# Phy 410
# Quiz #9, April 9, 2010

**The Fermi energy (FE) of an Ideal gas of spin ½ fermions of mass m and density N/V is given by**

$$\varepsilon_F = \frac{\hbar^2}{2m}\left(3\pi^2 \frac{N}{V}\right)^{2/3}$$

**The Fermi energy of electrons (m=m$_e$) in metal with density 2.5x10$^{28}$ (1/m$^3$) is 3.1 eV.**

**(i) What is the FE of electrons in a doped semi-conductor with density 2.5x10$^{25}$(1/m$^3$)**

$$Since \; \varepsilon_F \propto \left(\frac{N}{V}\right)^{2/3}; \varepsilon_F = 3.1\,eVx\left(\frac{2.5x10^{25}}{2.5x10^{28}}\right)^{2/3} = 3.1x10^{-2}\,eV$$

**(ii) What is the FE of heavy fermions with mass m=1000m$_e$ with the same metallic density, 2.5x10$^{28}$ (1/m$^3$)?**

$$Since \; \varepsilon_F \propto \frac{1}{m}; \varepsilon_F = 3.1\,eVx\left(\frac{m_e}{1000m_e}\right) = 3.1x10^{-3}\,eV$$