general relativity – September 8, 2009

material discussed in class

Roughly equal to sections 1.4-1.8 in Carroll. It is recommended that you read these sections as well.

exercises

- Recall that ${\Lambda^{\mu'}}_{\mu}$ and ${\Lambda^{\mu}}_{\mu'}$ are not the same, but each others inverse, in other words
  $${\Lambda^{\mu'}}_{\mu}{\Lambda^{\mu}}_{\nu'} = \delta^{\mu'}_{\nu'}.$$
  Use this to show that $\eta^{\mu\nu}$ is a tensor, i.e.
  $$\eta^{\mu'\nu'} = {\Lambda^{\mu'}}_{\mu}{\Lambda^{\nu'}}_{\nu}\eta^{\mu\nu}.$$
  .
- Similarly, verify that δ^{μ}_{ν} is a tensor.
- Given the transformation rules of x^{μ} and those of the components of a vector A^{μ}, show explicitly that
  $$A^{\mu}\frac{\partial}{\partial x^{\mu}}$$
  is a scalar.
- Show that $p^{\mu}p_{\mu} + m^2 = 0$ is equivalent to the familiar relation $E^2 = p^2c^2 + m^2c^4$, with $c = 1$.
- Consider a tensor R_{μ} with values (R_0, R_1, R_2, R_3). A second observer moves with constant velocity v in the y-direction. What are the values of $R_{\mu'}$ that the second observer measures?
- Exercises 1.6-1.7 in Carroll.