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Overview of Solar Flares and Their Distribution around the Sun

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ABSTRACT

The star at the middle of the solar system is the Sun. It consists of hot plasma interwoven with magnetic fields and is almost perfectly spherical. The sun is a star of the G2V main sequence and thus produces its energy by the nuclear fusion of nuclei of hydrogen into helium. At its heart, 620 million metric tonnes of hydrogen is fused into the sun every second. The radioactive zone and the convective zone surround the nucleus. There are three layers of the solar atmosphere: the photosphere, the chromospheres and the corona. Above the convective zone is the photosphere and most of the sunlight is produced from this area. The temperature of the photosphere is between around 5800 K and 6050 K. Bright, bubbling granules of plasma and darker, cooler sunspots mark the photosphere. The inner dark cool region is called the umbra and the penumbra is known as the outer relatively light sunspot region. Above the photosphere lie the chromospheres and corona. The sun's gentle X-ray pictures display coronal loops and light points. Where the magnetic field is open and from which the solar wind streams outward, coronal holes are seen. Due to magnetic reconnection, solar flares and coronal mass ejections are thought to occur. This CME produces massive interplanetary magnetic field (IMF) disturbances that are responsible for generating cosmic ray Geomagnetic Storms (GSs) and for bush Decrease (FDs).

Keywords: *Solar Flares, Distribution*

INTRODUCTION

The most interesting and commonly discussed phenomenon of the sun is solar flares. The energy emitted during the flare eruption in a very short period of a few seconds to minutes is the order of 1023 to 1032 e gs. Flares are visible in white light that is emitted at the photospheric level but visible from minute to hour in EUV nd X-r y w veloces m y last. Their effect is characterized by different emission forms in the radio area (i.e. at radio w lengths). The energy of solar flares is emitted primarily in the form of electromagnetic radiation and energy particles. Th se X-ray and EUV waves pass at light speed, requiring just 8 minus o r ach us h re at arth. The energy released in the solar flares phase increased the solar wind ratio v loci y and acc l ratio that affects the space weather. It can be imagined that a single flare might produce an explosion equal to several billion hydrogen bombs, each of which exploded simultaneously with 100 megatons of destructive force.

The periodic X-ray flux of M and X-class flares impacting the atmosphere of our planet by increasing the ionization of the earth's upper atmosphere (i.e. the uppermost layer of earth known as ionosphere) that can interfere with short radio communication and increase the drag on low orbiting satellites, resulting in decay of the orbit. They can destroy satellite solar cells by solar flare protons, produce plasma bubbles in the earth's ionosphere, affect the safety of astronauts, disturbance of radio waves, scintillation of signals, airline passenger radiation that passes through the auroral zone, disruption of the electricity grid, disruption of telecommunication cables, earth current, etc. The great flares impact interplanetary space and greatly affect the lower ionosphere of the earth. The paper offers a brief description of the solar flare and CME effect on Earth.

HISTORY OF OBSERVATIONS

The first flare to be detected was the most strong flare in the last 150 years. On 1 September 1859, the first detection of a white light flare was made independently by two physicists, Richard C. Carrington and Richard Hodgson, who were observing the same active area from different locations at the same time. In recent decades, solar flares have been observed at different wavelengths, such as H alpha, radio waves, visible, UV, EUV, as well as X-ay (soft and hard) and gamma-rays. The observations provided by the space project, such as GOES, Yohkoh, TRACE, RHESSI, SOHO and HINODE, of solar fla es an e enla. Solar flares' white light measurements are rather r re t the photosphere stage, but disp y enormous energy release and structural shifts in chromospheric level, EUV and X-ray wave engths. Fig. Fig. 1.1 reveals the first detection of f re in white light.

