**Vocabulary**

**Antimatter (antiparticles)** – All types of matter particles have opposite analogs that have equal mass but opposite charge and lepton or baryon number.

**Arachne** – Computer software interface that shows data from the MINERA experiment

**Baryon number, B#** – One of the conservation numbers of particle reactions. Baryon numbers are calculated from the number of quarks and antiquarks in a particle:

B# = 1/3 (#quarks - #antiquarks)

**Beta Particle (-)** – the name given to an electron that is created during a high energy particle collision or decay.

**Electron (e-)** – A fundamental particle in the lepton family. Its electric charge is -1e; its rest mass is 0.511 MeV/c2.

**eV (electronvolt)** – A unit of energy. 1 eV = 1.6 x 10-19 Joules. The typical energy difference between an atom’s quantum levels is on the order of 1-10 electronvolts.

**Fermilab** – The largest particle accelerator facility in the Western Hemisphere (2nd largest in the world) is located near Chicago, Illinois in the town of Batavia.

**Fundamental particle** – One of the 12 basic building blocks of matter broken into two families, quarks (six) and leptons (six). Each family has antiparticle analogs.

**Histogram** – A type of chart used to interpret large data sets according to the frequency of an event or data type within the set.

**Lepton** – a family of six fundamental particles that includes electrons, muons, tau, and corresponding neutrinos.

**Lepton number** – One of the conversation numbers of particle reactions. Lepton numbers come in three categories (electron, muon, and tau) and equal +1 for matter but for antimatter analogs, the number is -1.

**MeV (mega electronvolt)** – A unit of energy. 1 MeV = 1,000,000 eVs = 1.6 x 10-13 Joules. Particle rest energies are often reported in MeV.

**MeV/C** – a unit of momentum used by high energy particle researchers. The unit allows for quick conversion between momentum, energy, and rest mass.

**MeV/C2** – a unit of mass used by high energy particle researchers. The unit is used for quick conversion between momentum, energy, and rest mass.

**MINERnA** – a multi-million dollar, multi-year experiment to investigate the nature of neutrinos.

**Module** – A pair of hexagonal scintillating panels (xv or xu) used to track particle paths in the MINERνA experiment. The panels are constructed from long strips of scintillator. Each panel within a pair is aligned so the scintillator strips are offset by 60° per panel.

**Muon ()** – A fundamental particle in the lepton family. It has an electric charge of -1e and a rest mass of 106 MeV/c2. It is ~200 times heavier than an electron (106 MeV) and much less stable.

**Neutrino (ν)** – A fundamental particle in the lepton family. Very difficult to detect, but found in great numbers throughout the universe. Neutrinos have no charge; the rest mass is a miniscule 0.00005 MeV/c2.

**Neutron (n0)** – An electrically neutral subatomic particle commonly found in an atom’s nucleus. Made of 1 up quark and 2 down quarks (udd), it has a rest mass of 939 MeV.

**NuMI Beam** – a high energy neutrino beam in Fermilab that provides the stream of neutrino particles that initiate the reactions of interest in the MINERνA experiment.

**Particle decay** (beta, pion, muon, etc.) – The process mediated by the weak force that allows less stable particles to change identity to a more stable state.

**Pion ()** – Any of several commonly produced particles in high energy reactions. Always composed of two quarks (up and/or down), a pion’s charge may be +1e, 0, or -1e and its rest mass is approximately 140 MeV.

**Quarks** – A family of fundamental particles including the up, down, top, bottom, charm, and strange quark. These particles have charges of +2/3 e or -1/3 e and have masses on the order of MeV’s.

**Rest Mass** – the minimum mass of a particle, describing the particle at rest. Every particle’s mass increases as it moves faster; this is in accordance with Einstein’s theory of relativity.

**Scintillation** – a process where a high energy particle dumps some of its energy as it passes through a special target. The chemicals in the special target convert some of the deposited energy into photon or light energy.

**Standard Model** – A broad physics theory that describes the existence of fundamental particles and forces in nature. This model describes and predicts the appearance of a whole “zoo” of exotic particles that have been observed in high energy particle accelerators.

**Strong force** – attractive force between quarks. It is the force responsible for holding all the positively charged protons together in the nucleus.

**Weak force** – an interaction between leptons or quarks that allows them to switch identities through very massive exchange particles called bosons. This force is responsible for nuclear fission or fusion reactions.

**xu view** – the information from a module a pair of panels in the MINERνA experiment oriented .

**xv view** - a pair of panels in the MINERνA experiment oriented to map a particles 3-D path through the target.

**z-axis** – the axis in space that runs straight through the MINERνA detector modules.