SEARCHING FOR COMETARY BELTS IN THE EXOPLANETARY SYSTEMS. A.S. Kobunov, Astronomical Observatory, State Pedagogical University, Respublikanskaya 108, Yaroslavl 150000, Russian Federation. E-mail: kobunator@mail.ru.

Introduction: It is known comets are the most effective bodies of the Solar system. Such they were during all history of mankind; such remain and till now [1]. The comet is the small celestial body moving in interplanetary space and plentifully allocating gas at rapprochement with the Sun. Probably comets are the rests of primary substance from which the Solar system, probably was generated, they are connected to interstellar substance [2]. The problem of their origin is unsolved. Though there are many hypotheses of their origin [3]. The modern cometary's catalogues are numbered about 2000 comets in the Solar system. It is interesting to localize by theoretically way the regions of motion of comets in the exosolar planetary systems. It should be noted at this decade several cosmic apparatus (for example "COROT") will be investigate the star of the Galaxy and they must discovered tens thousands of exoplanets.

The Fundamental System of Equations: Below the celestial-mechanical model (based on the work [3]) of origin in the exosolar systems of comets, which orbital periods in k times (1) are differed from the periods of the planets is considered.

$$T\text{p}/T\text{к}=k, \qquad (1)$$

Tp is the period of a planet, Tк is the period of a comet. Let's consider motion of a parabolic comet which in perihelion of the orbit approaches with a planet; the comet and the planet move in one and the same plane. Velocity of the comet in respect of the planet we shall find from the equation (2)

$$V_{kp1} = \sqrt{\frac{G \cdot M_O}{a_p}} \cdot (\sqrt{2} - 1). \qquad (2)$$

V_{kp1} is velocity of the comet in respect of the planet before turn, G is the gravitational constant, Mo is the mass of the star, a_p is a semimajor axes of the circular orbit of the planet. Interaction of the comet and the planet we shall present as instant turn of the comet in respect of the planet for the condition

$$|\mathbf{V}_{\text{kp1}}| = |\mathbf{V}_{\text{kp2}}|.$$

Thus the velocity of the comet in respect of the star after passing into the new orbit is expressed by the equation

$$(V_{k2})^2 = (V_{kp2})^2 + (V_p)^2 + 2 \cdot V_{kp2} \cdot V_p \cdot \cos(\vartheta). \qquad (3)$$

V_{kp2} is the velocity of the comet in respect of the planet after turn, V_p the new velocity of the comet in respect of the star, V_p is the velocity of the planet in respect of the star, ϑ is an angle of turn of the comet in the sphere of action of the planet. From the law of conservation of energy, within the framework of a problem of two bodies, for motion of the comet we have:

$$(V_{kp2})^2 = G \cdot M_O \cdot \left(\frac{2}{a_p} - \frac{1}{a_{k2}}\right). \qquad (4)$$

a_{k2} is a semimajor axes of the elliptic orbit of the comet. From Kepler's third law and from the equation (1) follows:

$$a_{k2} = a_p \cdot (k)^{\frac{-2}{3}}. \qquad (5)$$

Then ratios (2-5) it turns out

$$\cos(\vartheta) = \frac{-k^{\frac{2}{3}}}{2^{\frac{3}{2}} - 2} + 1. \qquad (6)$$

The angle ϑ for all planets does not depend on values of radius of the planet (R), its mass (Mp), mass of the star (Mo) and radius of the orbit of the planet a_p. For the case Tp/Tк=2, we have *cos* (ϑ_{K}) =-0.91616, ϑ_{K}=156.37137°. For maximal value of $k_{\max}$ (for $\vartheta_{\max}$ =180°) we have $k_{\max}=8(-7+5\cdot 2^{1/2})^{1/2} \approx 2.13268$. This result follows from equation (6). For the short periodical comets of the families of the solar giant planets k~2 [3, 4].

A Method of Localizing of Short Periodical Comets in the Exoplanatory Systems: Supposing in the frame of the considered model for the giant extra-solar planets k=2, it is easy to find apastron $R_{\max}$ and periastron R_{min} distances and eccentricity e of a comet

$$R_{\max} = a_{k2}(1+e) = a_p, \qquad (7)$$

$$R_{\min} = a_{k2}(1-e), \qquad (8)$$

$$e = 2^{2/3} - 1 \approx 0.587401052, \qquad (9)$$

using equation (5). The eccentricity is the constant (!)value for the given k.

With help of these values cometary's belts in the exosolar systems are localized. The results of calculations for the hypothetical families of the comets in the exosolar systems are presented in the table 1.

Table 1. The orbital parameters of the hypothetical comets near the stars with the planets (k=2).

Planets	Comets		
	a, AU	R_{min}, AU	R_{max}, AU
47 Ursae Majoris b	1.3229	0.5458	2.1
47 Ursae Majoris c	2.3498	0.9695	3.73
55 Cancri d	3.7168	1.5335	5.9
Epsilon Eridani b	2.0789	0.8577	3.3
HD 12661 c	1.6442	0.6784	2.61
HD 37124 c	1.8584	0.7668	2.95
HD 37124 d	2.0096	0.8291	3.19
HD 38529 c	2.2112	0.9123	3.51
HD 74156 c	2.8159	1.1618	4.47
HD 82943 b	0.7308	0.3015	1.16
HD 160691 b	1.0394	0.4289	1.65
HD 160691 c	1.4489	0.5978	2.3
HD 168443 c	1.808	0.7460	2.87
Upsilon Andromedae d	1.5749	0.6498	2.5

Conclusion: For localizing of the comets here we used the definite orbital parameters of the exosolar giant planets (a_p>1 AU, M_s ~ M_{Sun} , m_p ~ $m_{Jupiter}$), discovered till 2006 year. M_s and M_{Sun} are mass of the star and the Sun, m_p and $m_{Jupiter}$ are mass of the planet and Jupiter. Of course, high temperature of the cometary's surface at the periastron of the orbit will cause throwing out of the matter and this fact should be taken into account for solving the problem for searching for comets into the exosolar systems.

References: [1] http://www.krugosvet.ru. [2] http://www.pereplet.ru. [3] Perov N.I. (2005) *SSR*. V. 39. № 3. 281 - 287. [4] Kobunov A.S. (2006) Vernadsky-Brown microsymposium. Abstract ms44-38.