INTERACTION OF METEOROIDS AND ELEMENTARY PARTICLES.

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Introduction: The action of elementary particles (such as photons, protons, electrons) upon the meteoroids is intensively investigated now.

After averaging the differential equation (1) over the particle orbital period the corresponding invariant (2) was deduced [1].

The differential equation of motion submitted in the vector form, absolutely black spherical body, isotropic reradiating solar energy and moving with velocity v, making an angle u with a direction of a heliocentric radius - vector is:

$$\ddot{\mathbf{r}} = -GM'\mathbf{r}/r^3 - 2\pi R^2 q r^2_{S\text{-}E}/(Mc^2) v \cos u \mathbf{r}/r^3 - (1+\gamma)\pi R^2 q r^2_{S\text{-}E}/ /(Mc^2 r^2)\ v \sin u \mathbf{e_t} \quad (1)$$

Here G is the gravitational constant, r is a distance between the Sun and a particle, R is the radius of a particle, c is a speed of light, q is the solar constant for average distance $r_{S\text{-}E}$ from the Sun to the Earth, $\mathbf{e_r}$ и $\mathbf{e_t}$ are the unit vectors of radial and transversal accelerations, M′ is the reduced mass of the Sun.

$$a/a_0 - \left[(1-e_0^2)e^{\frac{4+2k}{5+2k}}\right] / \left[(1-e^2)e_0^{\frac{4+2k}{5+2k}}\right] = 0 \quad (2)$$

Here $0 < \gamma < 0.6$, $0 < k < 1.5$ [2].

The calculations are made in the unit system, where G=1, unit of distance is R_{S-E} =1 AU, the mass unit is M_S =1. The orbital period of Earth (T) equals 2π in the taken unit system.

Numerical Experiments: Let`s consider meteor`s particles at the initial moment of time at the following orbits: a_0 = 5 AU, e_0 = 0.990. We assume the meteoroid`s density ρ = 1000 kg/m^3, and the parameters of the model take the following values k =1.5, γ =0.6 [1], [2].

Example 1. Radius of a meteoroid is equal to R = $100 \cdot 10^{-6}$ m.

The interval of considered time equals 17800 units.

The final values of a and e according to (1) are equal to a_γ and e_γ ; a_k and e_k are found from (2).

$e_k \approx e_\gamma$ = 0.945;

a_γ =0.901 AU, a_k =0.896 AU

Example 2. Radius of a meteoroid is equal to R = $10 \cdot 10^{-6}$ m.

The interval of considered time equals 2700 units.

$e_k \approx e_\gamma$ = 0.520;

a_γ =0.080 AU, a_k =0.078 AU

The relative error of a and e from equation (1) and invariant (2) isn`t exceed 3 % in these examples.

Conclusion: The invariant (2) is assumed to use in meteor astronomy alongside the Tisserand`s criterion, the Drummond criterion, the Lidov–Kozai criterion.

References:

[1] Tikhomirova E. N. 2009. Abstract #1087. 40th Lunar & Planetary Science Conference. [2] Ryabova G.O. 2005. *Proc. of the 197th Coll. of the International Astronomical Union.* pp.. 411–414.