DELTA-V TO NEAR-EARTH ASTEROIDS: AN EXAMINATION OF THE SHOEMAKER-HELIN EQUATIONS

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Abstract

Near-Earth asteroids present promising opportunities for future human spaceflight missions. Many of these objects have orbits that come within close proximity to the Earth, allowing a significantly lower cost in comparison to missions to Mars or even the Moon. This cost is directly related to the change in velocity (Delta-V) necessary to move a vehicle from low-Earth orbit to the orbit of a near-Earth asteroid.

This paper will discuss the merits of asteroid rendezvous missions in the near future and assess the validity of Delta-V approximations for ~1200 known asteroids candidates. A 1979 paper by Shoemaker and Helin suggested a class-specific set of equations for approximating the Delta-V for these objects. Modern numerical calculations provide accurate measurements for these values and will serve as a test to the strength of the Shoemaker-Helin equations.

Contents

1 Equations and Constants

I will use the following constants and equations in my calculations and analysis.

Equations

1. Escape velocity: $v_e = \sqrt{2GM/r}$
2. Tsiolkovsky's "Rocket Equation: $\Delta v = v_{eff} ln \frac{m_0}{m_f}$ and $e^{\frac{\Delta v}{v_{eff}}} = \frac{m_0}{m_f}$
3. Specific Impulse: $I_{sp} = \frac{v_{eff}}{g_0}$
4. Shoemaker & Helin:
   a. $F = U_L + U_R$
   b. $U_L = \sqrt{U_t^2 + S^2} - U_0$
   c. $U_t^2 = 3 - \frac{2}{Q+1} - 2\sqrt{2Q/Q + 1 \cos(i/2)}$
   d. $U_R = \sqrt{U_c^2 - 2U_r U_c \cos(i/2) + U_r^2}$
   e. $U^2{}_{c,am} = \frac{3}{Q} - \frac{2}{Q+1} - \frac{2}{Q}\sqrt{2/Q + 1 \cos(i/2)}$
   f. $U^2{}_{r,am} = \frac{3}{Q} - \frac{1}{a} - \frac{2}{Q}\sqrt{a/Q (1 - e^2)}$
   g. $U^2{}_{c,ap} = \frac{3}{Q} - \frac{2}{Q+1} - \frac{2}{Q}\sqrt{\frac{2}{Q+1}}$
   h. $U^2{}_{r,ap} = \frac{3}{Q} - \frac{1}{a} - \frac{2}{Q}\sqrt{a/Q (1 - e^2)\cos(i/2)}$
   i. $U_{c,at}^2 = \frac{3}{Q} - 1 - 2(\frac{2}{Q})\sqrt{2 - Q}$
   j. $\Delta V = 30F + 0.5$

5. Semi-minor axis: $q = a(1 - e)$
6. Semi-major axis: $Q = a(1 + e)$
7. Hyperbolic excess velocity: $v_\infty = \sqrt{G/-a}$
8. Radius of ellipse: $r = \frac{a}{1-e(cos\theta)}$

1.2 Constants

1. Gravitational constant (*G)*: 6.67384×10^{-11} m^3 kg^{-1} s^{-2}
2. Mass of Earth (*M*): 5.972×10^{-24} kg
3. Effective exhaust velocity (v_{eff})
    a. Solid rocket: 2.50 km/s
    b. Bipropellant liquid rocket: 4.40 km/s
    c. Ion thruster: 29.0 km/s
4. Standard acceleration due to gravity (g_0): 9.806 m s^{-2}
5. Mean orbital velocity of Earth (v_0): 29.78 km/s
6. Orbital velocity at LEO – 6,680 km (U_0): 7.73 km/s
7. Escape velocity from Earth (*S*): 11.2 km/s

2 Introduction

Asteroids are remnants of the early Solar System as it formed 4.5 billion years ago in the Orion–Cygnus Arm of the Milky Way. A group of planetesimals – precursors to planet/moon sized objects – not captured by the gravitational pull of neighboring protoplanetary disks became the Main Belt. In comparison to the icier comets that formed beyond Saturn, these rocky objects formed from dust and ice grains in the warm region between Mars and Jupiter. The significant size of Jupiter caused gravitational perturbations that altered the fate of Main Belt planetesimals. In combination with high orbital velocities and population density, these perturbations prevented the formation of a protoplanet (or protoplanets) in the region and triggered destructive collisions that split apart planetesimals into smaller objects known today as asteroids. Continued resonances between Jupiter and Main Belt asteroids scattered many of the objects into orbits that allow close passes with Earth every few decades. Those that fall within 1.3 AU of the Sun are known as Near-Earth Asteroids (NEAs). While NEAs are considered to be dynamically young – their orbits have been altered significantly on hundred million year timescales – they accurately represent the populations of asteroids found in the Main Belt (Cheng, 1997).

