Written Examination Special Relativity MFN 1313

Academic Year 2011–2012, 11 July 2012, 2.30-4.30 PM

Please read the following **INSTRUCTIONS**

A. Answer at most TWO questions. You may answer in english or in italian. A pass is obtained for one complete answer.

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

1. Argue that the set of all Lorentz boosts is a group (the direction of the x and x' remaining the same). What are the physical meanings of the identity and the inverse of an element in this group? Is this group abelian? Given a pair of consecutive transformations corresponding to velocities v_1 and v_2, what is the velocity corresponding to the composition of the two transformations? Justify all answers.

2. If particle 1 has mass m_1 and particle 2 has mass m_2 and the energy of particle 2 is E in a frame of reference in which particle 1 is at rest, what is the energy of particle 1 in a frame of reference in which particle 2 is at rest? Justify your answer.

1. $m_1 m_2 / E$

2. $m_2 E / m_1$

3. $m_1 E / m_2$

4. none of these

3. A stick of proper length l sits at rest in frame S, lying in the $x - y$ plane at an angle $\theta = \arctan(3/4)$ with the x axis. Another frame S' moves with velocity v along the positive x axis of S. In S' the stick is angled at $45°$ with respect to the x' axis.
(a) What is v?
(b) What is the length l' of the stick as measured is S'?