EQUATION OF MOTION

EQUATION OF MOTION:

- We derive the equation of motion of an electron in an energy band .
- we look at the motion of a wave packet in an applied electric field.
- Suppose that the wave packet is made up of wave functions near a particular wave vector k.
- The group velocity is vg=dw/dk
- The effects of the crystal on the electron motion are contained in the dispersion relation.

PHYSICAL DERIVATION OF **hk=F**

- The transfer of momentum between the electron and the lattice when the state k of the electron is changed to $k+\Delta k$ by the application of an external force
- The neutral crystal suffers no net interaction with the electric field , either directly or indirectly to the free electron

HOLES:

- The properties of vacant orbitals in an filled band are important in semi conductor physics and in solid state electronics
- Vacant orbitals are commonly called holes
- The hole acts in applied electric and magnetic fields as if it has a positive charge +e.

EFFECTIVE MASS:

- In semi conductors the bandwidth the free electron energy is of the order of 20 eV, while the band gap is of the order of 0.2 to 2 eV.

- Thus the reciprocal of the mass is enhanced by a factor 10 to 100 and the effective mass is reduced to 0.1 -0.01 of the free electron mass.

PHYSICAL INTERPRETATION OF THE EFFECTIVE MASS:

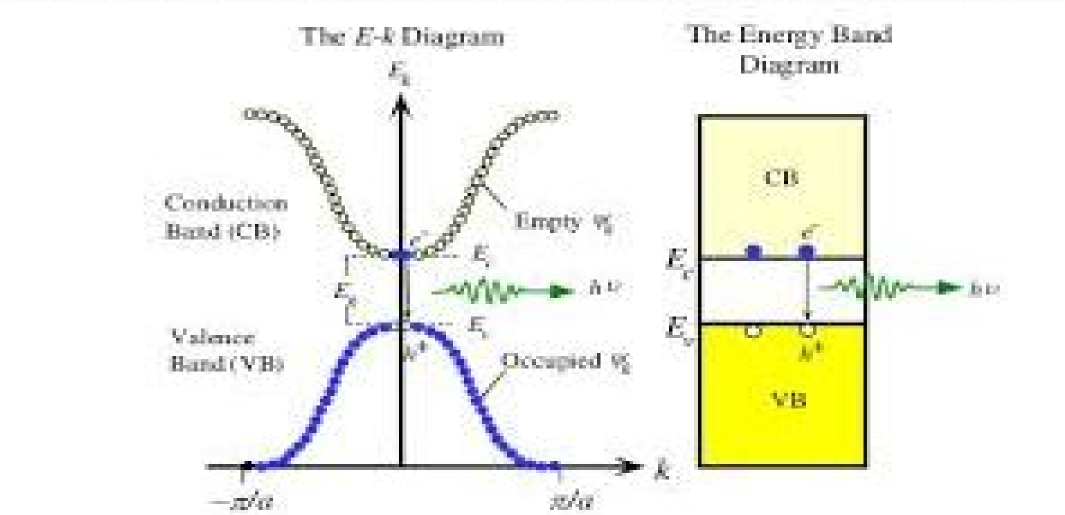
- A negative effective mass means that going from state k to k+Δk the momentum transfer to the lattice from the electron is larger than the momentum transfer from the applied force to the electron.

- Although k is increased by Δk by the applied electric field the approach to Braggs reflection can give an overall decrease in the forward momentum of the electron when this happens the effective mass is negative

EFFECTIVE MASSES IN SEMI CONDUCTORS:

- The determination of the energy surface is equivalent to a determination of the effective mass tensor.

Cyclotron resonance in a semi conductor is carried out with centimeter wave or millimeter wave radiation at low carrier concentration



SILICON AND GERMANIUM:

- The valance band edge in both crystal is at k=0 and is derived from p3/2 and p1/2 of the free atoms from the tight binding approximation.

- The valance band edges are not simple. Holes near the band edge are characterized by two effective masses, light and heavy

The conduction band edges in ge are at the equivalent points L of the Brillouin zone .

Each band edge has a spheroidal energy surface oriented along the <111> crystal axis, with a longitudinal mass ml=1.59m and a transverse mass mt=0.082m

The light and heavy holes in germanium have masses 0.043 m and 0.34 m ;in silicon 0.16m and 0.52m;in diamond 0.7m and 2.12m

HALL EFFECT:

The hall field is the electric field develop across the two faces of the conductor in the direction $j \times B$, when a current j flows across a magnetic field B.

consider a rod shaped specimen in a longitudinal electric field and a transverse magnetic field. This is negative for free electron, for e is positive.

By definition the lower the carrier concentration the greater the magnitude of the hall coefficient.

THANK YOU