Theoretische Physik 2 (Elektrodynamik)
Wintersemester 2016/17

Aufgabe 1:
Length contraction, time dilation and the relativity of simultaneity   3 Punkte

Let a bus with length l_0 when at rest move with velocity v in x direction on the road.

(a) What is the length of the bus measured by an observer A who is at rest on the road.

(b) Now let a ball move with velocity u_0 from the back to the front of the bus. What is time interval for this to happen measured by A?

(c) Suppose a passenger B on the bus releases two beams of light at the center of the bus, then these two light beams will arrive at the two ends of the bus simultaneously observed by B. Is this still true for A? If not, what is the time difference?

Aufgabe 2:
Transformation law for electromagnetic fields   4 Punkte

Suppose there is an electromagnetic field $\mathbf{E}\perp\mathbf{B}$ in a reference system Σ. Let another reference system Σ' move in the direction of $\mathbf{E}\times\mathbf{B}$. What is the velocity of Σ' relative to Σ when the observer in Σ' can only detect the electric field or the magnetic field?

Aufgabe 3:
Compton scattering   3 Punkte

According to quantum mechanics, a photon of angular frequency ω has energy $\hbar\omega$, momentum $\hbar\mathbf{k}$, where $\hbar$ is the reduced Planck constant. Consider a photon with angular frequency ω colliding with an electron of mass m_e which is at rest.

(a) Prove that the electron cannot absorb this photon, otherwise the conservation law of energy and momentum will not be satisfied.

(b) The photon can be scattered by the electron. What is the relation between the angular frequency ω' after the scattering with the scattering angle θ?