

Exam Electrodynamics of Radiation Processes

There are four questions, each 30 minutes. Questions 1 and 2 are closed book and should be handed in after not more than 1 hour. Questions 3 and 4 are open book. The total time for the exam is 2 hours.

Question 1 (Special Relativity):

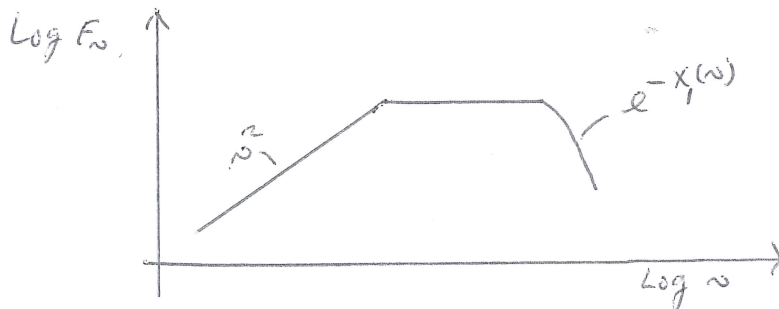
- a. Explain the basic principles of special relativity and illustrate your arguments with 3 Lorentz invariants that are related to radiation.
- b. Explain conceptually how beaming of radiation works by considering a rest frame for a charge and an observer's frame in relative motion.

Question 2 (Radiation Processes):

- a. Describe the 3 radiation processes studied in this course. Specifically mention what the driving mechanisms are and how they differ.
- b. Consider a medium in thermal equilibrium with some optical depth. Explain the difference between thermal radiation and black body radiation in this context.

Question 3 (free-free emission):

- a. Non-relativistic Bremsstrahlung has a $\sim \ln(b_{max}/b_{min})$ dependence on the impact parameter b . Derive an approximate method for non-relativistic free-free emission that allows for deviation from a straight line approximation.
- b. Consider the figure below and argue what information can be gained from this observation.



Question 4 (Compton Scattering and Synchrotron Emission):

- a. Indicate, using mathematical equations, the fundamental similarities between synchrotron emission and Compton scattering. Make sure to involve the gamma factor.
- b. Consider the figure below and argue what information can be gained from this observation.

