

A Very Easy Guide To Basic Heliophysics

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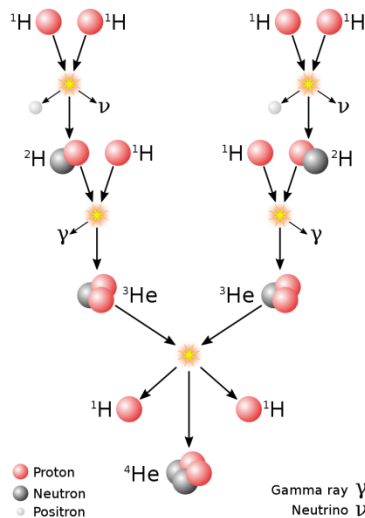
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Abstract: Heliophysics is the physics of the Sun. The study of the Sun with detailed aspects of Heliomagnetodynamics, Proton-Proton chain reaction, instability fields, coronal mass ejections, sigmoid signatures and other basic properties has been reflected in this paper.

1. Proton-Proton Chain Reactions

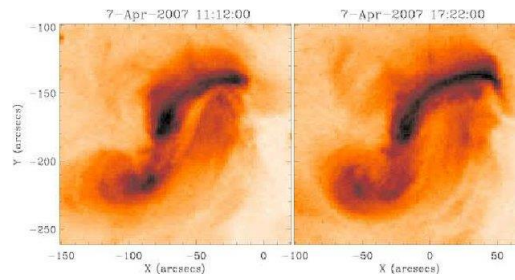
2 Protons are accelerating in a high temperature. The 2 Collides and formed A single Proton & Neutron. The W^+ Bosons takes away the Positive charge from 1 Proton & releasing 1 Positron & Neutrino. The Hydrogen Atom formed with 1 Proton & 1 Neutron. Another Proton collides with the H_2 Atom via Z^0 Boson. The He_3 Atom formed. Helium 3 has 2 Protons and 1 Neutrons. The same reaction takes place in another way.... And another He_3 Atom forms. Two He_3 Atoms collide and transfused together to form a He_4 Atom with 2 Protons left over freely for further accelerate into the core. He_4 has 2 Protons & 2 Neutrons. Protons contains 2 Up quarks (+2/3) & Neutron contains 1 Down Quarks (-1/3). This yields a Positive charge. Neutron is Neutral (-1/3-1/3+2/3). The Quarks are bound together by Strong nuclear force. The W^- Bosons carried over the electric charge from the Exclusion state electrons and formed a region of Positive energy, Positive Anti-Matter called Positrons which when comes in contacts with Electrons yield a vast thrush of Gamma rays. The gamma rays then coupled with negative hydrogen ion which yields or knocks out electrons from the nearby atom. The weak forces play their role... The Electron-Positron annihilation responds to energy state $E=0$ which makes a hole in vacuum which ultimately covered up by the electrons by a burst of gamma rays. The "Kaon" is formed with 3 Strange quarks which are charged ion (-1/3-1/3-1/3). Kaon's are heavy but short lived like "Pions".... They are a type of Bosons. They instantly annihilate to Photons. Photons are governed by the Dirac matrix by generalising Special relativity with Quantum mechanics where $E = mc^2 + pc$ Conversely it turned out that to release the Photon a Negative matter but positive energy is needed. This is borrowed from Paulis exclusion principle. E^2 generalises to E . As Root E^2 contains $(+5)^2$ & $(-5)^2$. But energy can't be negative, so, it turns out that E must not be a square where mc^2 is the rest energy with "pc" as the kinetic energy which the Photon assembles inside a newly formed fermions. The result is the Dirac's Gamma matrix. According to Plank, the Dirac's electrons must move in Discrete Quanta of energy states and they are a multiple of "n" where "n"= 1,2,3,4,5,6..... The gamma rays are absorbed by the surrounding electrons and the electrons move in Lower orbits by releasing the excess energy in Discrete Quanta called Photons which takes a Zig Zag way and took almost 1,70,000 years to overcome the Sun's gravity and then bursts through the corona. The Sun Shines & there is light.



PP Chain Reaction. Courtesy: Sarang, Wikipedia.

2. Sigmoid Signatures of the Sun

"S" or "Z" - The Sigmoid Signature for Magnetic Flux flares Of the Sun. The Intense Solar Flares That Occurs in The Sun Are due to the Twisting and bending of the flux lines due to the Coriolis force. The Flux lines Has the plasma Trapped in it... The plasma is Comparatively of lower Temperature than the Chromospheres Which Is 1,00,000 Joules... Therefore due to The Low density, the Buoyant plasma raises Upwards Through the flux ropes From the Photosphere or the surface Of the Sun. Here, The Strange Phenomena Called Magnetic reconnection Takes place, Which Can be think of a rubber Band analogy. Imagine a Rubber band stretched & twisted, When you release the band, The band will Fly away due to The Trapped Kinetic Energy Embedded in it during The Stretching of it. The Flux lines with trapped plasma... Is A "Toroidal" Magnetic field. When A magnetic field Moves, the electric field associated with it also moves along the Magnetic field orthogonally Called the Polaroid field lines. But in Sun, The twisted fields are so much deformed that, instead of moving orthogonally, The Moves In a Deformed Way with some In a Closed connecting loop and some open loop. The CMR or Coronal Mass Rejections Occurring in the Trapped plasma of The Field raises an intense temperature of 1 Million Joules Due to The Electromagnetic Gamma radiation and the Free Ionized Atom along with The Loose Electrons that Floats on The Peripheral Of The field. This "S" or "Z" Shaped lines when appears on the Sun Then it is a Sign of the intense Magnetic Flux which Will eventually sprout as Flares. The Kinetic energy is So strong that, sometimes even the Speed is much less than the escape velocity but Still The Flux Plasma Makes its way Out Of The Photosphere at 480 km/Sec (Escape Velocity is 618 Km/Sec). Some Plasma Flux Discharges at 2000 Km/sec and therefore are unable to Drop back at The Sun and hence forms a magnetic highway of Open Flux Layers which spreads out to The Sun's Atmosphere.