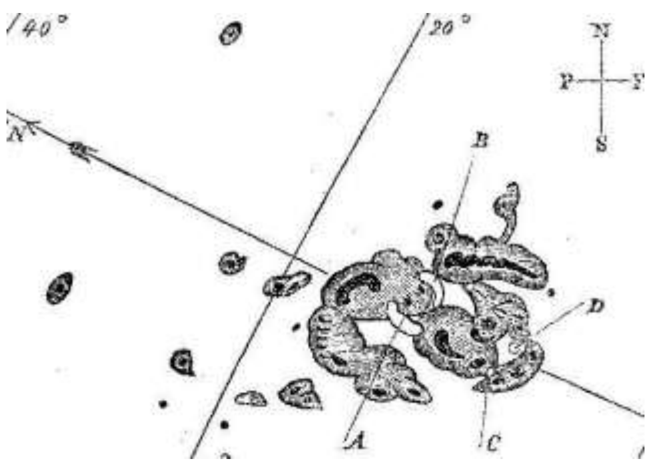
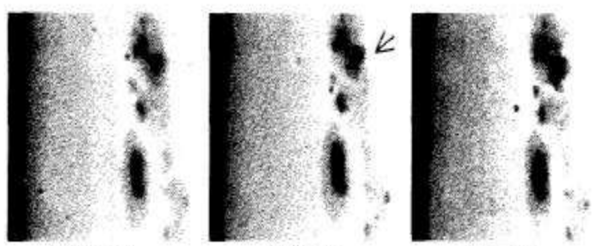


Figure 1.1 First flare observation

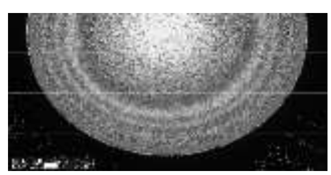
Flare Observation in White Light

One of the very unusual short-term phenomenons is the detection of solar flares in white light. The first solar flare observation was in white light, although the white-light flare emission mechanism is still unknown. White light flares are equidistant to one or two bright points from the magnetic neutral line. These points are similar to the spots of opposite polarities, or in the penumbrae. White light flares display almost 50 percent greater brightness than the intensity of the photosphere. Fig. Fig. 1.2 reveals a small white light as two tiny bright points above a sunspot penumbra flaeobseved on April 2, 2001. With the emission of hard X-ray and microwave bursts, such fla is a closely elated e. It is generally agreed that ccelerated particles should be bound to the origin of the optical spectrum of white-light flares. Such accelerated particles go deeply into the thick chromosphere (Hudson 1972; Rust and Hegwer 1975; Neidig 1989; Hudson et al. 1992; Neidig and Kane 1993; Rieger et al. 1996; Ding et al. 1999). In 1991, the Yohkoh spac craft launch observed the first white light observation of solar flare from space, showing the emission of white light more regularly, down to the weak flar s (Hudson al. 1992; Sylwester and Sylwester 2000; Matthews et al. 2002; Metcalf et al. 2003). From these types of flares in the photo phericconinuum, around 1030 rgs n rgy are produced. Here we have pre entomb pictures of solar flare in white light from different observatories.



Development of a small white light flare observed on April 2, 2001 at the Udaipur Solar Observatory near a sunspot penumbra in active region NOAA no. 9393. Solar west is on the left and south on the top (courtesy from the book - fundamental of solar astronomy)

White light image from Big Bear Solar Observatory (California)



White light image from Mees So r Observ tory (Hawaii)

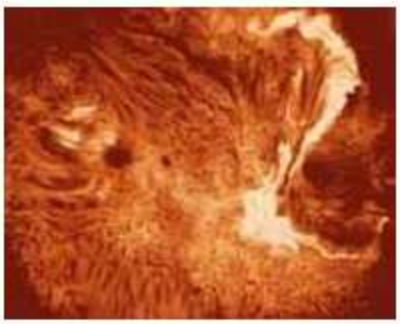
Highlight image from Lost Pleiad Observatory

White light image from Kanzelhohe Solar Observatory

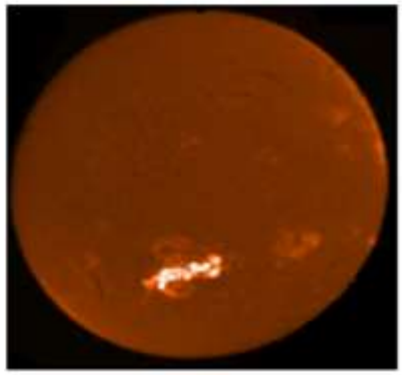
Figure 1.2 Represents the observation of solar flare in white light.

