Eleven Year Cycle and Other Periodicities of the Sun: A New Interpretation through Planetary Conjunction and Opposition

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Abstract

The sunspot number changes fairly uniformly following an eleven-year cycle. This fact has been simply recorded without any plausible answer. A new 85-year cycle has also been recorded by this author. Many short-range periodicities (154, 129, 104, 84, 78, and 51 days) are also noticed from the study of solar activities. The cause-oriented analysis is missing for the periodicity of the Sun. This article suggests that the external periodic forces derived from planetary conjunction and opposition are the primary cause of periodicity in the solar activities. The computed values of the periods of different planetary conjunction and opposition matches remarkably well with those of the observed sun's periodic activities and hence testify the new hypothesis.

key words: *Sunspot cycle, Sun's periodicity, Eleven-year cycle of Sun, Periodic planetary motion, Planetary conjunction, Planetary opposition, External periodic forces, Motive forces.*

Discussion

The 11-year sunspot cycle is well-known and is popularly called the `11-year cycle' of the sun. According to some scientists, different complex phenomena occurring in the Sun, set an eleven-year periodic motion of the dynamo operating within the Sun. The author, while examining the reported sunspot cycles, identified a new 85-year period [1]. Now, the above anticipated complex phenomena occurring in the Sun becomes more complicated as it has to set the dynamo for both 11- and 85-years periodic events. While trying to realize the complex phenomena, it is extremely difficult to perceive a kind of self-organized periodicity in the turbulent Sun.

In the year 1984, a periodicity of 154 days was found from the solar flare activities and this has been confirmed by many [2]. Further short-range periodicity of 51, 78, 104 and 129 days have been identified by Bai and Sturrock [2]. The above authors have drawn the attention to the fact that except for 81 days, the periods are close to multiples of 25.8 by factors 2, 3, 4, 5, and 6. Hence, they have suggested that the short-range periodicity is formed due to formation of sub-harmonics of a fundamental period. In this regard they have postulated a non-linear dynamical system with periodic forcing terms to visualize the sub-harmonics (i.e. the integral multiples of fundamental period) and suggested the use of following Duffing's equation.

$$\ddot{x} + \delta\dot{x} + \alpha x + \beta x^3 = \gamma cos(\omega t) \quad ....(1)$$

Where, the numbers δ, α, β, γ and ω are constants.

Equation 1 exhibits periodic behaviour for certain values of δ, α and β. While examining the feasibility of application of the above equation for the internal dynamics of the Sun, it is required to perceive the periodic forcing terms from within the Sun. The Sun, as understood today, is a ball of hot plasma with continuous nuclear and chemical reactions in progress. Thus, to expect a kind of periodic forcing term of very regular nature with its cause lying within the dynamics of turbulent Sun, seems least probable. The periodic forcing terms required for generation of sub-harmonics cannot possibly be derived from the Sun without considering the solar system as a whole. The factors that control the values of the constants δ, α and β in equation-1 must find physical significance towards the motive forces if the equation is to be used for evaluation of sub-harmonics for the periodicity of the Sun.

According to this author, the periodicities in the Sun can only be caused by the periodic conjunction and opposition of planets due to the periodic nature of motion of the planets. Such periodic force interaction for gravitationally coupled Sun and the planets is most probable. Gravitational interaction is not as well understood as electromagnetic interaction. Therefore, the analysis of the exact nature of gravitational wave interaction leading to exact solar events may require some more time. Tidal bulging of sea water on the Earth at its nearest distance to the Moon and at diametrically opposite location is well known. If similar bulges are produced at the gaseous photosphere of the Sun due to the action of planets, it might then result in an adiabatic drop in temperature causing sunspot. However, many uncertainties exist in the gravitational problems. One such fact is that the soil temperature of the Earth dropped suddenly by 20^{o} C during the total solar eclipse [3]. With the present knowledge of gravitational interaction, one cannot possibly explain the sudden drop in temperature on the surface of the Earth. Once again, the ionosphere of the Earth undergoes an excursion for ±1 km in the equivalent height during the transit of the Moon [4]. Perhaps to understand such problems we need to understand gravity right from its cause and its linkage with other fundamental forces of nature. As on today the tidal effect on the Sun due to the planets are not considered because they produce a small gravitational pull on the photosphere of the Sun compared to the Sun's own gravity. Now leaving some room for any peculiar gravitational interaction of planets and the Sun, which may be analyzed later for the cause of temperature drop in sunspot location, we may try to find out if the planetary conjunction and opposition has any bearing with the sunspot cycle. The introduction of non-electric charges and their exchange among celestial bodies, as suggested by this author, has a great scope for a new type of interaction [5]. At this stage without going into further detail, one can develop a correlation between the period of conjunction/opposition and the periods of solar activity to establish the mutual interaction linkage.

