NEW PHENOMENA IN THE EVOLUTION OF INTEGRAL BRIGHTNESS AND OUTBURST ACTIVITY OF COMETS

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For the first time the idea that comets may be considered as the indicators of the solar activity was proposed by L. Capocci in 1826 and O. Bruhns in 1867. But despite more than one hundred fifty years of a research of this problem the mechanism of the Sun-comets relationships is still unknown. The new ideas about influence of the solar activity on light curves and outburst activity of comets obtained by authors are discussed in the present paper.

A lot of visual observational data was compiled by authors with the aim to study cometary light curves and their relation to the solar activity, as well as appropriate conditions in the interplanetary space. As a result of this work a catalogue of more than 400 real brightness outbursts of comets observed during 1927–1994 was compiled.

We have compiled a detailed light curve of Comet Halley (using near 5000 estimations of visual integral magnitude obtained during July 1985 – June 1986 by observers of the IHW and SOPROG nets). The linear correlation between the fluctuations of cometary integral brightness and the variations of solar activity indexes was found. The correlation coefficient is 0.62 ± 0.22. The comparison of light curve of Comet Halley with the changes of velocity of solar wind near the comet measured by spacecraft VEGA-1 showed that there was a reliable statistical dependence between them. The correlation coefficient is 0.71 ± 0.13. These results refute the conclusion, which was made by S. V. Orlov, about absence of influence of solar activity on the integral brightness of this comet during its apparition 1909–1910.

The study of light curves of one of short-period Comet Tempel 2 during its three different apparitions (1967, 1983 and 1988 years) gave a chance to find a new phenomenon in flare activity of this comet. It has been found that peaks and minimums of the brightness occurs at the same heliocentric distances of the comet in different apparitions. We showed that the found phenomenon is typical for 129 comets observed during 1847–1975.

So, we can formulate a new observed property of cometary flare activity: outbursts of all the observed comets are most probable at the distinct heliocentric distances. This new fact has to be added to the observational criterions for selection of a physical mechanism of cometary outburst activity.

We proposed a quantitative index of cometary outburst activity:

$$I = \bar{A}\nu = \frac{\sum \Delta m_i}{T},$$

where $\bar{A} = (\sum \Delta m_i)/N$ is the average amplitude of outbursts (Δm_i is the amplitude of an individual outburst, N is the number of the outbursts), $\nu = N/T$ is the frequency of outbursts, and T is the time interval of continuous observations of a comet. Since the total amplitude of brightness outbursts $\sum \Delta m_i$ corresponds to the total energy, which was released during the outbursts, then the index I characterizes, in fact, the power of outburst activity.

The study of the 280 outbursts in 27 cometary light curves showed that comets can be divided into two groups depending on the values of the I index: a) the group of low and middle outburst activity ($I \leq 1$), and b) that of high outburst activity ($I > 1$). We can assume that only small-amplitude outbursts ($\Delta m \leq 1^m$) correlate with the level of the solar activity. High-amplitude brightness outbursts seem to have another trigger mechanism. A periodicity in the cometary outburst activity with quasi-period $6\overset{d}{.}8 \pm 0\overset{d}{.}6$ has been discovered. This quasi-period is equal to 1/4 of the Kerrington period of the Sun rotation. This is a new argument for influence of the solar activity on nonstationary active processes in cometary nucleus.