THE SUNSPOTS AND COMETS

V.V. Shutenko[1], A.A. Petrukhin[1], Yu.I. Stozhkov[2]

[1]National Research Nuclear University MEPhI, Moscow 115409, Russia. E-mail: **VVShutenko@mephi.ru**

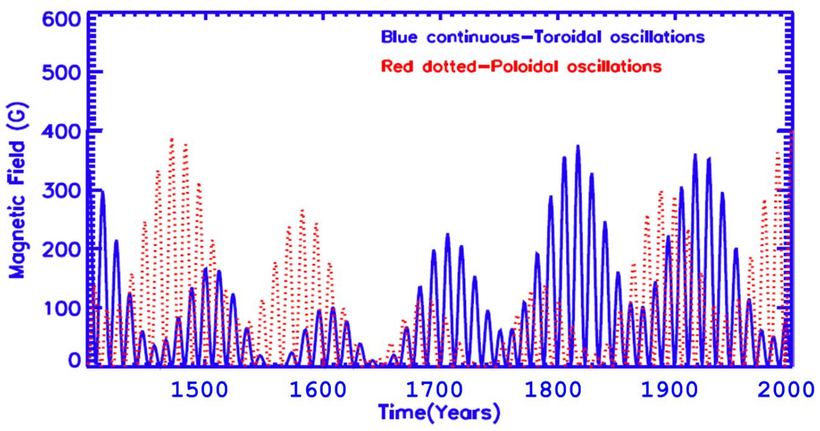
[2]P.N.Lebedev Physical Institute, Russian Academy of Sciences, Moscow, Russia

For solution of the problem of the origin of sunspots and quasi-periodicity of changes of their number, first of all 11-year cycle, many various models connected to processes which occur or could occur on the Sun have been offered. However the satisfactory solution has not been found yet. This is confirmed by unexpectedly long minimum of the 24-th solar cycle. In this connection it seems expedient to consider a possibility of formation of sunspots as a result of external influence on the solar surface. As carriers of such influence, various heavy bodies (comets, asteroids, and other celestial bodies) falling on the Sun can be considered.

The Sun

It is known that the Sun has a magnetic field. In the beginning of each new 11-year cycle this field has a poloidal structure. Then due to differential rotation of the solar photosphere it gradually becomes a toroidal one.

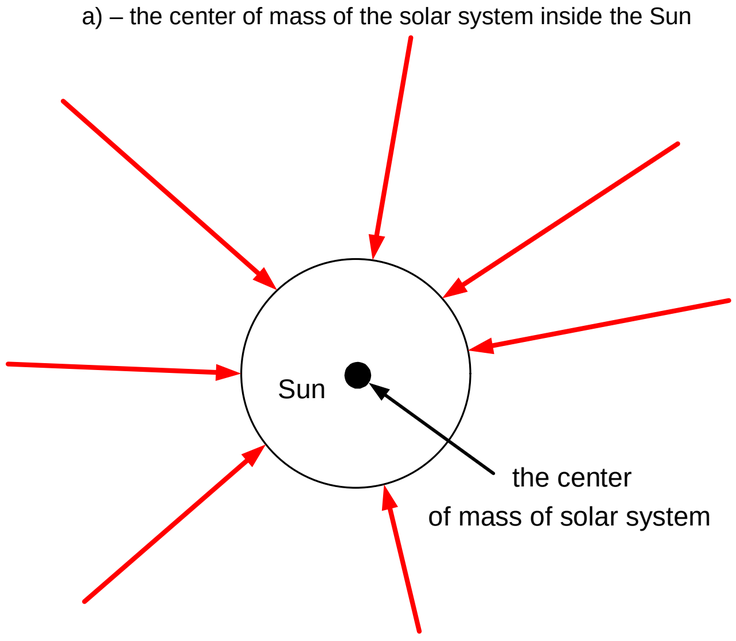
Figure 1. [K. M. Hiremath arXiv:0909.4420v1]
The sun's long period coupled oscillations of the poloidal and toroidal magnetic field structures. The sunspot activity that results from the superposition of toroidal field oscillation modes is represented by blue continuous line and the poloidal field oscillations is represented by the red dotted line.



