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# 2007 TY430: An Ultra-Red, High Albedo, Low Density, Wide, Equal Sized Plutino Binary

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## Abstract

Kuiper Belt object 2007 TY430 is the first equal sized binary known in the 3:2 mean motion resonance with Neptune. The two components can have a separation of over 1 arcsecond and are on average less than 0.1 magnitudes different in apparent magnitude with identical ultra-red colors ($g-i=1.49\pm0.01$). Using nearly monthly observations of 2007 TY430 from 2007-2011 with the Gemini telescope, the orbit of the mutual components were found to have a period of $961.2\pm4.6$ days with a semi-major axis of $21000\pm160$ km and eccentricity of $0.1529\pm0.0028$. The inclination with respect to the ecliptic is $15.68\pm0.22$ degrees, where the extensive observations have allowed the mirror orbit to be eliminated as a possibility. A total mass for the binary system was found to be $7.90\pm0.21\times10^{17}$ kg. Equal sized, wide binaries and ultra-red colors are common in the low inclination ``cold'' classical part of the Kuiper Belt and likely formed through some sort of three body interactions within a much denser Kuiper Belt. The physical and binary orbital properties of 2007 TY430 indicate it had a formation history similar to the cold classical population. Numerical simulations suggest 2007 TY430 is moderately unstable in the outer part of the 3:2 resonance and thus 2007 TY430 is likely an escaped ``cold'' classical object that got ``stuck'' into the 3:2 resonance. Similar to the equal sized, wide binaries in the cold classical population, the binary 2007 TY430 requires a high albedo and very low density structure to obtain the total mass found for the pair. For a realistic minimum density of 0.5 g/cm$^3$ the albedo of 2007 TY430 would be greater than 0.17. For reasonable densities, the radii of either component should be less than 60 km, and thus the relatively low eccentricity of the binary is interesting since no tides should be operating on the bodies at their large distances from each other. The low prograde inclination of the binary also makes it unlikely the Kozai mechanism could have altered the orbit, making the 2007 TY430 binary orbit possibly one of the only primordial binary orbits known. Under the model of Schlichting and Sari (2008), the low inclination prograde orbit of 2007 TY430 would suggest relatively high velocities (super-Hill velocities) between Kuiper Belt objects during binary formation through three body interactions. The analysis and details of this work can be found in our paper that has been submitted to the Astronomical Journal, which is expected to be published in late 2011.