Sigmoid Curve. Courtesy: Tripathi, D., Kliem, B., Mason, H. E., Young, P. R., & Green, L. M. (2009). TEMPERATURE TOMOGRAPHY OF A CORONAL SIGMOID SUPPORTING THE GRADUAL FORMATION OF A FLUX ROPE. The Astrophysical Journal, 698(1), L27–L32. <https://doi.org/10.1088/0004-637x/698/1/L27>

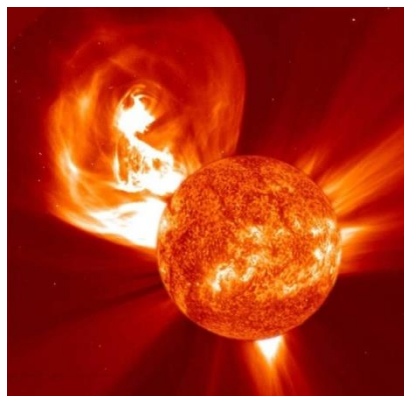
3. Heliomagnetodynamics

The Sun is 150 trillion miles away from the Earth with a gravity of 27g and escape velocity of 618 Km/Sec. The Core Of the Sun is the place of intense pressure with a Temperature of 10,000 Joules that Accelerates The Free Protons to collide together by a Phenomena called Quantum tunnelling thereby formed A Proton Linked with a Neutron along with a Positron & Electron neutrino. The positron-electron Collides and annihilates thereby making the gamma rays. From Two Sides of proton proton chain reaction the deuterium is formed which is hydrogen of 2 protons & 2 neutrons which fuses with another Deuterium to make a Helium atom. The Electron-Positron annihilation takes place in every step thereby forming the gamma radiation. This gamma rays comes out from the core to the surface at about a distance of 1,52,000 kilometres in 1,75,000 years thereby making is way to the Photosphere. the speed is extremely low at about 4 km/Sec. There a strange thing happens called the ionisation of negative hydrogen ions which Accepts the Gamma rays and thereby making the electrons to jump into a slightly higher orbit. But according to quantum Mechanics the Electron tries to stabilise itself by emitting another photons and this comes out from the surface of the Photosphere. The Temperature in the photosphere is 1,00,000 Joules.

The Sun rotates in differential movement around a period of 27 days. It is made of plasma & hence different regions rotate with respective velocity. the magnetic flux lines are dragged by the rotation of the sun from east to west which twists the Magnetic field lines into a "S" Shaped Sigmoid which ultimately leads to a release of tremendous amount of kinetic energy when they tries to straighten themselves from the twisted Position. This results in the formation of secondary & Tertiary flux lines and so by forming the flux lines over and over the Photosphere, The pressure dramatically increases in the Lower Flux lines and forms a Pressure gradient. This leads to a flow or a Buoyant Flow of the Magnetic Flux Upwards. The plasma is trapped in the flux lines and so with those lines, the plasma comes out from the photosphere in the Form of two interconnecting loop gradient called the Leading & the following sunspots. Thereby the plasma gets heated and heated due to the constantal Electron-Gamma Reaction & the photon Gets Trapped in the Chromospheres', a layer above the Photosphere. The trapped photons about 1 in a 1000 makes its way to the Corona, the Outermost Part of the Suns atmosphere to make a Coronal Mass Ejections at a Speed of 2000 Km/Sec with a temperature of 1 million Kelvin's. The Plasma From the equator flows towards the Poles and The more plasma is Trapped in the poles, the more magnetic gradient occurs which results in the Sweep of the Poles of the sun In a 11 Year Cycle. Magnetic reconnection & helicity are the most important aspects during the Solar Flares. the Comparatively low energy plasma which is Trapped by the Flux Lines are shoted outwards by coronal Mass Rejections through the Corona which heats up 1 square centimetre of the Suns Surface by $4 * 10^{36}$ Joules Per Second.

The Atmosphere of the Sun extends to over 18 billion Kilometres' which is 21 Times the combined orbit From the mercury to Pluto. The sun emits the Electromagnetic radiation in Both the visible & invisible Spectrum. the invisible spectrum is a High Energy spectrum Called the UV Rays, X Rays & Hard X Rays, and the low energy spectrum is the Microwave, Radio Wave, And Gamma waves. The Heliosphere affects the Meteors coming from the Orot Cloud in an orbit beyond the Kupiers Belt Along the border line of Neptune. The UV rays of the Sun makes the Atoms inside the meteors to knock down the Electrons inside it thereby forming a Blue Tail Of Ionised gases which is known as the tail Of The meteors.

Beyond the heliosphere, there is interstellar Space. The High energy cosmic rays from the Starburst Nebulae to the Neutron stars are protected by the suns atmosphere. and the Suns Atmosphere with all those ionised Gases along with Ripped apart Electrons and neutrinos are Protected by the Ozone layer of the earths atmosphere.



Coronal Mass Ejection. Courtesy: SOHO (ESA/NASA)

Reference:

Green, L. (2021). *15 Million Degrees: A Journey to the Centre of the Sun*. Viking (an Imprint of Penguin Books).