As the leftover building blocks that created our Solar System, asteroids can provide evidence for the ingredients of planet formation and allow us to test models of planetary-system evolution. However, asteroids are not all alike in their composition and are divided into three main groups. Carbonaceous asteroids (C-type) have a low albedo (~0.03) and are similar in composition to the Sun – carbon rich with concentrations of Nitrogen and Oxygen – but depleted in Hydrogen and Helium. C-type

asteroids form 75% of the known asteroid population and are typically found in the outer regions of the Main Belt. Silicaeous asteroids (S-type) are brighter than C-types with an albedo of ~0.15 and are predominately metallic iron mixed with silicates. The remaining 8% are mostly M-type, metallic, asteroids that have a composition dominated by metallic iron and heavier metals including Nickel, Gold, and Aluminum. In addition, the 3μm absorption line found in infrared spectra of S-type NEAs 443 Eros and 1036 Ganymed provide evidence for water ice and Hydrogen Peroxide present on the surface of asteroids (Emery, et al., 2015).

Meteorites found on Earth can also give insight into the composition of NEAs. Rocky objects that are smaller than an asteroid – less than a meter across – are referred to as meteoroids and are often scattered parts of other space rocks. Once they enter the Earth's atmosphere most meteoroids burn up, but any part that reaches the surface is called a meteorite. Chemical analysis of meteorites thought to have once been part of asteroids have shown deposits of precious metals including Gold, Platinum, Palladium, and Rhenium – used in the construction of jet engines – and the semiconductor Germanium (Ross, 2001).

Beyond improving our understanding of a young Solar System's formative years, the presence of rare materials in asteroids offers another valuable opportunity. An unmanned mining vehicle deployed on an NEA could excavate metals used in the fabrication of spacecraft and surface-mission vehicles as well as Hydrogen and Oxygen, the critical elements of rocket fuel. Using resources acquired from NEAs at space stations orbiting Earth may be cheaper than either returning the spacecraft to a surface facility or shipping materials mined on Earth, both of which require more frequent trips

out of Earth's gravitational well. SpaceX lists the launch cost of the Falcon 9 v1.1 rocket as $61.2 million (or about $2111 per pound for the 28,991 lb payload necessary to get to LEO), and NASA's shuttle program saw launch costs exceeding $300 million (SpaceX Capabilities and Services, 2014). Asteroid mining may help eliminate some of these expenditures and make future human spaceflight a more efficient enterprise.

Determining a suitable candidate for an asteroid mining mission would require knowledge of both the object's composition and orbit. NASA's NEOWISE survey estimates a population of 19,500 NEAs smaller than 1 kilometer but larger than 100 meters, and 981 larger than 1 kilometer (Mainzer et al. 2014). One of the first filters a mining entrepreneur may apply to this lengthy list is finding the objects that require the least amount of travel time and fuel cost. As I will show in the following sections, these parameters are fundamentally connected to the acceleration – change in speed and direction - necessary to move a spacecraft from LEO to the orbit of an NEA. The goal of this project is to test the Shoemaker-Helin model for calculating the change in velocity (Delta-V) of NEAs and to discuss additional considerations that may improve the statistical accuracy of Delta-V estimates.

2.1 History

The tale of asteroid study begins at the turn of the 19th century (quite literally January 1st 1801) when Giuseppe Piazzi became the first scientist to observe an asteroid. Initially thought to be another planet orbiting near 2.8 AU, as other such objects were found it eventually became clear that they were something new - minor planets. In 1944, O. J. Schmidt proposed that these objects were remnants of a failed

planet formation due to influence from Jupiter's gravitational pull, a theory that is widely accepted today. Tom Gehrels initiated the first formal discussion of a potential asteroid mission in 1971, and detailed proposals from Stuhlinger et al. (1972) and by Whipple et al. (1973) soon followed. A few unusual ideas regarding the exploitation of asteroids also became topics of lively debate, including a forced impact to create another Panama Canal (Herrick 1979).

Astronomers quickly realized that any visit to an asteroid would require extensive observations of NEAs and a method of quantifying the difficulty of reaching each object. Dr. Eugene Shoemaker, appointed chief scientist at the USGS Center for Astrogeology in 1965, and Eleanor Helin, the principal investigator of the Near Earth Asteroid Tracking (NEAT) program run by NASA's Jet Propulsion Laboratory (JPL), spearheaded the first systematic search for NEAs at the 0.46-meter Schmidt Telescope on Palomar Mountain. One of Dr. Shoemaker and Helin's papers, written in 1979, outlined a method (see Section 3.3) for determining the Delta-V of the asteroids they observed in order to gain a better understanding of flight trajectories between Earth and NEAs (Shoemaker & Helin, 1979). The development of this method was one of the important first steps toward an unmanned rendezvous mission with an NEA.

