SPACE DENSITY DISTRIBUTION OF METEOROIDS OVER THE SPHERE WITH RADIUS 1 A.U.

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ABSTRACT. Space density distributions of meteoroids over the sphere with radius 1 AU and the centre in the Sun were found for meteoroid masses greater than 10^{-3} g, 10^{-2} g and 1 g. Meteoroids with greater masses concentrate to the ecliptic plane

Key words: meteoroid, Solar system

Introduction

Ground-based radar observations of meteors are the most numerous and therefore the most reliable now. All ground-based observations are related to the small part of the Solar system, i.e. to the vicinity of the Earth's orbit. But we have to know meteoroid distributions in a more volume of the cosmic space to study their origin and evolution.

Observational data

The four dimentional distribution of the flux density of sporadic meteors over the celectial sphere $QP(\varepsilon, \psi, v, m)$ has been found as a product of the radiant distribution $P(\varepsilon, \psi)$, the conditional distribution of velocities $P_\varepsilon(v)$ and conditional cumulative mass distribution $F_\varepsilon(m) = (m/m_0)^{1-s}$ (Andreev *et al.* 1994):

$$QP(\varepsilon, \psi, v, m) = QP(\varepsilon, \psi) P_\varepsilon(v) F_\varepsilon(m), \qquad (1)$$

where ε is the meteor radiant elongation from the Earth's apex, ψ is the azimuth angle measured between the ecliptic plane and plane crossing through apex, radiant and antapex, v is the meteoroid velocity, m the mass of a meteoroid, m_0 is the minimum mass and s is the distribution parameter. Here Q is the total flux of meteoroids with masses greater than m_0 over the complete range of velocities and from the whole celestial sphere.

Distributioins of meteoroid radiants and masses were obtained from radar observations in Kazan, Russia, for the last several years (Andreev *et al.* 1994). All observations have been avereged over a year. Velocity distributions have been taken from the Lund set of meteor orbit catalogues (Lindblad, 1992). Selectivity of observations have been taken into account.

Solution of the problem

The meteoroid flux density distribution over the celestial sphere (1) have been calculated for the three minimum masses: 10^{-3} g, 10^{-2} g and 1 g and then transformed to the heliocentric frame of references (Andreev *et al*, 1993). The space density ρ of meteoroids can be obtained as a function of the only variable β i.e. the ecliptic latitude because of the data averaging for a year:

$$\rho_\beta = Q_\beta \int\int\int \frac{P_\beta(\varepsilon, \psi, v)}{v} \sin\varepsilon \;\; d\varepsilon \;\; d\psi \;\; dv, \qquad (2)$$

where the flux density distribution relates to the same latitude β as the ρ.

As was shown by Andreev *et al.* 1993, perihelion arguments of sporadic meteoroid orbits with given values of orbit elements a, e, i have the uniform distribution. So, it can used the same method as one given in the paper by Belkovich, 1983 for taking into account the astronomical selectivity. In this case the relation between flux density distributions in the ecliptic plane ($\beta = 0$) and in the point at the sphere with given β is:

$$Q_\beta P_\beta(\varepsilon, \psi, v) = Q_{\beta=0} P_{\beta=0}(\varepsilon, \psi, v) \cos\gamma^{-1}. \qquad (3)$$

Here γ is the angle in the orbit plane between the node and the point with the coordinate β. Finaly, from (2) and (3)

$$\rho_\beta = Q_{\beta=0} \int\int\int \frac{P_{\beta=0}(\varepsilon, \psi, v)}{v \;\; \cos\gamma} \sin\varepsilon \;\; d\varepsilon \;\; d\psi \;\; dv, \qquad (4)$$

The variation of the space density as a function of the ecliptic latitude β is shown in Fig.1 in the relative units, in the ecliptic plane $\rho_{\beta=0} = 1$.

Conclusion

As one can see in Fig.1 the space density of meteoroids near the pole of the eclipic is very low. It can be explained by the fact that meteoroid orbits with inclinations about 90° are very unstable. Meteoroids with greater masses concentrate to the ecliptic plane. Some

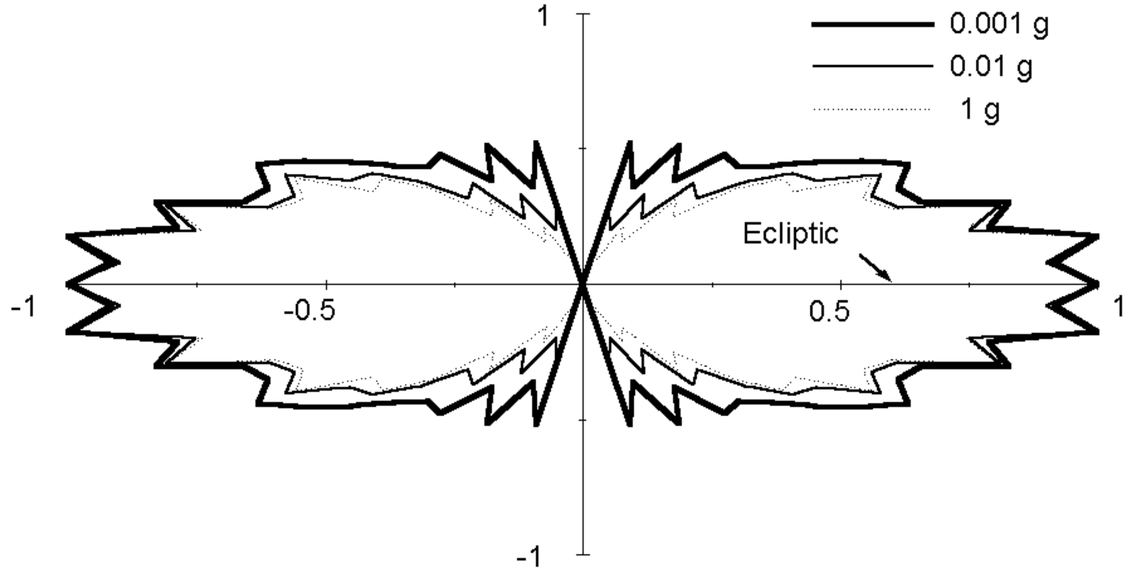

Figure 1. Space density of meteoroids (in relative units) at the distance 1 AU off the Sun as a function of the ecliptic latitude.

pikes at the diagram are not reliable and can be considered as artifacts.

References

Andreev V.V., Belkovich O.I., Filimonova T.K., Sidorov V.V.: 1993, *Meteoroids and their parent bodies*, 157.

Andreev V.V., Belkovich O.I., Evdokimov O.I., Suleymanova S.L.: 1994, *Planet. Space Sci.*, **9**, 785.

Belkovich O.I.: 1983, *Astron. vestnik*, **17**, 108.

Lindblad B.A.: 1992, *Documentation of Meteor Data Available at the IAU Meteor Data Center*