ON ORIGIN OF SEDNA. N. I. Perov, Astronomical Observatory, State Pedagogical University, Respublicanskaya, 108, Yaroslavl, 150000, Russia. E-mail: perov@yspu.yar.ru.

Introduction: Sedna (2003 VB12), – announced in March 15, 2004, - probably is the first observing object of the Oort's Cloud [1]. Elements of the orbit of Sedna are following: M=357º.88148, n=0.0008040 º/day, a=531.6576335 AU, e =0.8574338, ω = 311º.82711, Ω=144º.49288, i=11º.93041 (for the Epoch 2004, July, 14) [1]. Brown, Morbidelli, Levison maintain that only scattering by so-far-unobserved Planet X could produce such a high-perihelion orbit [2]. A celestial mechanics model of origin of Sedna is presented below.

A Model of Origin of Sedna: Let us consider a model of interaction of an object (Sedna), with a preliminary parabolic heliocentric orbit, and a planet (Planet X) of (unknown) mass M_{pl}. The object (Sedna) at the perihelion of the heliocentric orbit closes with the planet (Planet X), which moves along circle orbit (of unknown radius r_{pl}) with (unknown) velocity V_{pl}. An initial angle between the orbital planes of the object and the planet is equal to i_i (unknown). The process of interaction of the object and the planet will be considered like momentary turn of velocity vector V_S of the object, experienced the closest approach of the planet. An angle of turn θ of the object velocity vector (in the sphere of action of the planet) is maximum, if the object approaches with the planet at the minimal distance without destroying. For this distance we take the (unknown) radius of the planet R_{pl}. (Roche limit is not taken into account). A target parameter of the object (Sedna) is ρ should be in excess of ρ_S (otherwise the object will collide with the planet (Planet X) and recover from further existence in the given model of motion). The object with velocity of V enters into the sphere of action of the Sun, mass of which is M_{Sun}.

Setting for the heliocentric motion $r_{pl} \approx r$ (for the moment of time of "collision' of Sedna and Planet X) we determine by analytically tractable an angle of turn θ of a velocity vector of Sedna in the sphere of action of the Planet X, a semimajor axis a, an eccentricity e , true anomaly v of Sedna for the new heliocentric orbit (after scattering Sedna by gravitational field of the Planet X and egress of this object from the sphere of the planet action) and an angle α between the heliocentric radius–vector of Sedna **r** and the vector of the heliocentric velocity **V**.

The parameters of the final orbit of Sedna are presented above and in [1] and they are concerned with some parameters of the original (parabolic in accordance with the model) orbit of Sedna as well as the parameters of the Planet X by the following formulae :

$$\nu' = \frac{1}{\left[\frac{M_{Sun}}{M_{pl}} \cdot \frac{R_{pl}}{r_{pl}} (3 - 2\sqrt{2}\cos i_i)^2 + 1\right]^2}. \qquad (1)$$

$$a = \frac{r_{pl}}{4 \cdot \nu' (\sqrt{2}\cos i_i - 1)}, \qquad (2)$$

$$e^2 = 1 - 8\nu' (\sqrt{2}\cos i_i - 1)\{[1 - \sqrt{2}\nu'(\sqrt{2} - \cos i_i)]^2 + 2\nu'^2 \sin^2 i_i\} \qquad (3)$$

$$tgi = \pm \frac{\sin i_i (1 - 2\nu')}{\cos i_i - \sqrt{2}\nu'(\sqrt{2}\cos i_i - 1)} \qquad (4)$$

Here, in (1)-(4), it is put - Planet X moves in the plane of ecliptic. In this section a model of origin of Sedna is based on the detailed space model of migration of minor bodies (comets) from Oort's Cloud into the internal parts of the Solar System [3]. The plane model of migration of parabolic comets into the planetary region of the Solar System is considered in [4].

Parameters of Orbit of Unobserved Planet X and Parameters of Planet X: Equations (1) – (4) may be solved for i_i, ν', r_{pl}, R_{pl}/M_{pl} and then it is possibly to determine the true anomaly (*v*) of Sedna, for the moment of time of "collision", and finally the heliocentric ecliptic longitude (λ_{pl}) of Planet X (for the Epoch of 2005 year) may be set up (if "quasi-collision" was near the ascending node of Sedna in the past). So, we found –ν'=0.376, i_i=38º.32, *v*=44º.096 (Epoch: 2004, July, 14 - 11600.88 years); $R_{pl}/M_{pl}=0.677\cdot10^{-17}$m/kg (for the Earth: $R_E/M_E=0.106\cdot10^{-17}$ m/kg), r_{pl}=87.63 AU, λ_{pl}=209º.76 (Epoch: 2005, July, 14). Note, *v* and r_{pl} approximately satisfy the independent equations z=0, $r_{pl}=r_{Sedna}$.

Conclusion: In work [5], analyzing the distribution of objects of Kuiper belt, it is stressed, that inclination of Planet X equals 20º and the semimajor axes is equal to 100 AU. These values , as it is shown above, may be derived in the frame of the model of quasi-collision of an object of Oort's Cloud and Planet X.

References: [1] http://cfa-www.harvard.edu/iau/mpc.html. [2] Matija Čuk (2004) Abstracts of *IAU Colloquium N 197. Dynamics of Populations of Planetary Systems.* P. 44. [3] Perov N.I. (2005) *Solar System Research*, V. 39. N 2 (in print). [4] Perov N. I. (2004) *LPS XXXV, Abstract #1040.* [5] Biryukov E.E. (2004) Abstracts of *VAC-2004 "Horizons of the Universe"*. SAI MSU. V. LXXV. P. 45-46.