Flare Observation in H_α Light

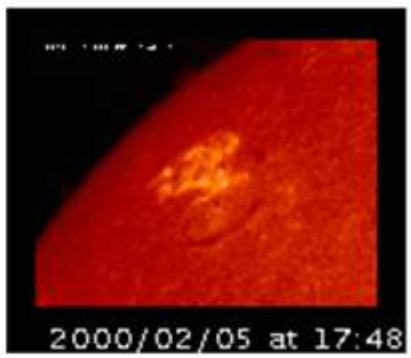
Solar flare observation in H alpha light provides details about the occurrence, significance, shape, production and lateral motion of the flare. The Balmer sequence (with transformation from n=3 to n=2) at 6563 Å called the H-a line are the lowest atomic levels of hydrogen atom in visible light. From ground-based instruments at higher altitudes, Flare can easily observe through the H aha axis. The H alf flares normally appear either as an extremely compact bight area or as a chromospheres inflames called a two or multi-ribbon structure. In the early 1930s, G HALE developed a spectrohelioscope to record many such H alpha flaes per active day. The middle of the H aa line with a pass-band of to 0.5 Å can be observed as the most intense and optically thick fl re t. In the H alpha line t 2.5 Å, the flare kernels are best observed.



Solar flare as seen in H_α (Courtesy- National Solar Observatory/Sacramento Peak)



This H_α image was made at Holloman Air Force base and provided at 512 x 512 pixel resolution. Such images are available from the NOAA Space Environment Lab (SEL), and are known as SELSIS images (SIS-Solar Image System).



Holloman Air Force Base, New Mexico

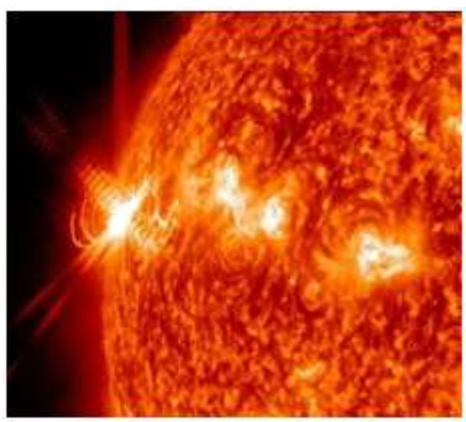
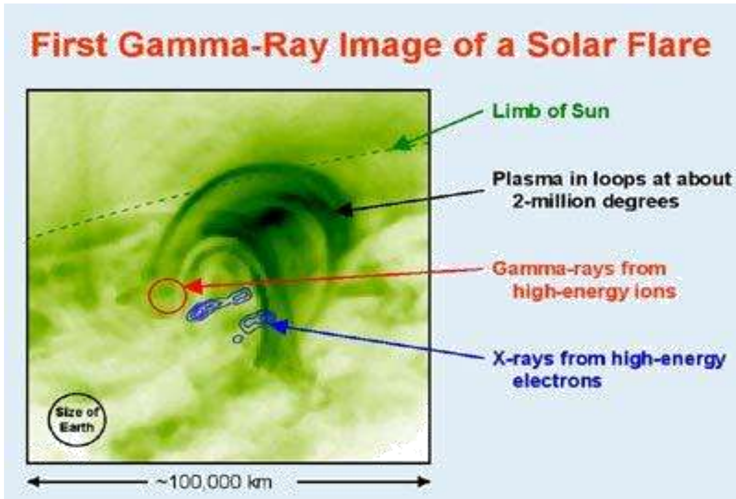


Figure 1.3 Represents flare observation in the Hαight.

Gamma-Ray Image of Solar Flare

The gamma-ray observations were obtained from the SMM Gamma-Ray Spectrometer (GRS), the Hinotori Spacecraft, the Yohkoh Spacecraft Wide-Band Spectrometer (WBS), the Burst and Transient Source Experiment (BATSE) and the CGRO Centered Scintillation Spectrometer

Experiment (OSSE), and most recently from the RHESSI Spacecraft. For the first time, some of the gamma ray lines in solar flares are resolved by RHESSI's cooled germanium detectors (Aschwanden, 2006). are numerous papers on gamma-ray absorption in solar flares (2003).



