



ently colored photons of the **visible spectrum**. Another million times smaller and more energetic are the photons produced when an **electron and positron** join and transform into photons.

Up to this point on the scale, all individual energy units had been photons. The energy of the next item, **hydrogen fusion**, is released not as photons but as the kinetic energy of the Helium and Hydrogen nuclei and neutrons speeding away from one another. A few times more energy is produced in the fission of an atom of **Uranium-235**. Photons are produced in these events, but the majority of the energy is contained in rapidly moving neutrons and nuclei. The two photons produced in **proton-antiproton annihilation** each have energies of just under one billion electron volts.

The next few items on the scale are the units of energy used in science and commerce. The **erg** is the energy of a gram of mass moving at a velocity of  $\sqrt{2}$  centimeters per second. A **foot pound** is the energy of one pound moving at  $\sqrt{2}$  feet per second. A **calorie** is the amount of energy required to raise the temperature of one gram of water one degree Celsius.

At about 50 Joules, the **most energetic cosmic rays** to be measured are probably photons with wavelengths of about  $10^{-25}$  meters and masses of about  $10^{-15}$  kilograms. They are part of a background photon spectrum that originated when the matter of the universe was created. The photons at the upper end of this creation spectrum are extremely rare but they have almost unlimited energies with masses approaching that of the universe itself. The masses and wavelengths of selected photons from this spectrum are shown at random points on the spiral.

One **British thermal unit** raises the temperature of a pound of water by one degree. A **watt-hour** is a standard unit of electricity. A **horsepower** is a unit of work. **Natural gas, gasoline, TNT, coal, and hydrogen** are common fuels used to produce energy.

The kinetic energy of a **human being's motion relative to the CBR photon rest** is similar to the energies of the **Titanic's fall** to the bottom of the ocean, the **first atomic bomb** exploded in New Mexico or a **bumblebee** flying at half the speed of light.

The photon energy produced by the **annihilation of one gram of matter with one gram of anti-matter** is similar to the energy produced by the **fission of 1000 grams of uranium-235**

The mysterious explosion that occurred in 1908 near the **Tunguska** River in Siberia could well have been caused by a photon from the creation photon spectrum hitting the atmosphere.

The kinetic energy of a **human being moving at half the speed of light** is only a few times less than the **annual electricity production of the United States**. The **Earth's daily receipt of energy** from the sun is about 10 times greater than all the **electricity generated since Tesla** both invented and discovered three-phase alternating current and about 30 times less than the kinetic energy of the **Titanic moving at half the speed of light**.

The kinetic energy inherent in the **earth's motion relative to CBR photon rest** is equal to the **sun's total energy output** for about 100 years. If the **earth were moving at half the speed of light** its kinetic energy would be equal to the sun's output for about 10,000,000 years.

On **May 8<sup>th</sup> 1997** a **gamma ray burst** was detected far off in the universe that released as much energy in a few seconds as the sun has produced since its formation. On **December 14<sup>th</sup>** of that year a much larger burst was detected that produced more energy than the entire Milky Way galaxy puts out in 10,000 years and even larger bursts have been measured since. Gamma ray bursts are most likely to be caused by photons from the upper end of the creation photon spectrum hitting bodies of matter in the universe at large.