**APOLLO ASTEROID 1999 YC: ANOTHER LARGE MEMBER OF THE PGC?**

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**Introduction:** (3200) Phaethon and (155140) 2005 UD are near-sun Apollo asteroids and (km-sized) large members of the Phaethon–Geminid stream complex (PGC) [1], thus genetically related to each other [2, 3, 4]. Both Apollos are classified as thermally metamorphosed C-types, i.e. F- or B-type [3, 4] having bluish reflectance spectra, presumably due to a solar heating effect since the subsolar points on the surface of both objects reach $T_{eq}$ of >700 K. Their surface (meteoritic) analogues would be related to the dehydrated CI/CM chondrites [5]. The F- and B-type asteroids are rare, ~5%, among all the Apollos [3]. The Geminid meteor stream, belonging to the PGC, also underwent a thermal history which caused the observed Na-depletion [6]. In order to explore the PGC's formation, here we surveyed the "JPL asteroid orbit database" to determine whether any further large members of the PGC can be identified.

**Results:** The method for our survey is the same as in [2], numerically integrating back and forward the orbital motion for 20000 yr by applying the KS regularized Adams method. As a result, we found a candidate, Apollo asteroid 1999 YC. The variations for three criteria ($\varpi$ and two integrals of motion $\Theta$ and $K$) [1] of 1999 YC are compared to those of the other PGC members, where $\varpi$ is longitude of perihelion, $\Theta = (1 - e^2) \cos^2 i$ ~const. and $K = e^2 (0.4 - \sin^2 i \sin^2 \omega)$ ~const., and the orbital parameters, $e$, $i$ and $\omega$, are eccentricity, inclination and argument of perihelion, respectively. The orbital behaviour of 1999 YC is dominated by the Lidov-Kozai mechanism during the integrated interval, as is that of the other PGC objects, $\Theta$ being almost constant at around ~0.20. Besides, its critical argument librates in the (weak) 7:1 mean motion resonance with Jupiter from JDT 1.8e+06 to 5.3e+06, during which 1999 YC avoids close encounters with the terrestrial planets. Correspondingly, the semimajor axis ($a$) of ~1.42 AU is also constant over the integrated timescale and comparable to that of the Geminids, although considerably larger than Phaethon and 2005 UD which both have $a$ ~1.27 AU. This means large differences in the orbital energy.

**Discussion**: Based on the three criteria $\varpi$, $\Theta$ and $K$, 1999 YC seems to be another large member of the PGC. However, whereas the difference in $a$ between Phaethon–Geminids is explained in terms of the Geminids, having masses of gram-order, being ejected from Phaethon at perihelion and then accelerated by >0.2 km $s^{-1}$, such an ejection mechanism is not acceptable for 1999 YC because of the large energy required for a km-sized body. Instead, we hypothesize that 1999 YC may have undergone a grazing encounter with a terrestrial planet long ago, allowing the necessary transfer of orbital energy. This would be an *a priori* rare event, but if it occurred then 1999 YC would simultaneously be subject to planetary tides. Physical observations for 1999 YC, such as colourimetry (rare F- or B-type Apollo?) and light-curve measurements (tidally distorted?), may make clear whether it has a PGC origin.

**References:** [1] Babadzhanov P. B. and Obrubov Yu. V. 1992. *Celestial Mechanics and Dynamical Astronomy* 54:111–127. [2] Ohtsuka K. et al. 2006. *Astronomy and Astrophysics* 450:L25–L28. [3] Jewitt D. and Hsieh H. 2006. *Astronomical Journal* 132:1624–1629. [4] Kinoshita D. et al. 2007. *Astronomy and Astrophysics* 466:1153–1158. [5] Nakamura T. 2005. *Journal of Mineralogical and Petrological Sciences* 100: 260–272. [6] Kasuga T. et al. 2005. *Astronomy and Astrophysics* 438: L17–L20.