THE USE OF THE D-CRITERION METHOD FOR THE ANALYSIS OF OBSERVATIONAL DATA OF TUNGUSKA EVENT

Y. A. Nefedyev[1], M. G. Sokolova[1], A. O. Andreev[1], M. V. Sergienko, N. Y. Demina[1]
[1]Kazan Federal University, Engelhardt Astronomical Observatory, Russia, Kazan, Kremlyovskaya st., 18.
E-mail: star1955@mail.ru

Introduction: More than 100 years passed after the mysterious explosion of an unknown body in the area of the Podkamennaya Tunguska River in Russia (30 June, 1908), but the phenomenon of the Tunguska meteorite continues to attract scientists' attention. It was expected that the composition of meteoritic material was utterly heterogeneous. The upper limit of the Tungus cosmic body's density was about 2.8 g/cm³. Owing to the interaction with the Earth's atmosphere, the cosmic body disintegrated into fragments from 10^{-7} to 10^{-3} m in size, and it is known that most of the material was ejected into the upper layers of the atmosphere. However, the mystery of the Tungus nature is unsolved. No craters or any meteorite fragments were found on the ground after the explosion of the Tungus object. A number of exotic hypotheses were caused by it: a meeting with body of antimatter; a small black hole; an explosion of a 'UFO', etc. The suggestion of the Earth's collision with a 50 m body of cometary origin is the most realistic today. The findings are based on eyewitness testimony and calculations within the mechanics and aerodynamics: 47% of testimonies of bolides flight described its structure in detail, marked out its core and tail ('lump flame', 'fireball' with a fiery white, pink and red tail 'broom'). Thus, most researchers agree that the Tungus bolides couldn't be a stone, iron-stone, or an iron asteroid, as there is a dark plume of smoke in the atmosphere during the combustion of such objects. It can be assumed that it was a body composed of ice water and hydrocarbon components, including methane.

Methods: Large sized meteoroids (10–100 m), called 'inasans', have low brightness and most visible velocity, as well as an uncertainty of direction of their arrival. Therefore, small bodies of this class are difficult to detect by telescope. There are two main options for exposure to a dangerous space object: the object's destruction; or a change in its trajectory. In any case, the object must be detected as early as possible to achieve the goal. All the found inasans belong to meteor showers, so the important task is to establish the link between a small body and its parent body, for studying its evolution and possible approach between these objects and the Earth.Genetic identification of a meteoroid with a meteor shower can be done in different ways. The way to compare the radiant is the most reliable when radiant coordinates of a meteor shower are known and radiation area is small; that is, for well-studied and relatively new meteor swarms. The D-criterion method is more universal [1]. The distance between the orbits of the bodies in the five-dimensional phase space is accepted as a measure of genetic commonality.

Results: As result, the D value for two orbits of the comet and meteoroid was calculated for a range of emissions speeds 300 – 2100 m/s, and at the same time, the points of release before and after perihelion, which is the true anomaly -90^0 -60^0, -30^0, 0^0, $+30^0$, $+60^0$, $+90^0$ were selected. It is established that the D value does not vary for particles which were emitted in various points in the orbit with the same speed. The D value which is equal to 0.2 is only attained for particles that were emitted at speeds higher than 2,000 m/s. According to modern gas-dynamic ideas, the ejection velocity doesn't exceed 600 m/s at the disintegration of a comet nucleus.As a result of heating, the comet's core collapses, throwing meteoric matter at each approach to the Sun. The orbits of discarded fragments are connected with the parent body at the disintegration of the comet's nucleus, so the D value depends on the initial conditions of ejection (ejection velocity and the ejection point position in orbit.) We can analyze the D-criterion values for various velocities of particle emissions and various positions of the emission points in orbit.

Conclusions: Thus, D-criteria are some of the tools for the genetic identification of cosmic bodies, with one or another group of small bodies in the asteroid-comet and meteor complex. However, the uncertainty upper of the limit remains a major problem of their use. The value of the D magnitude as a measure of a common origin of two bodies cannot be transferred artificially to different types of small bodies. To improve the reliability of identification of the observed objects, the value of the upper limit D-criterion must be investigated individually for each group of asteroids, comet family, or meteor swarms complex as its evolutionary response [2]. This poses the problem of the permanent monitoring of near-earth space for the purpose of detecting dangerous space objects, and determining the elements of their orbits and identification with the parent body.

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