Homework Set 22: Fermi Energy
Due Wednesday, April 9, 2025

Problems from or after TRex[1]

When you get a result, comment on it!! Does it make sense, is it interesting, is it ridiculous and indicate that the model doesn't work very well?

TRex 9.26) The Fermi energy for gold is 5.51 eV at T = 293 K.

a) Find the average energy of a conduction electron at that temperature. Also find the average energy of electrons excited above the Fermi level.

b) Compute the temperature at which the average kinetic energy of an ideal gas molecule would equal the average energy of the conduction electrons in part a.

c) Comment on the relative temperatures in a and b.

Note that $E_{\text{Conduction electrons}} = \bar{E}_F$, and $E_{\text{Excited electrons}} = E_F + 2(E_{EC})$

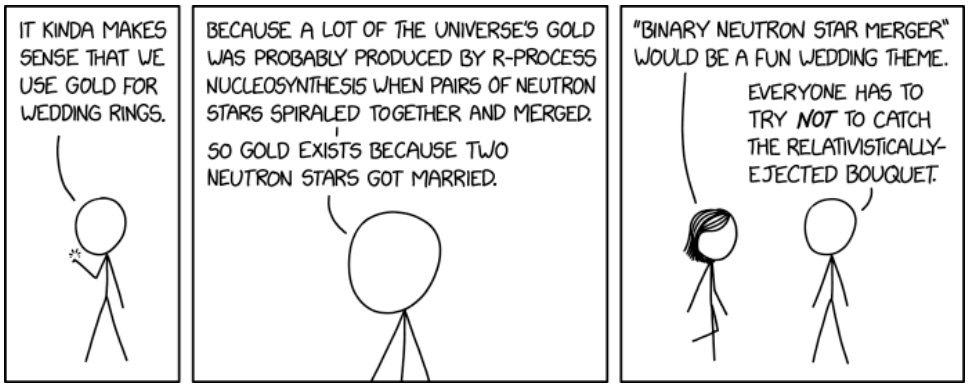
TRex 9.35) In a neutron star, the entire star's mass has collapsed essentially to nuclear density. For a neutron star with radius 10 km and mass 4.50×10^{30} kg, find the Fermi energy of the neutrons.

TRex 9.36) Consider a collection of fermions at T = 293 K. Find the probability that a single-particle state will be occupied (given by F_{FD}) if that state's energy is

a) 0.1 eV less than E_F,

b) equal to E_F, and

c) 0.1 eV less than E_F.



[1] Thornton and Rex, *Modern Physics for Scientists and Engineers*, 3rd Editon, Cengage Learning, 2013