

### PHYS 704 - Test 1.

- 1. [4 points] You are at the equator, it is dawn, and the sun is directly to the east. Consider scattering of sunlight from a spot that is 2 miles above you. Why is the scattered light blue and not red? Is the scattered light polarized? If so vertically or horizontally? If horizontal is the polarization north-south or east-west or something else?
- 2. [4 points] Determine if the quantity  $d^4x$  is Lorentz invariant. Same for the quantity  $d^3p/E$  where  $\vec{p}$  and  $E$  are the momentum and energy of a particle of mass  $m$ .
- 3. [4 points] An electron of energy 7 GeV goes up the  $z$ -axis. It collides head on with a positron of energy  $E$  coming down the  $z$ -axis. The collision produces a single particle  $U$  of mass  $M = 10 \text{ GeV}/c^2$ . Neglecting the electron and positron masses, find  $E$ , and determine the final momentum ( $x$ ,  $y$ , and  $z$  components) of the produced particle  $U$ .