In the past three and a half decades, many more papers have advanced our understanding of asteroid orbits in and out of the Main Belt. Estimations of Main Belt orbital and size distributions by Bottke et al. (2002) and Morbidelli et al. (2002) paved the way for theories explaining how asteroids are pushed into planet-crossing orbits. Throughout their turbulent history, asteroids were and continue to be destabilized by

Yarkovsky thermal forces that pushed them into orbital resonances with Jupiter (Bottke et al. 2004).

The Yarkovsky effect arises from a delay in the re-radiation of Solar heating. This thermal radiation from the asteroid causes photons escape in various directions as the object rotates and imparts angular momentum to the object as it cools (Vokrouhlicky, et al., 2015).

Mean motion resonance features with Jupiter occurring at 3:1, 5:2, 7:3 and 2:1 integer ratios as well as long-term perturbations (10^4 – 10^6 year timescales) leave observable gaps in the Main Belt population as those asteroids are deflected closer to the Sun.

Some astronomers are concerned that missed identification of the vast majority of small objects may result in an unpredicted collision with Earth (Brown et al. 2002). These type of events are not unprecedented; in 1908, a ~50m asteroid exploded above Tunguska, Siberia, with the force of 10 megatons of TNT – equivalent to 1000 times the power of the atomic bomb used on Hiroshima (Farinella, et al., 2001). More recently, a 'small' 15m, 13,000-ton asteroid broke through Earth's atmosphere just above Chelyabinsk, Russia, at a speed of about 65,000 km/h and injured 1,500 people as it exploded in midair (Popova, et al., 2013).

Fear of collisions with Earth led US Congress to pass the George E. Brown, Jr. Near-Earth Object Survey Act[1] in 2005, which directed NASA to step up research on asteroids. The asteroid population's wavy size-frequency distribution (see figure 39), which shows bumps in the population trend at 5 & 100 km asteroids, is thought to be a

[1] https://www.govtrack.us/congress/bills/109/hr1022

'fossil' of a tumultuous period of frequent high-impact collisions – probably during the formation of Jupiter (Bottke, et al., 2005). Also, the mixing of asteroid types relative to their semi-major axis indicates a more dramatic early history of the inner Solar System than envisioned earlier, in which shifting planetary orbits scattered asteroids in some regions of the Main Belt (DeMeo & Carry, 2014)

Other space agencies have also turned their attention towards missions to asteroids and other minor bodies in the Solar System. In 2003, the Japanese Aerospace Exploration Agency (JAXA) sent its Hayabusa explorer to the asteroid named "Itokawa", successfully retrieved a sample from the surface, and then returned to Earth to perform analysis of the sample. The spacecraft is especially interesting due to its use of an ion engine, which achieves greater efficiency than typical rocket engines by ionizing Xenon and electrically accelerating the resulting electrons. Hayabusa's successor, Hayabusa II launched in 2014 and is set to intercept the asteroid 1999 JU3.

The European Space Agency (ESA) launched the Rosetta mission in 2004 hoping to solidify our understanding of comets much in the same way the Rosetta stone improved our understanding of ancient Egyptian hieroglyphs. Since arriving at its target comet, 67P/Churyumov–Gerasimenko, in August 2014, Rosetta has made good use of its 11 scientific instruments and discovered traces of molecular Nitrogen trapped in ice in March, 2015 (Rubin, et al., 2015).

NASA also has long-term goals for NEO study in the form of an asteroid redirect mission (ARM). Their goal is to capture a 'cohesive asteroidal mass' using an

unmanned robotic vehicle[2] and guide it to a lunar orbit with a high power, long life solar electric propulsion (SEP) unit where it will be accessible for NASA's next-gen crewed mission technology, in particular the Space Launch System (SLS) heavy-lift crew launch vehicle and Orion multipurpose crew vehicle (Gates, et al., 2014).

2.2 NEA Classes

In order to classify Near Earth Asteroids, astronomers define three distinct classes based on their orbital characteristics (see figure 2). For this report, we analyze approximately 1200 known near Earth asteroids:

Apollo (54%): these asteroids cross into Earth's orbit, but spend most of their time outside of it. They have a perihelion distance $q < 1.017$ AU (point in their orbit closest to the Sun).

Amor (24%): these asteroids have orbits that exist entirely outside of the Earth's orbit. They have a perihelion distance $1.017 \text{ AU} > q > 1.3$ AU.

Aten (22%): these asteroids may cross Earth's orbit and spend most of their time inside of it. They have an aphelion distance $Q > 0.983$ AU (point in their orbit furthest from the SUN).

[2] ARM Robotic Mission (ARRM)

2.3 Asteroid Naming

Apart from the classes of NEAs and Main Belt groups, the official naming of asteroids does not depend on location or size. Instead, astronomers use a system of nomenclature based on the amount of observations and quality of orbital data.

