

## Elektrodynamik, Frühjahrssemester 2019

### Blatt 10

Abgabe: **Dienstag 14.5.19**, 12:00H (Treppenhaus 4. Stock)

Tutor: Michal Kloc, Zi.: 4.10

**Schriftlicher Test: Donnerstag, 23. Mai 2019, 10.15 - 12 Uhr**

**Erlaubte Hilfsmittel: bis zu zwei Seiten handgeschrieben**

(1) **Relativistic kinematics** (2 Punkte)

- (a) A particle of mass  $m$  whose total energy is twice its rest energy collides with an identical particle at rest. If they stick together, what is the mass of the resulting composite particle? What is its velocity?
- (b) A neutral pion of (rest) mass  $m$  and (relativistic) momentum  $p = \frac{3}{4}mc$  decays into two photons. One of the photons is emitted in the same direction as the original pion, and the other in the opposite direction. Find the (relativistic) energy of each photon.

(2) **Lorentz transformation of the Coulomb field** (4 Punkte)

Calculate the **E**-field and the **B**-field of a point charge  $e$  moving at constant velocity  $\mathbf{v} = (v, 0, 0)$  in the laboratory system  $K$ . The potential  $\phi$  and vector potential **A** form a 4-vector  $A^\mu = (\phi/c, \mathbf{A})$ , so you can use a Lorentz transformation  $\Lambda$  to go from the rest frame  $K'$  of the charge to  $K$ . Don't forget to also transform the argument  $x$  of  $A$ , i.e.,  $A(x) = \Lambda A'(\Lambda^{-1}x)$ . Discuss the geometry of all points with equal  $|\mathbf{E}|$  at a given time in  $K$ .

(3) **Capacitor in a moving frame** (4 Punkte)

A parallel-plate capacitor, at rest in  $K$  and tilted at a  $45^\circ$  angle to the  $x$ -axis, carries charge densities  $\pm\sigma$  on the two plates. System  $K'$  is moving with velocity  $v$  parallel to the  $x$ -axis.

- (a) Find **E**, the electric field in  $K$ .
- (b) Find **E'**, the electric field in  $K'$ .
- (c) What angle do the plates make with the  $x'$ -axis?
- (d) Is the field perpendicular to the plates in  $K'$ ?