Lecture 10

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1 Recap

The posulate of statistical mechanics is that in a closed system, the thermodynamic equilibrium is most likely found in a state of maximum entropy defined as

$$S(E, V, N) = k \ln \Omega(E, V, N)$$

We then define

$$\left(\frac{\partial S}{\partial E}\right)_{V,N} = \frac{1}{T}$$

This makes sense intuitively. At a low temperature, a small increase in energy would lead to a greater increase in Ω than at a higher temperature.
We can then think of a thermodynamic "force" which is the negative gradient of S. Entropy can be thought as thermodynamic potential in a closed system. In general, if $\frac{q}{N} >> 1$, then

$$S = kN \ln \frac{Ec}{\hbar \omega N}$$

The first derivative of S with respect to E is positive, but the second derivative is negative. Now for Einstein solids,

$$U = -\mu_0 BS, S = 2N_\uparrow - N$$

Note that potential is maximum at