

PHYS 704 - Test 3.

- 1. [10 points] Very high energy photons are known to traverse cosmological distances. However, the universe is also populated with low energy photons remaining from the Big Bang; these low energy photons resemble those from a blackbody at 3K. Collisions between the high energy photons and low energy photons can lead to production of e^+e^- pairs. Estimate the minimum energy needed for the high energy photons to create such pairs in the collisions described.
- 2. [10 points] Electric current of 1 A flows through a long straight wire of thickness 2 mm. The drift speed of electrons is 1 mm/s. What is the charge density and the current density in the lab frame? The same quantities in the rest frame of the electrons? What are the electric and magnetic fields 1 m from the wire in both cases?
- 3. [10 points] Define what it means to say that the electromagnetic field tensor is gauge invariant. Deduce the Lorentz covariant form of the inhomogeneous Maxwell equations in the Lorenz gauge. Write also a Lorentz covariant form for the homogeneous Maxwell equations and use the definition of the field tensor to demonstrate their veracity.