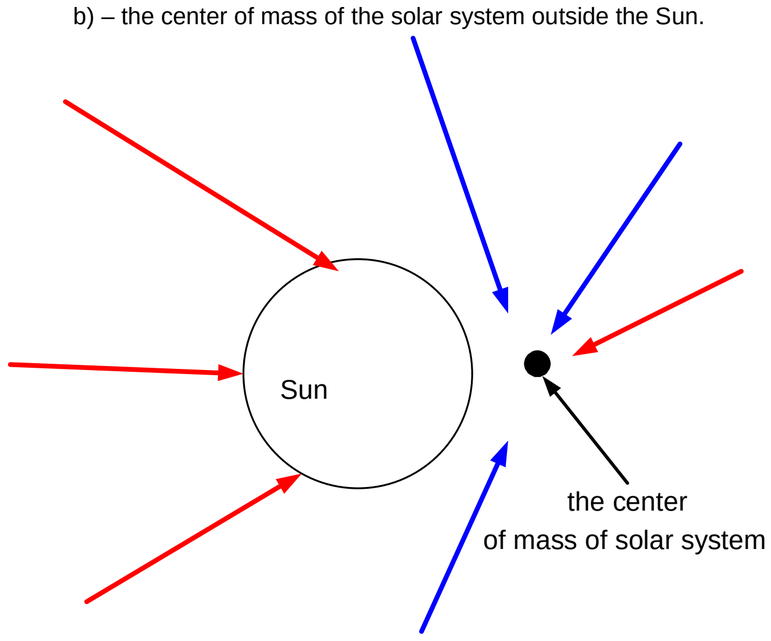
Heavy Bodies

At movement of such bodies in the solar system, gravitational fields of the Sun and planets influence them. And periodicity of the rotation of planets around the Sun will generate quasi-periodicity among heavy bodies falling on the Sun. For example, such situation appears when large planets are concentrated in one sector and form a kind of gravitational lens focusing (defocusing) the flux of heavy bodies which enter into the boundaries of solar system. The probability of falling of heavy bodies on the Sun can depend on the position of the center of the Sun relative to the center of mass of the solar system (the center of mass of the solar system can be either inside the Sun or outside it), see Fig. 2.

Figure 2. The scheme of moving of heavy bodies close to the Sun,
red line – hitting the Sun , blue line – missing the Sun.
a) – the center of mass of the solar system inside the Sun



b) – the center of mass of the solar system outside the Sun.

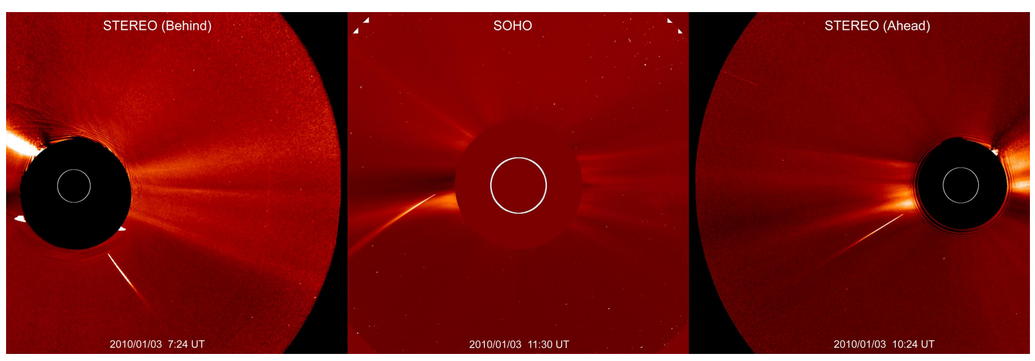


Sungrazing Comets

Falling of heavy bodies on solar photosphere causes disturbance of the toroidal magnetic field and serves as "a trigger hook" for the beginning of the process of formation of active regions and sunspots.

