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EXPECTED DISTRIBUTION OF SOME OF THE ORBITAL ELEMENTS OF INTERSTELLAR PARTICLES IN THE SOLAR SYSTEM

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A two-dimensions distribution p(e,q) of eccentricities e and perihelion distances q can be derived by means of the formula for the probability transformation:

$$p(e,q) = p(v,\alpha)\cdot \begin{vmatrix} \frac{\partial v}{\partial e} & \frac{\partial \alpha}{\partial e} \\ \frac{\partial v}{\partial q} & \frac{\partial \alpha}{\partial q} \end{vmatrix} \qquad (1)$$

where v is the heliocentric velocity at infinity, α is the impact parameter. Assuming v and α are independent and $p(v) = C_1$, $p(\alpha) = C_2\alpha^2$, we have

$$p(v,\alpha) = p(v)p(\alpha) = C_1C_2\alpha^2. \qquad (2)$$

Here C_1 and C_2 are constants.

The well-known relations of celestial mechanics give

$$(3) \qquad v^2 = \frac{e-1}{q}, \qquad\qquad \alpha^2 = \frac{e+1}{e-1}, \qquad (4)$$

where q is in AU and v is in units of the earth's velocity.

From eq. (1) taking into account for eqs. (2) - (4) one can derive:

$$p(e,q) = \frac{C_1C_2\ q^{3/2}\ e(e+1)^{1/2}}{(e-1)^2} \qquad (5)$$

Distributions p(e) and p(q) were derived from the integration of eq. (5):

$$p(e) = \begin{cases} C_3e(e^2-1)^{1/2}, & (1 \leq e \leq e_o) \\ C_4e(e^2-1)^{1/2}\left[\left(\frac{e_m-1}{e-1}\right)^{5/2} -1\right] & (e_o \leq e \leq e_m) \end{cases} \qquad (6)$$

e_o and e_m are found from the minimum and maximum values of the velocities and maximum size of the region near the sun that can be observed. In the real case $e_o \sim 1.0001$.

$$p(q) = C_5q^{1/2}, \qquad (7)$$

C_3, C_4 and C_5 are constants.

One can see from eq. (6) there is a strong concentration of the parameter e near 1.

Similar results were obtained for some other forms of the velocity distributions p(v).

https://doi.org/10.1017/S025292110005209X Published online by Cambridge University Press