When an asteroid is first discovered, it is checked against a database of asteroids that have also been observed at opposition once, and only have a provisional designation, as well as against all named asteroids. At opposition, the Sun, Earth, and asteroid are aligned in a straight line, a particularly favorable position for observations. If the discovered asteroid does not match with any previous discovery, a preliminary orbit is computed and further observations of the object continue. The asteroid may be observed for as long as its orbit remains near opposition, but if no identification is made the object is given a unique provisional designation, 1997 TW11 for example, and observations for the next opposition cycle are planned (www.minorplanetcenter.net).

Once an asteroid has four or more opposition observations it is typically given a sequential number as a permanent designation. Objects of special interest, such as NEAs, may be given a permanent designation after only two or three oppositions.

Gradually, numbered NEAs are given names that are appended to the number, for example 1 Ceres or 9283 Martinelus. NEAs are no longer named after living celebrities or historical figures in order to avoid headlines such as "OprahWinfrey will impact the Earth next year".

The lengthy 3 part naming process presents some book keeping difficulties when analyzing large portions of the known asteroid population. Orbit trajectory calculations are completed before the asteroid is officially named and therefore use the

provisional designation. While some of these objects eventually go on to receive a permanent number, studies using all known, but not necessarily named, NEAs must also cope with asteroids without a permanent number.

2.4 Commercial Interest and the Space Economy

While asteroids become a major focus for international space programs, these tiny remnants of a violent early Solar System are also capturing the interest of entrepreneurs and young astronomers. For over a century, science fiction writers have dreamed of a multi-planet industrial society. They would claim[3] that the human race is destined to explore beyond our protective planet, to a place where new politics, philosophies, and social norms can evolve with room to grow. The mid-20th century saw a flurry of human space exploration missions motivated by competitive nationalism, but once the Moon was 'conquered' by NASA's Apollo missions (1969-1972) public and political interest in manned-missions dwindled. In the ensuing decades, hundreds of satellites used commercially for navigation and communication, along with military and reconnaissance technology, were launched into low Earth orbit (LEO). Increasingly sophisticated detection hardware in LEO provided productive knowledge of Earth's global phenomena – including natural disasters and meteorological patterns – as well as highly accurate observations of the Universe without atmospheric perturbations. Beyond Earth's orbit, NASA's Curiosity rover and India's Mars Orbiter Mission have explored the surface of Mars along with a number of other Mars rovers and orbiters. The prolific Voyager missions continue to redefine the boundary of our Solar System.

[3] If interested, see novels by Ursula LeGuin, Isaac Asimov, and Orson Scott Card.

International cooperation in the 1980s ushered in a new era of human spaceflight with the Space Shuttle program. After the Challenger disaster in 1986, which resulted in the death of all seven crew members just 73 seconds after takeoff, the US deregulated the government's control on space travel with the Commercial Space Launch Act and the Launch Services Purchase Act. This legislation allowed the launching of independent commercial satellites as well as mandating a business deal between NASA's Space Shuttle program and commercial launch service providers. Nevertheless, government vehicles were reliably used for the building and maintenance over many space station missions, culminating in 1998 with the completion of the International Space Station (ISS). NASA's Shuttle program was finally ended in 2011 in order to focus on deep-space human missions to the Moon, asteroids and eventually Mars.

Human access to the ISS is now only possible with the Russian space agency until a US commercial replacement for the Shuttle is built. Trusted US defense contractor Boeing and newcomer SpaceX (founded by Elon Musk) were recently awarded contracts to build spacecraft for taxiing astronauts to the ISS. With Dragon and Falcon 9, SpaceX has launched five cargo resupply missions to the station between 2012 and 2014. Boeing's Crew Space Transportation (CST) capsule is currently undergoing testing and hopes to achieve human trial missions by 2017 (Howell, 2015).

A spaceflight option that may be more appealing to customer markets would take passengers on a shorter suborbital flight, but still provide a glimpse of the universe outside of Earth's atmosphere. Richard Branson's Virgin Galactic, along with engineering partners Scaled Composites, have seen promising test flights with SpaceShipTwo and its launch vehicle White Knight Two. Despite a lethal accident in

October of 2014 (Chang & Schwartz, 2014), the company hopes to resume testing in mid-2015, and social support for suborbital flights remains strong. Many customers are still willing to pay up to $300,000 for a chance to explore space.

Even startup companies have achieved success in space-based industries, without the safety net of a larger corporation. PlanetLabs has launched 71 of their 'Dove' satellites to image the Earth dialy with the newest versions of hardware and software[4]. Instead of building large, complex satellites that take years to get into space, Planet Labs focuses on far smaller more cost-efficient "cubesats". This will provide daily imaging of the Earth's entire land surface and allows PlanetLabs to quickly replace satellites with broken hardware. See figure 2 for a depiction of in-use satellites that need replacements.

A relative veteran in the new space business, Orbital Sciences[5] was founded by three Harvard Business School Alumni in 1982 and has found success with small- and medium-class space systems including Geosynchronous-Earth Orbit (GEO) satellites for communications and broadcasting as well as LEO spacecraft for remote sensing and scientific research. They are also planning planetary probes to explore deep space.

