
PROBLEM SET 2

Oct. 5 Colloquium: "Imaging the Early Universe: First Results from BOOMERANG"

Professor Andrew Lange, Caltech

3:30 pm, 101 Rowland Hall

1. Consider a nonrelativistic free particle in a cubic container of edge length L and volume $V = L^3$.
 - (a) Each quantum state s of this particle has a corresponding kinetic energy ε_s which depends on V . What is $\varepsilon_s(V)$?
 - (b) Find the contribution to the gas pressure $p_s = -(\partial\varepsilon_s/\partial V)$ of a particle in this state in terms of ε_s and V .
 - (c) Use this result to show that the mean pressure $\langle p \rangle$ of any ideal gas of particles is always related to its mean total kinetic energy $\langle E \rangle$ by $\langle p \rangle = \frac{2}{3} \langle E \rangle / V$.
2. Eisberg and Resnick: 1.16
3. Eisberg and Resnick: 11.3 (Note that in terms of the notation used in class $\varepsilon_F = \mu$.)
4. Eisberg and Resnick: 11.5 (Note that in terms of the notation used in class $\alpha = -\beta\mu$.)
5. Plot the blackbody distribution spectrum $\rho_T(\eta)$ versus $\eta = \hbar\omega/kT$ at $T=3$ K.
6. Eisberg and Resnick: 1.19 (Hint: Use the result of the previous problem and the result stated in problem 1.18.)
7. Eisberg and Resnick: 1.12