

In-class problem linked to lecture pages 60-70:

Consider a system in which the density of states increases by a factor of $10^{10^{22}}$ when the system's thermal energy is increased by 0.01%. How many degrees of freedom does this system have?

Physics 301

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$$\frac{\Omega_2}{\Omega_1} = \left(\frac{E_2}{E_1} \right)^{N/2} = 10^{10^{22}}$$

Find N when $\frac{E_2}{E_1} = 1.0001$

$$(1.0001)^{N/2} = 10^{10^{22}}$$

$$\log \left[(1.0001)^{N/2} \right] = \log \left[10^{10^{22}} \right]$$

$$\frac{N}{2} \log 1.0001 = 10^{22}$$

$$N = \frac{2 \times 10^{22}}{\log 1.0001} = \frac{2 \times 10^{22}}{4.3 \times 10^{-5}} = 4.6 \times 10^{26}$$