More provocative companies aim to provide asteroid mining operations for a hypothetical space-based market. Planetary Resources[6] and Deep Space Industries[7] are laying the groundwork for commercial space services such as asteroid processing, refueling stations, and solar power units in order to take advantage of potential space-based markets. Critics have condemned the inefficiencies of transporting resources

[4] https://www.planet.com
[5] http://www.orbitalatk.com
[6] http://www.planetaryresources.com
[7] http://deepspaceindustries.com

acquired in space back to Earth[8], however, it is apparent that these materials and services will be needed in orbit should deep space missions become common. Some asteroids harbor high concentrations of precious metals, worth billions of dollars to a consumer-based industry. Others contain abundant semiconductor materials, water, and fuel components. These are all valuable resources in orbit and may become marketable when the costs of spaceflight become more manageable. They will be even more valuable should Earth's supply be in jeopardy due to depletion, pollution, or geopolitics. In addition, some asteroids have orbits so similar to the Earth's that intercepting them is more energetically and cost efficient than a trip to Mars (see figure 3).

2.5 Spaceflight Mission Considerations

The largest and most immediate obstacle to overcome with current spaceflight missions is escaping Earth's gravitational well. Using the equation for escape velocity (eg. Khatri, Poudel, & Gautam, 2010):

$$v_e = \sqrt{2GM/r} \tag{1}$$

where G is the gravitational constant and M is the mass of the Earth, we get v_e ~11 km/s, a speed which becomes increasingly difficult to obtain as the mass of each spacecraft grows. The engines of modern spacecraft are built on the principles of motion described by Tsiolkovsky's "Rocket Equation" (Forward, 1995)[9]. In its most

[8] Why mine in space what we can mine on Earth? An average asteroid can hold an equivalent of $150 billion in precious metals that are prohibitively rare on Earth. Moreover, new research suggests that most of the heavy metals we find on Earth's surface today came from NEOs and our 'natural' deposits are deep within the Earth's core (Day, Walker, Qin, & Rumble, 2012).

[9] See equation 15 for non-relativistic rocket equation

simple form, a rocket expels some of its mass behind it in order to accelerate the object in the opposite direction following Newton's 3rd Law of Motion. Due to the vacuum of space there is no air resistance and therefore no negative acceleration due to the environment, so these rocket bursts need only be applied when a change in orbit is necessary. The required maneuvers can be calculated individually with the total change in speed (Δv) relative to the effective exhaust velocity (v_{eff}), the initial mass of the vehicle with fuel (m_0), and the final mass of the vehicle without fuel (m_f):

$$\Delta v = v_{eff} ln \frac{m_0}{m_f} \tag{2}$$

The effective exhaust velocity is a representation of the Specific Impulse (I_{sp}), the measurement (in seconds) of the efficiency of rocket engines specific to different rocket fuel. A useful way to think of I_{sp} is how long the spacecraft would be able to hover over the Earth's surface before running out of fuel:

$$I_{sp} = \frac{v_{eff}}{g_0} \ (sec) \tag{3}$$

where g_0 is the acceleration due to gravity at the Earth's surface.

In comparison to launching from the surface, initiating departure from LEO requires a slightly reduced escape velocity ~10.9 km/s, due to increased distance from Earth's gravitational center. In addition, the spacecraft would be moving at a brisk 7.73 km/s in LEO, further reducing the Delta-V necessary to embark on an interplanetary mission. The reason we care about Delta-V is that it serves as a reliable gauge of the total mass of fuel that will be necessary to get to the target object. Furthermore, if we

re-arrange equation 2 using log rules, it is evident that the amount of fuel needed to accelerate a payload rises exponentially in relation to the change in velocity that occurs during orbital maneuvers.

$$e^{\Delta v / v_{eff}} = \frac{m_0}{m_f} \tag{4}$$

Hence, any slight difference in Delta-V can have a drastic effect on the total fuel mass and therefore the total mission cost. For example, a one-way mission from LEO to lunar orbit has a Delta-V of 4.8 km/s[10], while a trip to low Mars orbit requires an estimated 6.1 km/s[11]. Using the v_{eff} of NASA's space shuttle, 4.4 km/s[12], the resulting mass ratio rises from ~3 to 4, meaning that a spacecraft would either need to have an engine that is 33% more efficient or hold 33% more fuel. Either of these options would significantly affect the design and manufacturing of a mission vehicle, presenting countless engineering hurdles to overcome.

