The extreme KBO binary 2001 QW$_{322}$. J-M. Petit[1,2], J.J. Kavelaars[3], B.J. Gladman[2], J-L. Margot[4], P.D. Nicholson[4], R.L. Jones[5], J. Parker[6] and M. Ashby[7], [1]Observatoire de Besançon, France (petit@obs-besancon.fr), [2]University of British Columbia, Canada, [3]Herzberg Institute of Astrophysics, Canada, [4]Cornell University, USA, [5]University of Washington, USA, [6]Southwest Research Institute, Boulder, USA, and [7]Harvard-Smithsonian Center for Astrophysics, USA

We report the discovery and preliminary orbital characterization of a Kuiper Belt binary with an extremely large mutual orbital semimajor axis.

The trans-neptunian object 2001 QW322 was discovered in data acquired Aug. 24, 2007 obtained in order to conduct a search for satellites of Uranus [1]. The object was immediately realized to be an exceptional binary as the measured separation of ∼4" at the distance of 43 AU corresponds to a physical separation of 125,000 km, about one third of the distance from Earth to the Moon! The two components had identical magnitudes within the measurement uncertainties of $m_R \simeq 24.0$, implying essentially equal sizes. Making common assumptions (at the time) of albedos of 4% and densities of order 1 gm/cm^3, radii of order 100 km were derived and assuming the separation was equal to the semimajor axis a period estimate of a little under 12 years was made [2].

We began a tracking program in order to determine both the heliocentric orbit of the system as well as the mutual orbit of the binary. By 2003, the heliocentric orbit was established and yielded a relatively 'normal' trans-neptunian object in the so-called 'main' classical belt [3], with semimajor axis a=44 AU, eccentricity e=0.024, inclination i=4.8°, and at a distance of R=44 AU from the Sun at time of discovery.

We continued to acquire high-quality observations on 8-meter class telescopes until late 2007, which resulted in the virtual elimination of the high-eccentricity solutions, and we thus here report that 2001 QW$_{322}$ has a low-eccentricity orbit with a record-breaking separation for a small-body binary, having an orbital period measured in decades. The separation is so large that this nearly equal-mass binary is incredibly fragile to dynamical disruption, and its continued existence in the middle of the main Kuiper Belt puts strong constraints on the formation and history of the belt.

In particular, this orbit confirm the work by Petit and Mousis [4], implying a disruption lifetime of 2001 QW$_{322}$ of 1-2 Gy, hence a 10-50 times larger inital population of such binaries. This also points towards Weidenschilling [5] mechanism for large binary formation. Last but not least, the very existence of 2001 QW$_{322}$ tell us that the strong mass erosion of the early Kuiper belt cannot be the result of collisional erosion, but rather that of dynamical erosion [4].

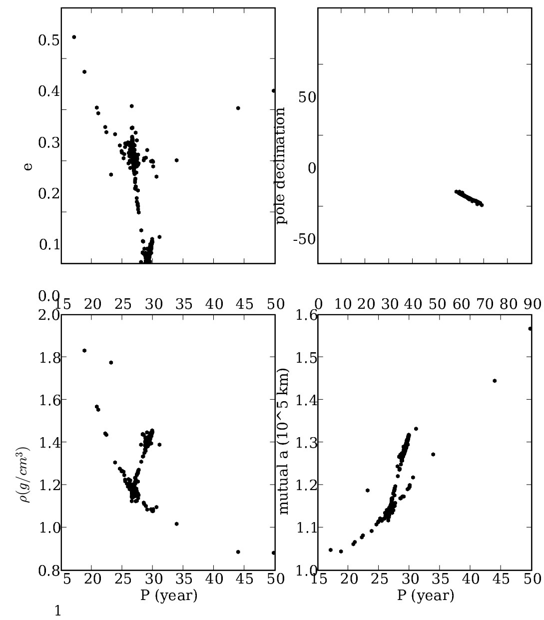

Figure 1: Likely orbital parameters (reduced χ^2 within 10% of the best fit value) for 2001 QW$_{322}$. The period of the orbit seems fairly secure at 25-30 yr. Eccentricity (upper-left) can be either $e \leq 0.05$ or $e \sim 0.2$. High eccentricity orbits are rejected. Hence, the semimajor axis (lower-right) is as initially estimated (110,000 - 135,000 km). The density (lower-left) is derived assuming an albedo of 0.16, and hence a radius of 50 km for each component. The 6 years of observations offer enough parallax to distinguish between the forefront and the back part of the orbit, hence pinpointing the pole orientation (upper-right).

References

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