Homework 4 due 5 Nov. 2007
PH507 Grad EM posted: 27 October 2007

Reading: Heald and Marion, 14.1-14.8

1) HM 14.5. Decompose the vector **x** into components that are perpendicular and parallel to the velocity, then use the boost equations to put this in vector form. Compare this result for the special case in which the boost is at an angle q to the z-axis in the x-z plane, where you directly rotate the Lorentz transform matrix with a similarity transform. This is probably easier to do in Mathematica, though you have to take care with the matrix multiplication (instead of M1.M2.M3, do M12=M1.M2, then do M12.M3).
2) HM 14.6. This is a straightforward application of the results of the previous problem.
3) Show that the quantity $E^2 - B^2$ is a scalar invariant by calculating directly (as I did in class for $\mathbf{E}\cdot\mathbf{B}$) from the field transformation equations 14.77. Next, show that the quantity $S^2 - c^2\mathsf{E}^2$ is invariant, where S is the magnitude of the Poynting vector and E is the energy density of the fields.