What's the Difference between Cosmic Rays and Gamma Rays?
And why do we care?

Light (electromagnetic radiation) has a *dual* nature. That means it can be defined as a transverse wave and as a series of particles. While light is both a wave and a particle at all times, it sometimes makes sense to focus on the wave properties and other times focus on the particle properties of light. For example, radio waves are often exclusively described and utilized as transverse waves, while gamma rays are often described as particles. The name given to these fast-moving, chargeless particles is *photons*. Photons can contain different amounts of energy, depending on the type of electromagnetic radiation. Gamma rays, as the most energetic electromagnetic radiation, also contain the highest energy photons. But, it's the fact that the photons are chargeless that's important; neutral particles will not be attracted or repelled by a magnetic field. So, gamma rays will not bend as they travel through the magnetic fields found within the universe (e.g. our planet Earth, the solar system, and galaxies). Gamma rays will travel in a straight line, at the speed of light (in a vacuum) from the source that created them to the detector that measures them.

Particles that are not chargeless are called charged particles. These charged particles can include electrons and protons, but also their opposites - the positron and antiproton. Pions, muons, alpha particles, and ions of common elements will also be charged. Charged particles will bend in a magnetic field; how much and in what direction they will bend depend on the charge (positive/negative) and the mass of the individual particle. Therefore, all charged particles will *not* travel in a straight line from the source to the detector.

In physics and astronomy, scientists have defined charged particles that come from outer space as cosmic rays. Unfortunately, the definition of cosmic rays changes depends on the person defining them. Sometimes, scientists will include neutral particles called neutrinos in cosmic rays, which requires a change in definition. Additionally, many scientists will discuss cosmic rays and either explicitly or implicitly include photons (gamma rays). This can lead to some confusion, but the connection makes sense. Both cosmic rays and gamma rays can originate from the same types of sources. These sources include active galaxies, pulsars, pulsar wind nebulae, and supernova remnants. Some of the largest stars of the universe end their stellar evolution in a supernova - a large explosion. A Supernova remnant is a shockwave of material and energy radiating out from the explosion. Sometimes, the core of the star will remain, collapsed down to form a white dwarf, neutron star, or a pulsar (magnetized, rotating star). Pulsars may also create a pulsar wind nebula, a nebula fueled by the pulsar that is found within the supernova remnant. Active galaxies are those galaxies that contain an active nucleus (black hole); gamma rays are emitted from the jets of active galaxies and are sometimes referred to as blazars.

In the last hundred years, scientists have developed technology to detect cosmic rays; it's been less than fifty years for cosmic gamma ray detection. Detecting cosmic rays is (relatively) easy - cosmic rays come from all over and form background cosmic radiation. This is because the cosmic rays do not travel in a straight line (due to the magnetic fields they travel through). However, detecting gamma rays is more difficult. Not only is the technology newer, but there are fewer gamma rays (due to the straight-line nature), and detectors for gamma rays will detect cosmic rays as well. Being able to separate gamma rays from cosmic rays is important; for it is the gamma rays that scientists can trace back to the source of the particles, and learn more about the astronomical objects that create them.