Before proceeding with the calculation of the periods of conjunction and opposition of planets, one might like to visualize the effect of conjunction and opposition. Lunar tide on the Earth exhibits two maxima: 1) during the conjunction of the Sun and the Moon (New Moon period) and 2) during the opposition of the Sun and the Moon (Full Moon period). A planet can as well cause tides in the photosphere like the Moon causing tides on the sea of the Earth. Since the effect of a single planet is less significant, we shall consider the combined effect of multiple planets. Imagine, the Sun has two planets P_1 and P_2 with sidereal periods of revolution as P_1 and P_2 respectively. The hypothetical planets P_1 and P_2 having different periods of revolution would form conjunction and opposition of the planets P_1 and P_2 periodically (Fig.1). Like the effect of the Sun and the Moon forming periodic tides on the liquid surface of the Earth, the planets P_1 and P_2 would cause tides and other associated solar activity maxima on the surface of the Sun by their conjunction and opposition in a periodic manner. Further new hypotheses of liquid sun have a direct tidal effect in sun like the water bodies in the earth.

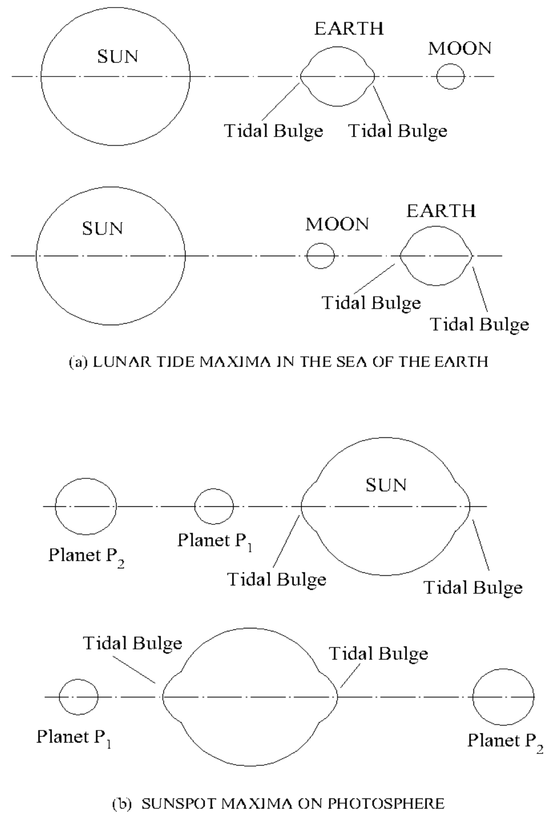


Fig.1 PLANETARY CONJUNCTION AND OPPOSITION CAUSING SUNSPOT MAXIMA

The time period (T) from any one conjunction of P_1 and P_2 to the immediate next conjunction is given by

$$T = 1/ (1/P_1 - 1/P_2) = P_1 P_2/ (P_2 - P_1) \qquad ....(2)$$

The time period (T') between any conjunction to immediate next opposition of P_1 and P_2 would be T/2.

