ON SHORT-PERIHELION METEOR STREAMS

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Research was conducted concerning relation of short-perihelion meteoroid streams with comets and asteroids. But the origin of meteoroid streams with small perihelion distances (of the Arietid and Geminid types) always represented a special problem for obvious reasons. Over four hundred meteoroid and fireball streams (by optical and TV-observations) contained 20 streams with perihelion distances of $q \leq 0.26$ AU. The research showed that 8 of 20 streams displayed a relation with small bodies. No relation was found either with comets, or asteroids for the remaining 12 streams.

Short-period streams may be formed on quasi-parabolic comet orbits with small q in the perihelion area as well. In particular, SOHO comets may be a rich source both of small and large meteor bodies, forming short-perihelion meteoroid streams among others.

Our knowledge as to the origin of meteoroid streams of small perihelion distance remains problematic, in particular it concerns meteor streams on orbits of small size (of the Arietid and Geminid types). V.N. Lebedinets (1985) proposed and mathematically substantiated a mechanism for the formation of short-period meteoroid streams of such type. He showed that comet orbits of large size might transform into meteor-type orbits of small size during evaporation of their ice

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nuclei under the action of reactive drag. Alternative mechanism for the formation of meteoroid orbits of small size was considered on the basis of close approaches with inner planets (Terent'eva & Bayuk, 1991; Andreev et al., 1990). Source of additional information on solution of this problem may be a recent discovery of SOHO comets a part whereof may be short-period (Hönig, 2006).

Over four hundred meteoroid and fireball streams (by optical and TV-observations) contained 20 streams of perihelion distance of $q \leq 0.26$ AU. The research showed that 8 of 20 streams displayed relation with small bodies: 4 streams – with comets (including with SOHO comets), one whereof might have relation with asteroids of the Apollo group (see the Scorpionids, Table 1), and 4 streams – with asteroids (one – of the Aten group, and the other ones – of the Apollo group). No relation was found either with comets, or asteroids for the remaining 12 streams.

Thus, streams of small q may originate equally both from comets, and asteroids (no matter what nature of these object is). Short-period streams may be formed on quasi-parabolic comet orbits with small q in the perihelion area as well (see, for example, the α-Virginids, Table 1 and Figure 1). Decrease of the orbit size even almost from parabolic to orbit of such small size that its aphelion turns out to be approximately 2 AU (maybe, even less) occurs during very moderate drag of particles when released from the comet nucleus. According to the well-known formula

$$V_h^2 = GM_{\square}\left(\frac{2}{q} - \frac{1}{a}\right)$$

{I guess this must be V_h^2 = G M_e [2/q – 1/a] - JR}

it can be found that decrease of the velocity during release into the perihelion comparing to the velocity of the parent body for the first hundreds of meters per second is sufficient therefore.

For the μ-Virginid meteoroid stream (Table 1, Figure 2) the theoretical radiant of the comet C/1737 C1, according to our calculation, refers to the southern (S) branch of the stream, if the μ-Virginids represent its northern (N) branch. We found that the similar situation takes place for the 31-Pegasid meteoroid stream and its comet 1995 LG (Table 1).

We discovered (Terentjeva & Barabanov, 2008) vast streams of meteoroid bodies related with large streams of SOHO comets or with separate SOHO comets. So, in the result of the existing comet catalogues (http://ssd.jpl.nasa.gov/dat/ELEMENTS.COMET) a family of the comet C/SOHO (2002 V5), consisting of 20 comets (Figure 3), was discovered. Their orbits come to the Earth's orbit in the point of closest approach, named appulse, for a distance of $\rho = 0.00444 \div 0.131$ AU in the area of descending nodes of orbits in the period since 7 till 13 June. Similar values of Tisserand´s constant C (the perturbing planet is Jupiter) do not contradict to the fact that this compact group of comets once (and probably recently) could be a unitary whole. Theoretical radiants of these comets are located in a small angular distance from the Sun (up to 30º), that is why their meteors are unavailable for optical observations. At the same time, by means of radio observations in Adelaide, Harvard and Obninsk we found 191 orbits of meteor bodies related with the above mentioned family of SOHO comets. This stream of small meteoroid bodies generating twilight meteor shower meets the Earth within 20 days (since 2 till 22 June) forming a continuous population of small bodies together with the comet family.

The orbit of the comet C/SOHO (2001 D1) has appulse with the Earth's orbit on 26 March in the area of the ascending node of the orbit with $\rho = 0.0577$ AU, and on 8 May – with $\rho = 0.210$ AU – theoretical comet radiant is similar to the radiant of the excellent shower of the Scorpionids of bright meteors and fireballs (Table 1). Besides, for the both approach moments of the comet orbit with the Earth's one, by means of radio observations in Mogadishu, Harvard, Kharkov, Obninsk and Adelaide, we discovered 155 orbits of meteor bodies related with the comet C/SOHO (2001 D1), on the whole. Here we deal with a sufficiently wide (over 0.2 AU) stream of meteor bodies active continuously within two months.

Thus, as to SOHO comets, we can draw a conclusion that they represent a rich source of both small, and large meteor bodies, may generate meteor streams of small perihelion distance, and in particular of short period. SOHO comets may also form vast comet-meteor complexes.

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