NARRATION: Created by the hottest, most violent, and most energetic objects and events in the universe, gamma rays travel across vast stretches of space, only to be absorbed by Earth’s atmosphere. Scientists had no way to detect and study gamma rays from the cosmos, until high-altitude balloons and rockets carried gamma ray sensors above the atmosphere. Deadly to humans, gamma rays are created on Earth by natural radioactive decay, by nuclear explosions, and even by the lightning in thunderstorms.

Coronal mass ejections from our Sun emit gamma rays, followed by masses of charged particles. Monitoring these gamma rays provides scientists with an early warning of incoming charged particles that may cause disruptions in power and communications networks.

The most energetic of all EM waves, gamma rays carry enough energy to kill living cells. Doctors are able to selectively use gamma radiation to destroy cancer growths.

Gamma ray wavelengths are the shortest of all electromagnetic waves, about the size of an atom’s nucleus. In fact, it is so short, that the rays sail through atoms as easily as comets sail through our solar system. This makes detecting gamma rays difficult for scientists.

Gamma ray detectors typically contain densely packed crystal blocks. As gamma rays pass through, they collide with electrons in the crystal. The sensor doesn’t directly detect gamma rays; rather, it detects the charged particles created by those collisions.

Scientists have used gamma rays to determine the elements that make up Martian surface soils. When struck by cosmic rays, chemical elements in soils and rocks emit uniquely identifiable signatures of energy in the form of gamma rays. The gamma ray spectrometer on NASA’s Mars Odyssey Orbiter detects and maps these signatures, such as this map of hydrogen concentrations.

Gamma rays stream from stars, supernovas, black holes, and pulsars to wash our sky with gamma ray light. NASA’s FERMI Gamma-ray Space Telescope imaged the location of these sources, mapping out the Milky Way galaxy by creating a full 360 degree view of the galaxy from our perspective here on Earth.

While the visible light sky is predictable and follows regular patterns, the gamma ray sky does not. Bursts of high energy gamma radiation arrive from deep space every day. These explosions of gamma rays last fractions of a second to minutes, popping like cosmic flashbulbs, momentarily dominating the gamma ray sky, and then fading. This video of the Vela pulsar beams gamma rays every 89 seconds as it rotates.

Gamma ray bursts are the most energetic and luminous electromagnetic events since the Big Bang, and can release more energy in 10 seconds than our Sun will emit in its entire 10 billion year expected lifetime. NASA’s SWIFT satellite recorded this gamma ray burst of an exploding star 13 billion light years away. It is among the most distant object ever detected, when the universe was just 630 million years old. A recent observation of a gamma ray burst produced the greatest total energy to date, equivalent to 9 thousand typical supernovae.

By continuing to study gamma rays, we will unlock important new understanding in astronomy, its use in medical treatments, and allow us to further enhance our protection for our satellites and other electronics here on Earth.