$$\text{Thus, } T' = P_1 P_2/ (P_2 - P_1) (1/2) \qquad ....(3)$$

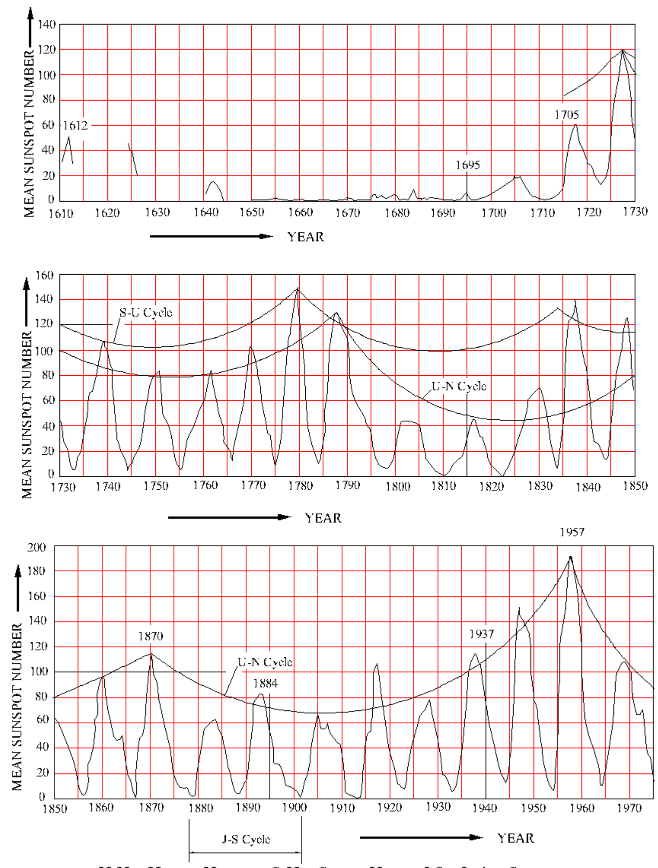
Long range periodicity of the sun

The sunspot on an average repeat after 11.2 years [6] (Fig.2). However, while examining the individual periods it is seen that in most cases the cycle is about 10 years, but for the few elongated periods, the long-range value of sunspot cycle is stretched to 11.2 years. It may be seen from Fig.2 that for a consecutive 7 periods starting from the peak of 1884 to the peak of 1957, the sunspot period almost remains constant at about 10 years. On the other hand, the three cycles starting from the peak of 1787 to the peak of 1830 have a three-cycle average period of 14.3 years. It is difficult to think how a periodic cycle that almost remains constant for a consecutive 7 years could increase for some three cycles by about 40%. On the other hand, if one assumes a missing cycle during 1787 to 1830, he would arrive at a 4-cycle average period of 10.5 years. An examination of the maxima of sunspots between 1870 to 1937 reveals that the cycle period is actually 20 years comprising two sunspot maxima of different classes, where one half cycle maximum has a lower magnitude with opposite magnetic polarity compared to the other half cycle maximum. A new long period cycle of 85 years may be seen in Fig.2, where the higher peaks in the so called 11 years cycle are recorded in 1957, 1870, 1788, 1705 and 1623 having successive periods as 87, 82, 83, 82 years with due margin to the suppressed values of sunspot maxima during 1610 to 1710.

Among the different periodicities of the Sun, the so called 11 years cycle is the most conspicuous one. Thus, while applying the planetary conjunction and opposition hypothesis, the two massive planets Jupiter and Saturn are taken into consideration. The time period T' which is the time gap between any conjunction of Jupiter and Saturn to the immediate opposition of Jupiter and Saturn or vice-versa is given by

$$T = \{1/ (1/12-1/30)\} \times 1/2 = 10 \text{ years}$$

where 12 and 30 years are the sidereal periods of revolution of Jupiter and Saturn respectively.



