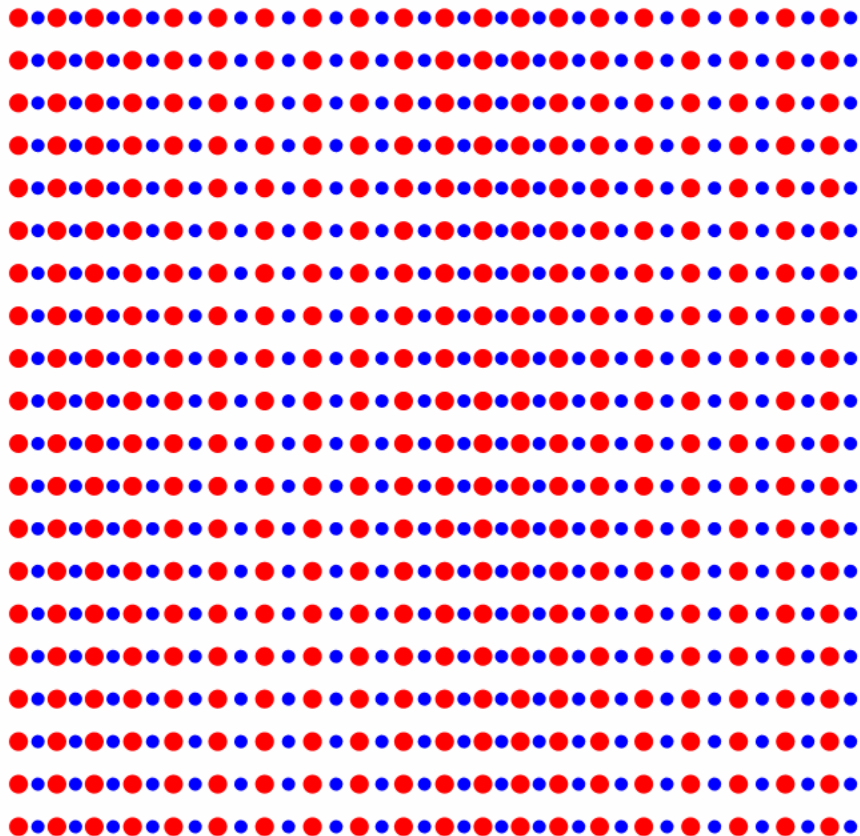


Optic phonons

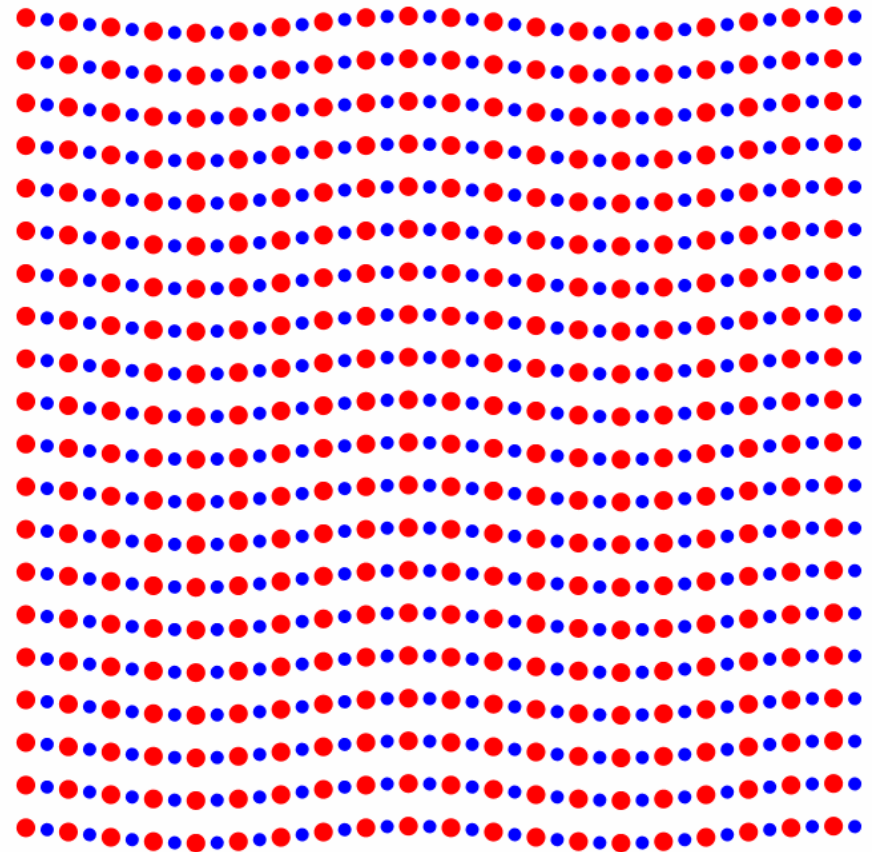
2D lattice; 2 atom per unit cell

Acoustic phonons:

Longitudinal phonon



Transverse phonon

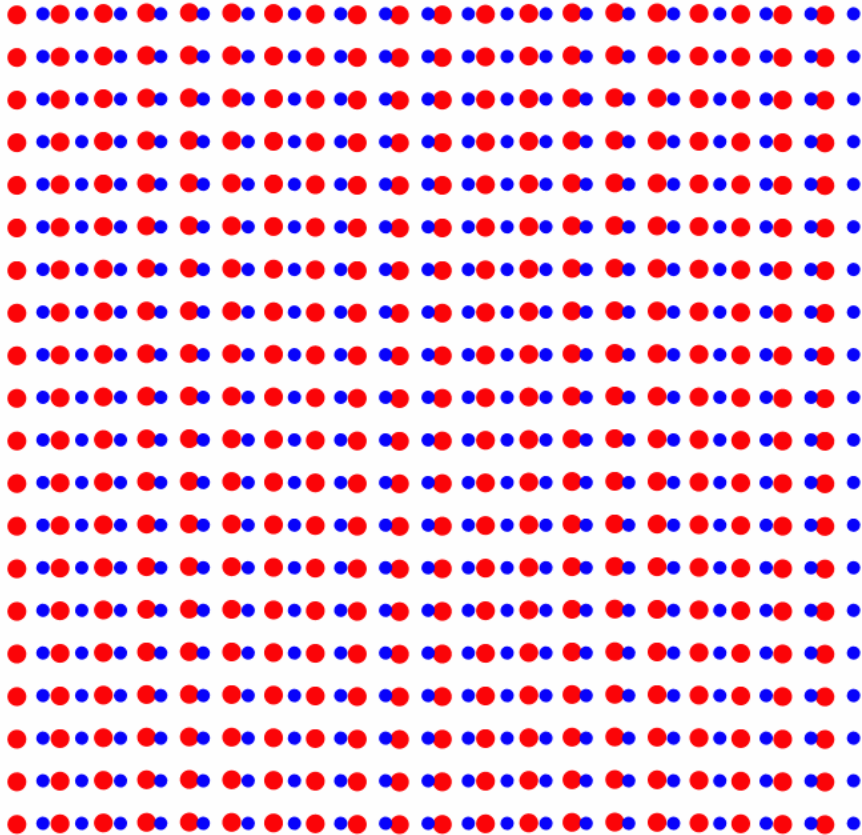


Optic phonons

2D lattice; 2 atom per unit cell

Optic phonons:

Longitudinal phonon



Transverse phonon

