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Visibility on the Earth of the η-Aquariid and Orionid meteor showers

A.M. Dubrovskiy, G.O. Ryabova

Tomsk State University, Tomsk, Russia (a_mad@sibmail.com; rgo@rambler.ru)

P/Halley meteoroid stream

At present association of the η-Aquariid and Orionid meteor showers with comet Halley is undisputed. Every year the Earth crosses the P/Halley meteoroid stream twice: in the descending node (April–May, η-Aquariids) the minimal distance from the cometary orbit is 0.065 AU, and in the ascending node (October) – 0.18 AU. The first known observation of the η-Aquariid shower dates to 74 BC, and the Orionid shower to 288 AD [1].

McIntosh & Hajduk [1], and later McIntosh & Jones [2] built the first models of the P/Halley stream, which explained some features of these showers. Ryabova [3] continued the investigations, and, inter alia, drew the following conclusion: the part of the P/Halley meteoroid stream manifesting itself as contemporary Orionid shower likely was generated before 1404 BC, and the η-Aquariids shower seems to be born between 1404 BC and 837 AD.

Numerical modelling of P/Halley meteoroid stream is very resource-consuming procedure. The model can be verified only by comparison with observations. So it is important to know periods of visibility on the Earth for particles ejected from the comet nucleus during various returns. The aim of this work is to investigate the mentioned periods.

Model

For modelling we used a numerical method, described in [3], and the same parameters. Two ejection velocity models were used: the Whipple model [4], and the same formula with the factor 0.1, because there are reasons to suppose [5 – 7], that the ejection velocities, computed by the classical model are very overestimated. The model meteoroids were taken to be spherical with density 0.35 g/cm^3 and mass 0.001 g. The 50 particles were ejected for each of 42 perihelion passages from 1402 BC to 1910.

The orbital motion equations were numerically integrated by an Everhart procedure of 19th order. Gravitational influences of all planets, Moon and Pluto, radiation pressure and Poynting-Robertson effect were taken into account.

Results

For each of 42 model streams we made a plot describing their ecliptic-plane crossings at present. We found that the particles ejected after 614 BC can not be observed at the Earth as Orionids. But the particles could be observed as η-Aquariids if they ejected till 913 AD. It is interesting that particles generated recently (i.e. during 1692 – 1910 returns) can be observed at Venus.

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References

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