A superposition of RHESSI images of gamma-ray and X-ray emissions with a TRACE satellite extreme ultraviol t image tak n 90 minutes later of the July 23, 2002, solar flare. The superposi ion cl arly shows he large s paration between the high-energy emissions. Solar physicis s exp c d o s X-rays and gamma rays emerging from the same spots at the base of the flare loops. (Credit: RHESSI and TRACE). RHESSI detected very high-energy gamma rays produced during solar flares (circled in red) (courtesy - Lin, R.P., et al. 2003, *ApJ*, 595, L69).

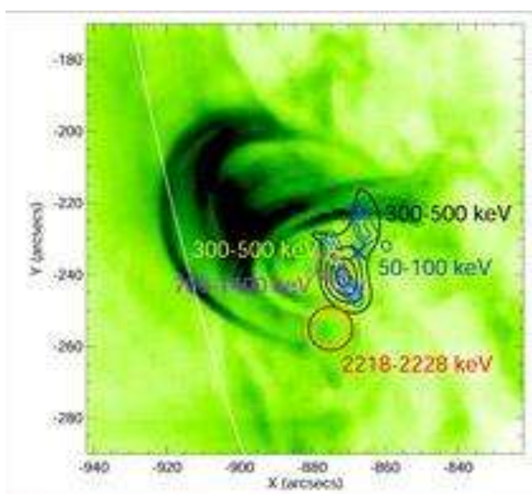


Figure 1.4 Represents gamma-ray images of solar flare.

CONCLUSION

We have selected 131 events for the current study. From our 1996-2012 analysis, we concluded the following points:- (1) During 1996 to 2012, only 37 percent of flares were under the CME period. (2) The maximum number of flares beyond the span is located. (3) Flare-CME followed by radio burst type II does not follow the paradigm of CSHKP flare-CME. (4) Of the 49 occurrences that fall during the CME span, maximum flares are located at the middle of the span. (5) The latitudinal belt of 10 to 20° is more powerful than the other latitudinal belts.

REFERENCE

1. Sbhyankar, K. D. 1977, BASI, 5, 40.

2. Afraimovich, E. L., Altynsev, A. T., Grechnev, V. V. and Leonovich, L. A. 2002, “The response of the ionosphere to faint and bright solar flares as deduced from global GPS network data”, Annals of Geophysics, vol. 45, N.1.

3. gGly, J. J. 1991, “How much energy can be stored in a three-dimensional force-free magnetic field?”, Aphys. J. Lett., 375, pp. L61-L64.

4. Ganderson, C. W., Lanzerotti, L. J. and MacLennan, C. G. 1974, Bell System Technical Journal, 53, pp. 1817-1837.

5. Endrews, M. D. and Howard, R. A. 2001, Space Sci. Rev., 95, pp. 147.

6. Antiochos, S. K., DeVore, C. R. and Klimchuk, J. A. 1999, “A Model for Solar Coronal Mass Ejections”, Astrophys. J., 510, pp. 485-493.

7. Archontis, V. and Torok, T. 2008, “Eruption of magnetic flux ropes during flux emergence”, Astron. Astrophys., 492, pp. L35-L38.

8. Aschwanden, M. J. 2006, “Physics of the solar corona: An introduction with problems and solutions”, Springer-Praxis Pub.

9. Aschwanden, M. J., Nightingale, R. and Tarbell, T. et al. 2000b, ApJ, 535, pp. 1027.

10. Hulanier, G., DeLuca, E. E., Antiochos, S. K., McMullen, R. A. and Golub, L. 2000, “The Topology and Evolution of the Bastille Day Flare”, Astrophys. J., 540, pp. 1126-1142.

11. Badruddin, R. S. and Yadav, N. R. 1983, “On the major solar flare activity in solar cycle 19, 20 & 21 (1955 - 79)”, Indian J. of Radio & Space Physics, 2, pp. 124.

12. Bala, B., Lanzerotti, L. J., Gary, D. E. and Thomson, D. J. 2002, “Noise in wireless systems produced by solar radio bursts”, Radio Science, 37(2).

13. Barlow, W. H. 1849, “On spontaneous electrical currents observed in the wires of the electric telegraph”, Phil. Trans. R. Soc., 61.