Black Holes, Problem Set 5 for Thursday, Sept. 19

Read Chapter L to p. 102, which is the derivation of the Lorentz Transformation formulas. The formulas are summarized in Eq. L-10a on p. 102.

Problem 1 — Transformation of Angles

Do Problem L-6 on p. 114. For part (b), see the picture and commentary on the reverse.

Problem 2 — Transformation of Transverse Velocity

Do Problem L-7 on p. 115.

Problem 3 — The Tilted Meter Stick

Do Problem L-10 on p. 115.

Electric Field Lines

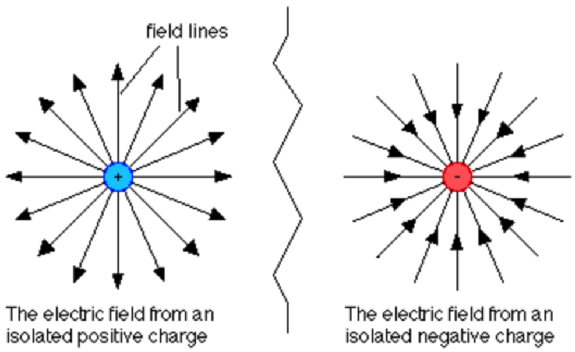
All you need to know about electric field lines to do L-6(b) is here.

Let's focus on the left drawing below. When we draw the electric field lines of a positive charge, we are actually just drawing a sampling of them. In the left drawing below, a field line has been drawn every 22.5°. So there are 16 lines radiating out in the complete circle. You could of course do a more complete sample, for example with 24 lines drawn every 15°.

In L-6(b) Taylor and Wheeler are just asking you to choose a bunch of angles, equally spaced, representing the electric field, and then see what happens to those angles when you transform them to a new frame. They will no longer be equally spaced! They still point outward. We can talk about what not being equally spaced means after you hand in your solutions on Thursday.

An electric field can be visualized on paper by drawing lines of force, which give an indication of both the size and the strength of the field. Lines of force are also called field lines. Field lines start on positive charges and end on negative charges, and the direction of the field line at a point tells you what direction the force experienced by a charge will be if the charge is placed at that point. If the charge is positive, it will experience a force in the same direction as the field; if it is negative the force will be opposite to the field.

The fields from isolated, individual charges look like this:



The electric field from an isolated positive charge

The electric field from an isolated negative charge