University of Utah
Physics Department
Physics 7120 Spring 2011

Classical Electrodynamics
Problem Set 11

1. Consider relativistic motion of a particle with the charge charge $q$ and the mass $m$ in homogeneous electric field $E$. Choose $z$ as the field direction. Initial conditions are: $p_z = p_y = 0$ and $p_x = p_0$. Using equation of motion

$$\frac{dp}{dt} = qE,$$

find

a. all components of velocity $v$ as a function of time. Find limits of these components at $t \to \infty$ and explain these limits (5 points).

b. Find equation of the trajectory $z(x)$ in the plane $zx$ (3 points).

Hint: Use $v = pc^2/H$, where $H = c\sqrt{(m^2c^2 + p^2)}$.

2. Find three possible gauges of vector-potential $A$ for the case when $B = \text{curl}A$ is a homogeneous and time-independent field in z-direction. (5 points)

3. Collision of relativistic particles.
A particle of mass $m_1$ with velocity $v_1$ hits a particle at rest with the mass $m_2$ and they stick together. Find velocity $V$ and mass $M$ of the compound particle. (4 points for writing correctly all equations necessary to find $V$ and $M$; another 4 points for correct solution of these equations)