A technique known as a "gravity assist" takes advantage of the orbital motion and gravity of a nearby planet (or other sufficiently large object) to accelerate the spacecraft without the need for rockets. The huge difference in mass between the planet and the spacecraft allows for the change of energy and momentum of the planet to be neglected. If a planet traveling with velocity V and a spacecraft travelling in the same direction as the planet's orbital motion enters its gravitational field, it can leave with an

[10] From Hirata's 'Rockets and Space Transportation': 4.1 km/s from LEO to Geosynchronous Earth Orbit (GEO) and 0.7 km/s from GEO to lunar orbit.
[11] From Hirata's 'Rockets and Space Transportation': 2.5 km/s from LEO to Geosynchronous Transfer Orbit (GTO), 0.7 km/s from GTO to Earth C3=0 (fully escaped from Earth's gravity), 0.6 km/s to Mars Transfer Orbit, 0.9 km/s to Mars C3=0 (to get inside Mars' gravitational pull), and another 1.4 km/s for Deimos and Phobos transfers into low Mars orbit.
[12] See http://www.astronautix.com/engines/ssme.htm

additional *2V* in a direction that suits the mission objective without having to burn significant fuel reserves (Vasile & De Pascale, 2006). This method can be challenging due to the complex mathematical predictions required for the speed and location of each object, as well as the foresight to understand when each gravity 'slingshot' will be needed. Nevertheless, this method is regularly used for deep space missions. For example, ESA's Rosetta Mission successfully used three Earth gravity assists and one Mars gravity assist to propel the Rosetta probe from LEO to an orbit with the Comet 67P/Churyumov-Gerasimenko.[13]

2.6 Delta-V of Asteroids

NEAs that we consider accessible to spaceflight missions can have one-way Delta-V values ranging from 3-9 km/s, producing widely varying mass ratios depending on the object. Space agencies and engineering corporations attempting to launch deep space missions of their own must consider the difficulties of high Delta-V transfer orbits when selecting an appropriate target.

Once accurate data on the target NEA's orbit is acquired (a process that will be discussed in section 3), several orbital transfer tools are available to define a rendezvous trajectory.

The "Hohmann transfer orbit" is a minimum energy solution that uses one engine impulse to leave the original orbit and another impulse to leave the transfer trajectory (Vallado, 2001). The Hohmann formulae only account for moving between circular orbits, which is primarily useful for moving to higher altitude Earth orbits.

[13] http://rosetta.jpl.nasa.gov/overview

However, the same principle holds for elliptical orbits such as those of NEAS, albeit with more computer-intensive calculations.

3 Delta-V Approximation

Performing an accurate calculation for Delta-V requires extensive knowledge of an object's orbit. First, we must observe the NEA as it passes close enough to the Earth to be detected[14], which may occur only once every two decades. Second, with the data from observations – spectra, motion, etc. – we must derive the object's complete orbit and orbital ephemeris in order to estimate the Delta-V required for rendezvous.

3.1 Orbit Measurements

Fortunately, recent sky surveys have been particularly effective in identifying NEAs. The Catalina Sky Survey[15] (CSS) based at the University of Arizona uses three 0.5-1.5m telescopes and discovered more than 625 NEOs in 2012 alone. Additionally, the team spends 20% of their observing time making follow-up observations to refine each object's orbit, significantly improving the accuracy of future Delta-V calculations. The Pan-STARRS[16] (Panoramic Survey Telescope and Rapid Response System) uses a 1.8-m telescope on Haleakala in Maui that has a massive 3-degree field of view. Their impressive CCD equipment - containing an almost complete 64 x 64 array of CCD devices for a total of ~1.4 gigapixels – has seen tremendous success and as of March

[14] This requires an apparent magnitude of V < 21 (Mainzer et al. 2014)
[15] http://www.lpl.arizona.edu/css/css_facilities.html
[16] http://pan-starrs.ifa.hawaii.edu/public/design-features/telescopes.html

2014 is 100% devoted to NEO observations. Other programs that have contributed the database of known NEOs include NEAT, Spacewatch, LINEAR, and NEOWISE.[17]

3.2 Trajectory Calculations

The first observation of an asteroid is a celebratory moment, but immediate follow up observations are equally important. In order to predict when and where the asteroid will return to a place in the sky acceptable for observation, a detailed orbit trajectory can be calculated by deriving the orbital element probability density. Modern techniques fit a preliminary orbit using the available observations (at least three) and improve it by accounting for planetary perturbations along with a differential correction process – the most common being a least-squares fit.[18]

The prevalence of online databases and software has positively impacted our ability to document and analyze asteroid discoveries. We will be using NEA ephemerides from the Jet Propulsion Laboratory's (JPL) *Horizons*[19] computational system, but there are several other prominent options including the Near Earth Objects-Dynamic Site 2 (NEODyS - 2)[20] located at the University of Pisa and the Minor Planet Center (MPC)[21] located at the Harvard-Smithsonian Center for Astrophysics.

