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DETERMINATION OF METEOR FLUX DISTRIBUTION OVER THE CELESTIAL SPHERE

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ABSTRACT

A new method of determination of meteor flux density distribution over the celestial sphere is discussed. The flux density was derived from observations by radar together with measurements of angles of arrival of radio waves reflected from meteor trails The role of small meteor showers over the sporadic background is shown.

INTRODUCTION

Morton and Jones (1981) proposed a method of determination of radiant distribution from observations by a single radar with a measurement of arrival angles of signals reflecting from meteor trails. The method was realized for shower meteors only. A new method was worked out in Kazan to derive meteor flux density distribution over the celestial sphere. Observations were carried out by the radar with the aerial turning every 15 minutes successively in four directions: North, East, South, West. So all meteor radiants above the horizon were observed for an hour. The radar has operated according to the GLOBMET program therefore observations of velocities of meteor trail drifts due to winds were carried out simultaneously.

DESCRIPTION OF THE METHOD

The celestial sphere was divided into 578 areas $\Delta\omega$ $10^\circ \times 10^\circ$ each in spherical frame of reference ε, ψ, where ε is the elongation from the apex and $\varepsilon = 90^\circ$, $\psi = 0^\circ$ is the direction relative to the Sun. If we know the direction to the reflecting point at a meteor trail then a position of the meteor radiant must be at the radiant line above the horizon. A radiant line is an arc of a great circle formed by intersection of a plane normal to the direction to the reflecting point and the celestial sphere. In this case the radiant line intersects some number of areas $\Delta\omega$. The probability P_i that the radiant is inside the area $\Delta\omega_i$ is

$$P_i = \frac{Q_i \; \Delta\omega_i \; \Delta S_i \; \Delta l_i}{\Sigma \; Q_i \; \Delta\omega_i \; \Delta S_i \; \Delta l_i}$$

Q_i is the flux of sporadic meteor bodies inside the area $\Delta\omega_i$, ΔS_i is the effective collecting area in the echo plane for the direction to the reflecting point, Δl_i is the radiant line length in the limits of the area. One can take $Q_i = 1$ as the first approximation and for every hour of observations and distribute all registered meteors to the areas by parts equal to P_i. So for every hour one can count hourly rate for every area N_{ki}. Meteor activity of every area can be represented as a point (shower) radiant with a flux

$$Q'_{ki} = Q_{ki} \Delta\omega_i .$$

The flux density Q'_{ki} for shower meteors can be calculated from known hour rate N_{ki} and position of the radiant relative to the radar aerial. Q_{ki} can be found from the previous formula. Then the mean values

$$Q_i = n_i^{-1} \sum_{(k)} Q_{ki}$$

is calculated for every area $\Delta\omega_i$ and for the entire interval of observation. n_i is the number of hours of observation. These values of Q_i are used for a second approximation, etc. The iteration process is repeated until the solution becomes stable.

RESULTS

The method permits us to obtain meteor flux density distribution over the celestial hemisphere for a diurnal interval of observation. An example of the distribution is given in Fig.1. Several picks are evident on the plot and they are apparently small meteor showers acting for a period from several hours to several days. In the last case one can trace them at successive diurnal distributions.

Radar observations for 1988 year have been used to get an averaged geocentric flux density distribution of meteor bodies with masses greater then some value. The ionisation coefficient was taken by V.Tokhtasjev (Andreev et al, 1976)

$$\beta = \beta_o (V/V_o - 0.2)^{3.5}$$

where β and β_o are the coeffitients for meteoroid velocities V and

V_o respectively, V_o = 40 km s^{-1}. The model of the velocity distribution was taken from Andreev and Belkovich (1987). The annual distribution of the meteor flux density is shown in Fig.2.

REFERENSES

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Morton J.D. and Jones J. (1981) A method for imaging radio meteor radiant distributions. Mon. Not. Roy. Astron. Soc., 198, 739-746.

Captions for Figures

Fig. 1. The distribution of meteor flux density over the celestial sphere, October 9, 1988.

Fig. 2. The annual distribution of flux density of meteoroids with masses greater than 10^{-5}g over the celestial sphere, 1988.

