ANALYSIS OF THE MAIN AND SMALL METEOR SHOWERS

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Introduction: The Earth as well as other planets and their satellites regularly collides with space bodies. The Earth's collision with a space body comparable with Tunguska meteorite of 50 meters in size occurs once in a hundred years. Larger meteoroids of 10 to 100 meters in size due to their low brightness, high extra-terrestrial velocity, and uncertainty of their entrance into the Earth's atmosphere are the real danger for our planet. All the detected large meteoroids are identified with a certain meteoroid shower. On the basis of stream and sporadic meteors observations the models of meteoroid matter distribution in terrestrial and interplanetary space are built. However, according to MDC IAU data, out of 112 reliably observed meteor showers in terrestrial space only 21 are explicitly identified with comets and 5 are linked with asteroids. But for about 80 showers parent bodies are not found. Let us call them orphan showers. Currently, the hypothesis on meteor showers genetic connection with asteroids is being considered in the context of an asteroid as a faded comet that has generated meteor swarm earlier. Different formation mechanism of swarms from comets (dust particles with gas emission during ice sublimation mainly when a comet passes the perihelion of its orbit) and, probably, asteroids (disintegration under the tidal and centrifugal forces or during collisions) as well as evolution stage of parent body (active, inactive) forms the features of meteor showers observed structure.

Methods: To study structural features of the observed meteor showers, a long-term statistically provided set of visual and television observations is used; the developed and adapted methods of the data processing and interpreting are given on the International meteor organization website (http://www.imo.net/data/visual). Using the example of main annual showers, it has been established that for the showers of cometary origin basic structure characteristics correlate with orbit elements of the parent comet [1]. This is why involving the data on shower structure may increase the reliability of searching for probable parent bodies among asteroids under the assumption that they are faded comets. In the work [2], structures of Ursid, Perseid, Lyrid cometary showers as well as Geminids, Taurids, Alpha Capricornids, presumably associated with asteroids, are investigated. Using the method developed in [1], for the main streams of Perseids, Lyrids, Geminids and α-Capricornids and small streams of the unknown origin k-Cygnids and δ-Cancrids having northern NCC and southern SCC branches a radiant structure analysis was conducted on the basis of TV catalogues of meteor orbits brighter than +3m (Japan Meteor Network SonotaCo, 2007–2015, http://sonotaco.jp/doc/SNM/index.htm; Croatian Meteor Network CMN, 2007–2012, http://cmn.rgn.hr/ downloads/downloads.html#orbitcat).

Results: As a result, the showers' radiation areas, their distribution depending on stellar magnitude, allocation for observational dates, correlation between the shapes of meteoroids orbits and their masses were analyzed. The smallest scatter of radiant coordinates (α, δ) is observed for the Lyrids stream (ellipse of $4^0\times8^0$), the greatest one which is about 28^0 both by right ascension and declination is observed for k-Cygnids. The change of δ for other streams varies between 7^0 and 10^0. The values of Lyrid, Perseid, k-Cygnid, and α-Capricornid radiants declination are growing in step with the increasing right ascension α, while for Geminids and δ-Cancrids a pattern of δ change does not correlate with change of α.

Discussion: The radiation area of the showers investigated is evenly filled with radiants without marking out single subradiants. According to 2 TV orbit catalogues, for Lyrids, Perseids, Geminids, Alpha Capricornids, and k-Cygnids there is a dependence of the radiants' coordinates as well as size and shape of meteor orbits on absolute stellar magnitude of the meteors. NCC and SCC branches of δ-Cancrids are observed simultaneously during the period between January, 1 and January, 31, but the branches' radiants do not match and are clearly localized both by declination and right ascension.

Conclusions: The study of orphan showers structures may become an additional criterion for refining the question of their origin. At the same time, it is necessary to study the shower structure over the entire period of its activity, which requires the sufficient observation statistics not only at the moment of its maximum activity, but also at the beginning and the end of the showers' activity.

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References: [1] Sokolova M., et al. 2016. Advances in Space Research. 58/4: 541-544. [2] Sokolova M.G., et al. 2014. Advances in Space Research. 54/ 11: 2415-2418.