Statistical Mechanics II and Relativity & Relativistic Electrodynamics

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Upon completion of Statistical Mechanics II and Relativity & Relativistic Electrodynamics course, students will be able to:

Statistical Mechanics II:
1. Remember: Recall the concepts of density matrices and quantum mechanical ensembles.
2. Understand: Explain the differences between pure and mixed states and apply density matrices to micro-canonical, canonical, and grand canonical ensembles.
3. Apply: Analyze the density matrix for various systems such as a free particle in a box, an electron in a magnetic field, and a beam of spin ½ particles.
4. Analyze: Interpret the statistical behavior of systems of indistinguishable particles using Bose-Einstein and Fermi-Dirac distributions.
5. Solve: Calculate the equation of state and thermodynamic properties of ideal Bose and Fermi gases, including the phenomena of BE condensation and blackbody radiation.
6. Evaluate: Analyze the statistical equilibrium of interacting systems using the Ising model, including the concept of exchange interaction and spontaneous magnetization.

Relativity & Relativistic Electrodynamics:
1. Remember: Recall the principles of special relativity and their implications for electromagnetism.
2. Understand: Explain the Lorentz transformations and their impact on the properties of space and time.
3. Apply: Utilize Maxwell's equations in a relativistic framework and solve problems involving relativistic electromagnetism.
4. Analyze: Evaluate the behavior of particles moving at relativistic speeds and calculate their energy and momentum in different reference frames.
5. Compare: Compare and contrast the predictions of classical and relativistic electrodynamics, including effects such as time dilation and length contraction.
6. Critically evaluate: Critically analyze the experimental evidence supporting the theory of special relativity and its implications for our understanding of the universe.