U-N – Uranus-Neptune, S-U – Saturn-Uranus, J-S – Jupiter-Saturn

Fig.2 PERIODICITY OF THE SUNSPOT NUMBER FROM 1610-1976
(Ref. G.S. Lakhina, Physics News, Vol. 21, No. 1 and 2 with extrapolation by author)

Assuming that the planets in conjunction produce a different magnitude of sunspot maxima with opposite magnetic polarity than those produced by the said planets in opposition, we get a better answer to the observed alternate change in magnetic polarity in the so-called 11-year cycle. If the magnetic features are taken into consideration, then the real period would be 22 years. The newly identified long period of about 85 years is also found to occur by the conjunction and opposition of Uranus and Neptune, the next significant planets of the solar system after Jupiter and Saturn. The orbital periods of Uranus and Neptune are 84 and 168 years respectively. Thus, the time gap between the conjunction to opposition of the Uranus-Neptune is given by

$$T' = \{1/ (1/84 - 1/165)\} \times 1/2 = 85 \text{ years}$$

Like the planetary conjunction and opposition of Jupiter and Saturn as well as Uranus and Neptune, other combinations such as Saturn and Uranus; Jupiter and

Uranus; Saturn and Neptune; Jupiter and Neptune are also likely to have their effects on the sun. For example, the sunspot maximum caused by Saturn and Uranus has a period of 25 years. The unscheduled peaks in 1778 and 1727 with a gap of 51 years appear to have a bearing with the Saturn and Uranus grouping. The effect of three or four planets in conjunction or in opposition giving greater peaks of sunspot maximum cannot be ruled out. The more numbers of planets in some angular setting may mutually cancel their effects. It is therefore necessary to study the effect of many planets in a heliocentric chart.

Short range periodicity of the sun

If the slow-moving planets produce the long-range periodicity of the Sun, then the fast-moving planets could as well produce the short-range periodicities. The fast-moving planets (Mercury, Venus, Earth, and Mars) may now be taken into consideration for their possible conjunction and opposition to form the short-range periods of the Sun. Using Equation-3, the time periods of conjunction to opposition and conjunction to conjunction of different pairs of fast-moving planets have been calculated and presented in Table-1 The observed short-range periods are also given in Table-1 for ready comparison.

Table-1

RELATION OF PERIODS OF PLANETARY CONJUNCTION AND OPPOSITION WITH SHORT RANGE PERIODICITY OF SUN

Planet pairs	Half Time period (conjunction to opposition or opposition to conjunction) days	Time period (Conjunction to conjunction or opposition to opposition) days	Short range periodicities of the sun days
Mercury - Venus	72.3	144.6	78 and154
Mercury - Earth	57.9	115.8	? and?
Mercury - Mars	50.4	100.8	51 and 104
Venus - Earth	291	582	? and?
Venus - Mars	167.3	334.6	? and?
Earth - Mars	389	778	? and?
Venus - Jupiter	128	256	129.9 ±0.7?

It may be seen from the Table that many of the short-range periodicities (51, 78, 104, 154, and 129 days) of the Sun can be explained by planetary conjunction and opposition of Mercury and Mars; Venus and Jupiter. The effect of other planetary combinations which have not yet been reported, and may be searched for in solar flare records. In case these periodicities are not found from this study, fresh studies of solar events may be made to establish facts by scanning at different wavelengths of solar radiation.

When a specific pair of bodies (planets) are considered to have their conjunction and opposition, the effect of other bodies in different orbits have to be taken into consideration. The other bodies may produce magnified effects or may neutralise the combination effect fully. Besides the gravitational interaction, the Sun and the planets appear to have a typical radiation exchange at different wavelengths since the interaction of solar activity and the brightening of Neptune is found to have a good bearing [7]. For almost two decades, Neptune's brightness varies inversely, at the level of a few percent with the solar cycle. The anticorrelation is so striking that some causal mechanism seemed necessary [8]. Perhaps, a clear understanding of different typical planetary interactions would unravel the exact nature of interplay of gravity.

Conclusion

All celestial bodies radiate energy through photons at different energy levels depending on the temperature and the chemical composition of the surface matter of the celestial body. In the new concept light particles (photons) carry photonic charge and the charge is negative below some temperature and is positive above that temperature. The radiation exchange among different celestial bodies in different angular orientations makes changes in the surface condition and the state of atmosphere of the celestial body. Further investigation would bring clarity on the new concept of non-electric charge and their inter-conversation.

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