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Orbital Resonances and Solar Activity

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Abstract

The paper gives some empirical evidence that planet resonances induce powerful central star pulsations reflected in periodic rises and falls of sunspot and solar flare numbers, alterations of solar and X-ray radiation levels, magnetic flux fluctuations, and solar wind.

1. Introduction

In astronomical studies, resonance is defined as commensurability of intrinsic frequencies of moving celestial bodies. Modern scientific research into the Solar System resonance began with the G. Chetaev's theorem of quantization of stable trajectories in the presence of dissipative forces. In 1963-1974 A. Molchanov published a series of studies demonstrating inevitable resonance character of evolutionary mature oscillation systems aligned in a whole-number relationship. K. Butusov established the similarity of planet-generated perturbation spectrum to the consonant accord (which is the most perfect one in acoustic terms). According to generally accepted views, planet resonances and planet orbit quantization result from the summation of the effects of very weak, but permanently acting dissipative gravitational forces. This effect demonstrates the universality of Huygens synchronization principle.

As of now, all of the resonance studies without exceptions are aimed at very long-term transformations of celestial body orbits. It is believed on *a priori* grounds that due to negligible values of forces so far known, actual planet interactions have no and cannot have any impact on the Solar System functioning, particularly, on the stellar processes and on the biosphere.

Special processing of long observation time series, however, have revealed multiple and perfectly evident signs of periodic perturbations both on the Sun and on the Earth. These perturbations are caused by outer planets during their passing through aphelion and perihelion. All this to taken together allow for further attempts to discover short-period resonance effects.

Mercury and Venus were selected as primary model objects, because this pair is characterized by diversity and high resonance repetition rate (such characteristics provide for maximum level of source data available). In order to get a clear picture of events generated by planet resonances, the analysis was focused on the years of maximum solar activity. The analysis was performed using the method of superposed epochs developed by C. Chree for similar tasks.

2. Mercury and Venus resonances

Mercury and Venus are unique planets in terms of their orbit characteristics: the former is characterized by extremely high eccentricity, 0.2053, while the latter actually circles with eccentricity of 0.0068. For Mercury, rotation period and sidereal period (58.646 and 87.969, respectively) are in resonance proportion exactly equal to 2:3. Motion of this planet is governed by the solar rotation, with which it is in 3:7 resonance. Venus, in turn, circles around the Sun in 9:1 resonance with its rotation period.

Due to the motion along strongly oblong ellipsoid, Mercury enters a resonance with Venus in orbit semiaxes on average 64-72 times per year at different frequencies. Of special interest are cases of radial 1:2 resonance, since such frequency ratio (similar to the so-called highly perfect consonance) is predictive of most pronounced effects.

3. Sunspots and radiation flux

With all mass incommensurability of Mercury and Venus with a star (1:6000000 and 1:370000, respectively), resonance locking between planets systematically causes drastic fall of the solar activity for 15-20 days. This is evidenced by the decreased number of sunspots and simultaneous fall of the solar radiation intensity (Fig. 1).

Against the background of an overall decrease in the Wolf number within several days prior to the resonance locking, the solar activity drastically increases (central anomaly); this paradoxical reaction is very characteristic of planet interaction.

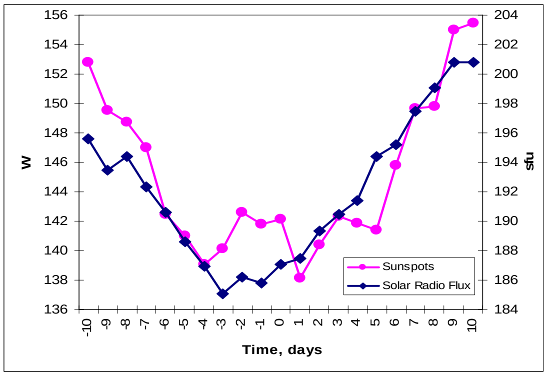

Figure 1. Changes in the sunspot number (W) and solar radio flux density at 10.7 cm/2800 MHz (sfu) at noon during Mercury and Venus 1:2 resonance locking in orbit semiaxes in 1957, 1968, 1979, 1989, and 2000; average of 41 records

Source: calculated basing on the data of the Royal Observatory of Belgium's Solar Influences Data Analysis Center and observations of Ottawa/Penticton observatory

It is noteworthy that when the daily Wolf number series was extended by 9 years of maximum solar activity (1860, 1870, 1883, 1893, 1905, 1917, 1927, 1937, and 1947), so that the number of analyzed resonance events increased from 41 to 116, the nature of the established dependence did not change at all, and, moreover, oscillation amplitude values increased.

4. Solar flares and X-ray radiation

Solar flares are the most dynamic manifestations of the solar activity observed in the H-alpha band. Flare frequency begins to decrease 10 days prior to the resonance locking and then increases quickly right before it. For example, in 1957, the year of maximum solar activity, the number of solar flares dropped down to minimum four days prior to Mercury and Venus resonance (8 flares per day; mean number 28) and achieved maximum on the third day after it (135 flares per day; mean number 55). In 85% cases, solar flares are significantly more frequent during the day preceding resonance locking, than a day before or a day later, i.e., observations record the existence of central anomaly.

At the very moment of resonance locking, flares occurrence rate is 40% higher than the mean daily rate.

Satellite monitoring data demonstrate that flares of soft solar radiation are timed to resonance locking between Mercury and Venus in orbit semiaxes. Fine frequency-time structure of central anomaly with short (approximately 30 min) periods of lower solar activity is revealed in the process.

5. Magnetic flux and solar wind

During the periods of Mercury and Venus resonance, full solar magnetic flux density undergoes sinusoidal changes with transitions of positive deviations from the mean level to negative at critical moments. Changes of solar wind rate and density are synchronous with fluctuations of the magnetic flux (Fig. 2). Thus, during the year of maximum solar activity, wind density increases before the resonance and drops down to minimum within 2-3 days. In general, solar wind density decreases, and, hence, its rate increases within several days after resonance occurs at any level of stellar activity.

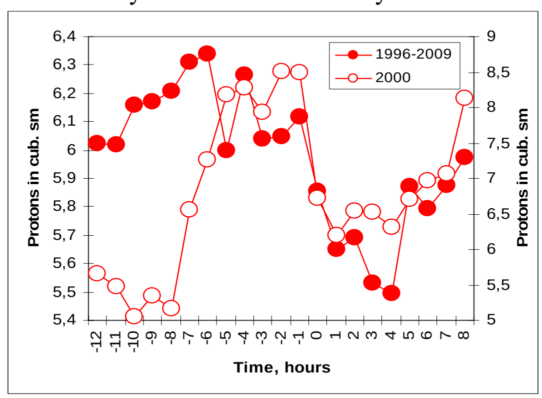

Figure 2. Solar wind density (protons/cm^3) during the days of 1:2 resonance locking between Mercury and Venus in orbit semiaxes in 2000 and 1996-2009; average of 8 to 98 events, respectively

Source: calculated basing on the data of the Solar Heliospheric Observatory (SOHO) spacecraft

6. Conclusion

Numerous facts provide evidence that resonance between two planets causes the effect of forced oscillations in the solar layers. Periodical changes in the sunspot and solar flare numbers, as well as variations in the solar radiation flux in all wavelength intervals are accompanied by space ray modulation. Thus, not only weak dissipative gravitational forces permanently act in the Solar System, but also impulses of extremely great energy exerting both direct and mediated effects on the Earth biosphere.