Physics 252 – Reading Exercise #4

(due Tuesday, May 3)

Read the paper:

A. Benvenuti, *et al.*, Phys. Rev. Lett. **30**, 1084 (1973)

Write a brief summary of this paper. Include answers to the questions below.

This experiment studied deep inelastic scattering using neutrinos. The underlying reactions were the weak interaction processes $\nu + d \to u + \mu^-$ and $\overline{\nu} + u \to d + \mu^+$. We will discuss later in the course that these processes are mediated by current-current interactions similar to those of the electromagnetic interactions.

1. What is the observation claimed in this paper? The experiment used 10^{15} protons on target. How many neutrino events were observed?

2. What is the physical size of the complex of accelerators and beamlines used to produce the neutrino beam?

3. Explain the sequence of steps used in the generation of the neutrino beam.

4. What is the physical size of the detector used for these measurements? What is the target material, and, why is this an appropriate choice?

5. What is the evidence that the events seen are actually initiated by neutrinos from the beam?

6. In the observation of $\nu + N \to \mu + hadrons$, what aspects of the final state are measured, and how are the measured? How is the energy of the initial neutrino estimated? What range of values of Q^2 is observed?

The theoretical 3:1 ratio of cross sections referred to in the text will be explained later in the course.