Unfortunately, possibilities of the experimental verification of this hypothesis are rather limited since it is extremely difficult to observe small heavy bodies falling on the visible part of the Sun. Heavy bodies falling near the edge of the solar disk can be an exception, but for their reliable identification the coincidence of several factors is required.

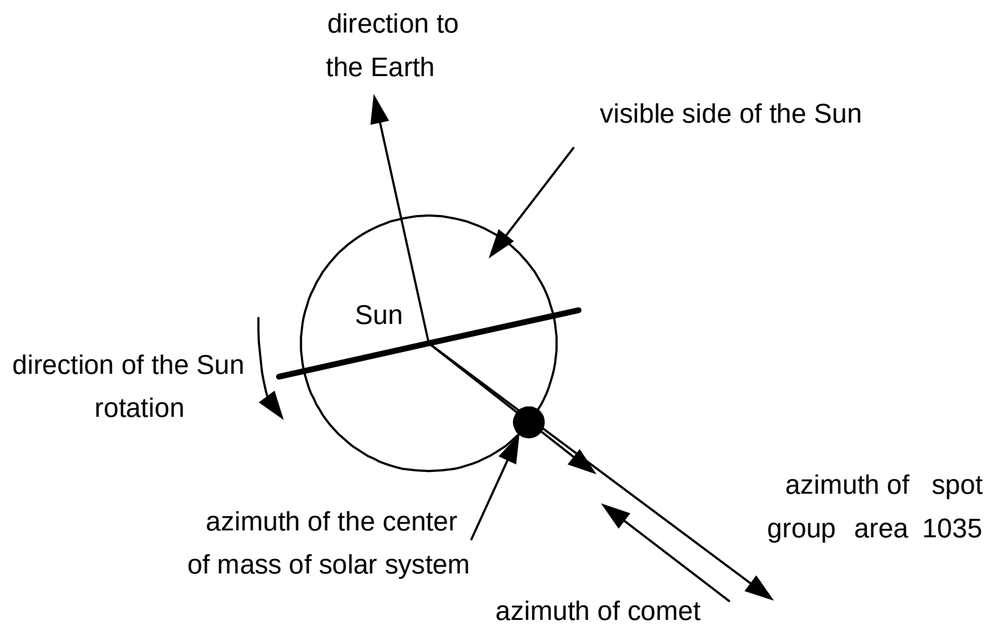
Figure 3. The sungrazing comet on January 3, 2010. Images by NASA's SOHO and STEREO.



Apparently, such event took place on January 3, 2010 when the Sun was hit by the comet (see Fig. 3) which was found by an Australian fan-astronomer Alan Watson on January 2. Falling of the comet occurred near the spot group area 1035 which was positioned at that time on the side of the Sun invisible from the Earth. On January 7 this area has appeared at the eastern edge of the Sun and on January 8 has obtained the number 1040. Taking into account the 27-day period of the Sun rotation and the time of occurrence of this area at the solar edge on January 7, it is possible to calculate that on January 2-3 the azimuth of the sunspot group 1035 was close to the azimuth of the center of mass of the solar system. Calculations show that on January 1-7, 2010, the center of mass of the solar system was at the distance of ~1.02 solar radius from the center of the Sun.

On January 3 the sunspot group area 1035 was close to the center of mass of the solar system. At this time the comet fell in this area. In Fig. 4, position of the center of the solar system mass and the direction to the Earth on 3.01.2010 00:00 UT are shown.

Figure 4. The scheme of azimuths of the comet, group of sunspots and the center of the mass of the solar system on January 3, 2010 00:00 UT. The view from the North Pole of the Sun in the ecliptic plane.



Thus, the coincidence of the azimuths of sunspot group area and the comet arrival on the Sun took place at the moment when they were in azimuthal closeness with the centre of mass of the solar system. This fact, certainly, cannot be the proof of the validity of the considered hypothesis of the sunspot formation by the heavy bodies hitting the solar surface. But it testifies to the necessity of the study of similar events.