Current models of orbit determination apply statistical inversion theory, first explored by Muinonen and Bowell (1993). The "inverse problem" describes the probability density of orbital elements as a linear relationship between observation,

[17] http://neo.jpl.nasa.gov/programs/
[18] http://www.columbia.edu/~my2317/asteroidproject.html
[19] http://ssd.jpl.nasa.gov/horizons.html
[20] http://newton.dm.unipi.it/neodys2/
[21] http://www.minorplanetcenter.net

theory and error. The precise location of an object may differ from the observed coordinates due to systematic error and random error; the former we can assume to have been examined and adjusted for by each asteroid survey program and therefore is negligible compared to the latter (Bowell, Virtanen, Muinonen, & Boattini, 2002).

Understanding where the error originates is crucial for predicting an accurate probability distribution. Based on historical evidence of the difference between an observed and a calculated position (the "O-C residuals"), the probability density distribution relating position and error is assumed to be Gaussian (Bottke, Cellino, Paolicchi, & Binzel, 2002). However, recent observations have shown that the error from observational noise is small compared to reference-star positional errors (Bowell, Virtanen, Muinonen, & Boattini, 2002). The latter are known to have regional biases, therefore presenting a distinctly non-Gaussian probability density. Although Muinonen and Bowell found noticeable differences between the Gaussian and non-Gaussian models, no clear advantage has been established.

Another attempt to improve orbit determination used an empirical approach. Carpino et al. (2002) computed O-C Residuals for all known asteroids with data from a number of observatories and modeled each specific bias. The result of their paper showed biases of up to 1 arcsecond and they were able to estimate correlation coefficients that related errors in different datasets.

Once the probability density of an asteroid orbit is understood, further observations can be made to improve its ephemerides and so predictions of any near-Earth flybys in the future. Furthermore, we can use the same technique to look at the object's previous coordinates. With this information, computers can search photographic

archives for images taken in the past that include the object in the field of view, thus providing another check to the accuracy of the orbit model (Bowell, Virtanen, Muinonen, & Boattini, 2002).

3.3 Shoemaker-Helin Equations

After founding the first sky-survey looking for asteroids back in 1978, Shoemaker & Helin published several papers describing potential interests in asteroid missions. In order to determine the accessibility of NEA's for exploration, they derived several equations to approximate the necessary Delta-V to rendezvous with such an object from LEO. Their methods for calculating Delta-V were not intended to be precise enough to be the sole trajectory prediction, but instead be an estimate for the minimum possible Delta-V – an upper bound on the feasibility of a mission.

Following from Hohmann transfers, Shoemaker and Helin sought to find the total impulse necessary to move into a transfer trajectory and then into the rendezvous orbit. This they calculated in two steps (two impulses) that differ depending on the type of NEA orbit (Amor, Apollo, or Aten; see section 2.2). They also assumed that half the plane change (for NEA orbits with inclination angles different than Earth's) would occur at the first impulse (U_L) and the other half at the second (U_R).

Delta-V can be conveniently calculated using the following equation for the dimensionless figure of merit:

$$F = U_L + U_R \tag{5}$$

Where U_L represents the impulse to move from LEO into the transfer trajectory and U_R is the impulse to move from transfer trajectory into the rendezvous orbit.

To simplify calculations, U_L and U_R have been normalized to the Earth's orbital speed and are therefore dimensionless. Shoemaker & Helin argue the lowest F value will be obtained by planning a trajectory that departs at the Earth's perihelion[22] and rendezvous at the NEA's aphelion[23]. By Kepler's second law, the object will have the lowest orbital velocity at aphelion and the highest at perihelion. However, for Aten-class asteroids Shoemaker & Helin claim that the minimum Delta-V will be at the NEA's perihelion because Aten orbits are so similar to Earth's. The likelihood that an Aten orbit permits a spacecraft to leave LEO at Earth's perihelion and rendezvous with an NEA at its aphelion (for the case of Apollos and Amors) is very low. Nevertheless, it is useful to neglect any other transfer trajectory start point as well as the time it takes for the object to return to the same position relative to the Sun and an observer on Earth (or the synodic period) in order to calculate a lower bound for Delta-V.

The first impulse is described by the following equation relating *S,* the normalized escape velocity in LEO, and U_0 the velocity of the spacecraft while in LEO.

$$U_L = \sqrt{U_t^2 + S^2} - U_0 \tag{6}$$

The other term U_t^2 is the encounter speed of an object in eccentric orbit (the NEA in our case) with an object in circular orbit (the spacecraft) and can be calculated using the NEAs aphelion Q and inclination angle i:

[22] Closest point to the Sun
[23] Furthest point from the Sun

$$U_t^2 = 3 - \frac{2}{Q+1} - 2\sqrt{{}^{2Q}/_{(Q+1)}}\cos\left({}^{i}/_{2}\right) \tag{7}$$

Where Q has been normalized to the semi-major axis of the Earth (1 AU). Here, the small eccentricity (e = 0.017) of the Earth's orbit is ignored.

Shoemaker and Helin determined an empirical correction of F using 8 other previously discovered NEOs. We will perform a more comprehensive test with the current NEA database to update the original figure of merit value and determine whether or not it is a useful correction.

