

## DIRECT BANDGAP

CONDUCTION  
BAND

Photon  
 $\hbar\omega > E_g$

VALENCE  
BAND

ABSORPTION

## INDIRECT BANDGAP

Photon  
Phonon

PHONON-ASSISTED  
ABSORPTION

- Energy conservation  $\hbar\omega > E_g$
- Momentum conservation  
 $k_i = k_f$  for strong processes
- Indirect gap materials have weak absorption