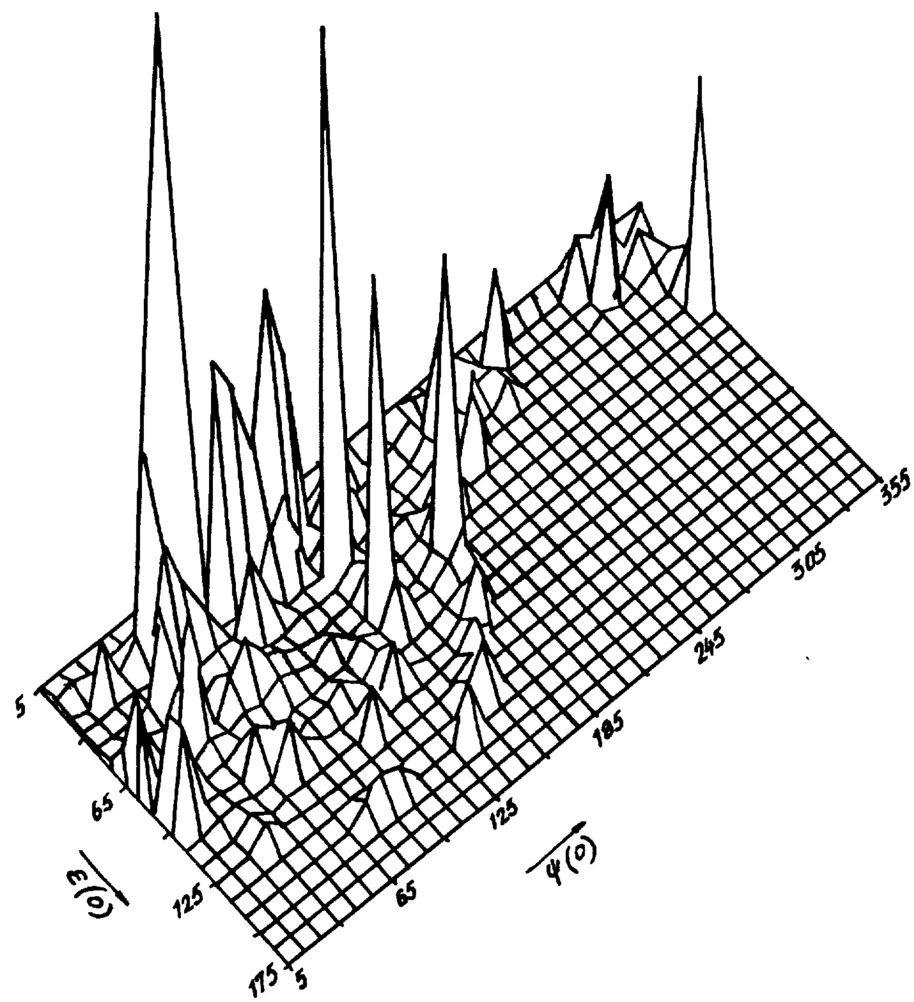

FIGURE 1.

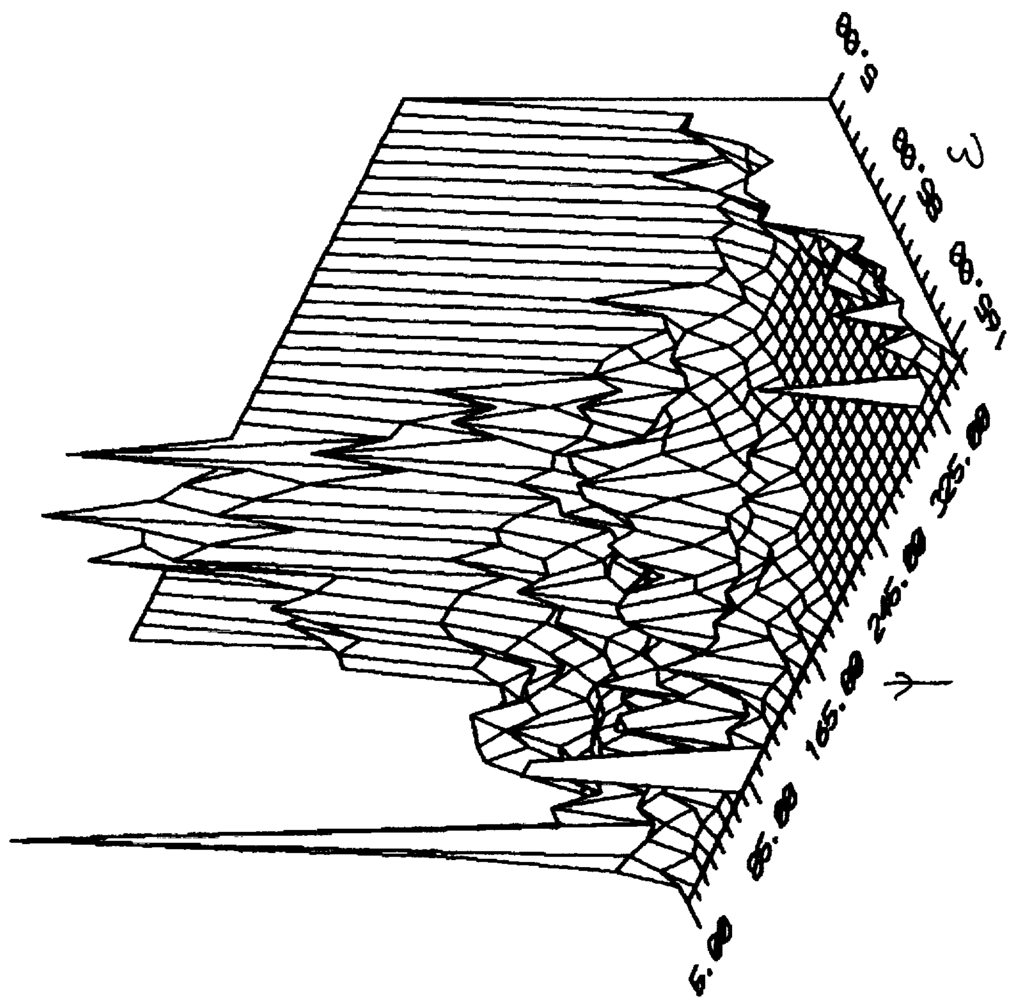

FIGURE 2.