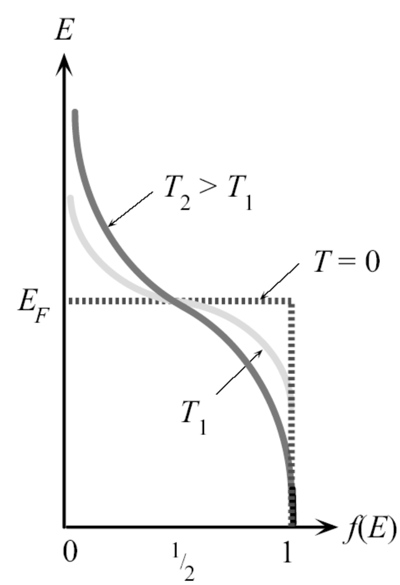
4.7 Quantum Theory of Metals

Fermi-Dirac Distribution

$$f(E) = \frac{1}{1 + \exp\left(\frac{E - E_F}{kT}\right)}$$



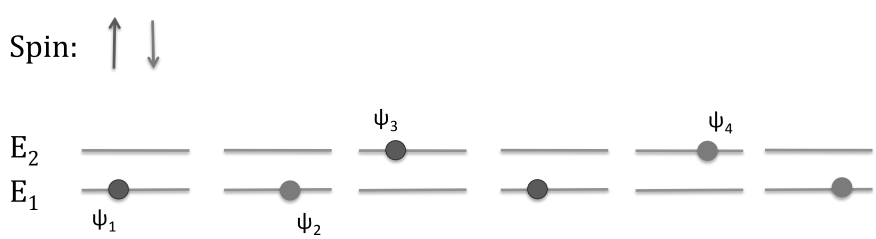
$$f(E) = \frac{1}{1 + \exp\left(\frac{E - E_F}{kT}\right)}$$

What does the Ferm-Dirac distribution tell us?

A) the probability of a state being occupied
B) the average occupancy of a state
C) both (A) and (B)

One electron in a two level system:

(that can exchange energy with the environment)



What is the classical limit?

A) f(E) ➔ 0

B) f(E) ➔ 1

C) f(E) ➔ ∞

D) ????

What is the classical limit?

A) f(E) ➔ 0

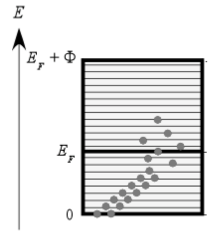
B) f(E) ➔ 1

C) f(E) ➔ ∞

D) ????

When the probability of *any* state being occupied is small, such that the probability of two particles occupying the same state is *very* small.

$$f(E) = \frac{1}{1 + \exp\left(\frac{E - E_F}{kT}\right)}$$



What is the occupancy of the Fermi level at T > 0?

A) 1
B) ½
C) 0
D) ∞

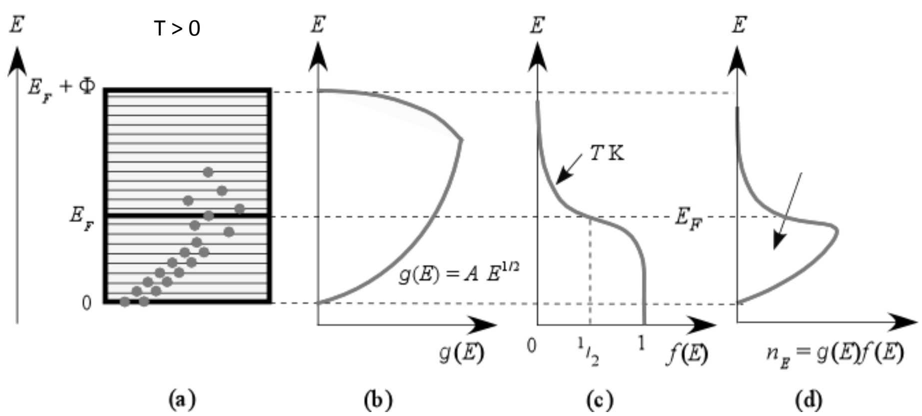


Fig 4.27

Why can we change the upper limit

of $\int_0^{E_F+\Phi} g(E)f(E)dE$ to ∞?

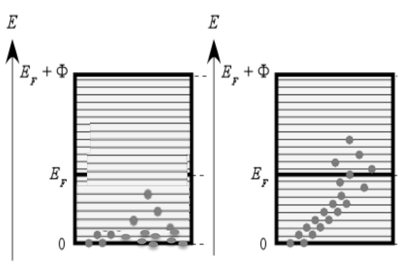
A) because f(E) = 1 for E > E_F

B) because f(E) = 0 for E > E_F

C) because f(E) ➔0 for E > E_F

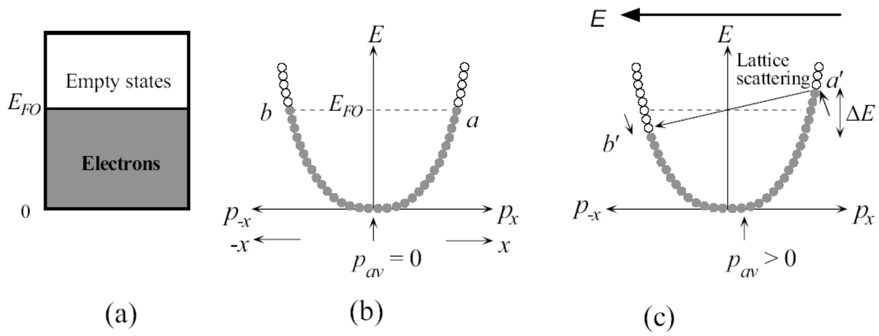
D) because f(E) ➔∞ for E > E_F

T > 0



Without Pauli exclusion With Pauli exclusion

E = KE = $p^2/2m$



UST Spring 2010 PHYS 225 Applications of Modern Physics: from the atom to the diode 11