

Written Examination Special Relativity F8066

Academic Year 2007–2008: 25 June 2008, 2.30-4.30 PM

Please read the following INSTRUCTIONS

A. Answer at most TWO questions. You may answer in english or in italian.

B. You may not use notes or textbooks, but the course notes are available for consultation at the front desk.

1. A proton and an electron have the same kinetic energy of 20MeV .

(a) Which has greater mass increase due to its motion?

(b) What are their velocities?

(c) What is the percentage mass increase for each of them?

(The rest energy of the proton is 938MeV , that of the electron is 0.511MeV)

2. Consider a process with a number of initial and a number (maybe different) of final particles. Show that if total energy is conserved for all observers, then so is total three-momentum, and vice-versa..

3. Let $A = (a_0, a_x, a_y, a_z)$ and $B = (b_0, b_x, b_y, b_z)$ be two four-vectors in frame S and let $A' = (a'_0, a'_x, a'_y, a'_z)$ and $B' = (b'_0, b'_x, b'_y, b'_z)$ be the corresponding four-vectors, Lorentz boosted along one spatial axis, in frame S' . By writing out the explicit Lorentz transformation for A' and B' in terms of the rapidity parameter η , show that the product $A^\alpha B_\alpha$ is indeed invariant, ie $A^\alpha B_\alpha = A'^\alpha B'_\alpha$.