

Answer on Question #46476, Physics, Atomic Physics

Problem.

What is the probability that a donor atom at energy ϵ_D is ionized ?

Solution:

There are three possible states of the system that consist of a single donor atom:

- one ionized state with no electron;
- two unionized states (either spin-up or spin-down).

If I is the ionization energy, then the Gibbs factors of these states are

- ionized state $\exp(0) = 1$ ($\epsilon = 0, n = 0$);
- unionized state $\exp\left(-\frac{-I-\mu}{kT}\right) = \exp\left(\frac{I+\mu}{kT}\right)$.

Hence the probability equals $\frac{1}{1+2 \exp\left(\frac{I+\mu}{kT}\right)}$.