The transfer trajectory to rendezvous impulse involves U_c and U_r, the encounter speeds. These values are dependent on asteroid orbit class (section 2.2):

$$U_R = \sqrt{U_c^2 - 2U_rU_c\cos\left({}^{i}/_{2}\right) + U_r^2} \tag{8}$$

For Amor asteroids (orbit entirely outside of Earth):

$${U_{c,am}}^2 = \frac{3}{Q} - \frac{2}{Q+1} - \frac{2}{Q}\sqrt{{}^{2}/_{(Q+1)}\cos\left({}^{i}/_{2}\right)} \tag{9}$$

$${U_{r,am}}^2 = \frac{3}{Q} - \frac{1}{a} - \frac{2}{Q}\sqrt{{}^{a}/_{Q}\left(1-e^2\right)} \tag{10}$$

For Apollo asteroids we have:

$${U_{c,ap}}^2 = \frac{3}{Q} - \frac{2}{Q+1} - \frac{2}{Q}\sqrt{\frac{2}{Q+1}} \tag{11}$$

$$U_{r,ap}{}^2 = \frac{3}{Q} - \frac{1}{a} - \frac{2}{Q}\sqrt{{}^{a}/_{Q}\,(1-e^2)\cos\,({}^{i}/_{2})} \tag{12}$$

For an Aten asteroid we might expect the minimum Delta-V to occur with a rendezvous at perihelion, but Shoemaker and Helin chose to bias for trajectories with minimum duration by rendezvousing at aphelion. Their strategy was to fix the semi-major axis of the *transfer* trajectory to 1 AU and require the transfer to arrive on a tangent to the asteroid orbit's aphelion. This adjustment allows for a substantially reduced impulse at rendezvous and just a slightly larger impulse when entering the transfer trajectory.

Hence for Aten asteroids:

$$U_{t,at}^2 = 2 - 2\sqrt{(2Q - Q^2)\cos\,({}^{i}/_{2})} \tag{13}$$

$$U_{c,at}^2 = \frac{3}{Q} - 1 - 2(\frac{2}{Q})\sqrt{2-Q} \tag{14}$$

To convert the figure of merit *F* to a Delta-V in km/s, Shoemaker & Helin used Delta-V calculated by Arnold & Duke (1977) and Bender (1977) for eight low Delta-V objects: 1976 AA, 1976 UA, 1977 HB, 1977 VA, Ivar, Eros, Anteros, and Mars (Shoemaker & Helin, 1979). The comparison yielded a correction of 0.5 km/s:

$$\Delta V = 30F + 0.5\ km/s \tag{15}$$

where the factor of 30 km/s is from the normalization factor – the orbital speed of the Earth.

In our calculations we updated the formula with a more exact measurement of 29.7847 km/s. Shoemaker & Helin claimed in their paper that these equations yield a minimum Delta-V value within a few tenths of km/s precision of the established Delta-V of well-studied objects.

3.4 NHATS

Since Shoemaker & Helin's paper in 1979, astronomers have made great strides forward in the orbital analysis of NEOs due largely to the availability of immensely greater computing capabilities.

NASA's Near Earth Object Program has undertaken the "Near-Earth Object Human Space Flight Accessible Targets Study" (NHATS) to identify known NEOs that are feasible targets for future spaceflight missions. Brent Barbee at NASA's Goddard Space Flight Center (GSFC) has developed a program that monitors new discoveries of NEOs and retrieves each object's orbital ephemerides from the JPL Small Bodies Database after each new discovery.

The computation of a precise orbit trajectory should involve numerical integration of the spacecraft's equations of motion and should consider every possible gravitational perturbation an object may encounter. However, doing so would be computationally inefficient. Instead, NHATS implements the "patched conics" technique for an analytical approximation of the trajectories[24]. This method simplifies the calculation by neglecting the effect of gravity from the Sun until the spacecraft is

[24] Invented by Gauss to determine the orbit of 1 Ceres in 1801. See the following link for more details http://neo.jpl.nasa.gov/nhats/

separated from the Earth by at least 1 million kilometers. At this distance, the spacecraft's velocity relative to Earth is almost exactly the hyperbolic excess velocity[25]. Shifting reference frames to that of the Sun, we can determine the new relative velocity and the heliocentric orbit it will now follow. NHATS only accounts for trajectories that follow Hohmann transfers and does not attempt to evaluate more complex orbital maneuvers, such as midcourse impulses, gravity assists, and continuous thrust. NHATS implements this approximation with full precision ephemerides of both the Earth and the target NEA from JPL's Horizons System[26].

NHATS calculates Earth-to-NEA round trip mission trajectories every 3 days over a 20-year window. This approach is feasible only because the scientists at NHATS have access to GSFC's climate modeling supercomputer for their calculations of Delta-V, quickening otherwise lengthy runtimes for orbital trajectory predictions.

The NHATS database of results allows several constants to be placed on missions: total round-trip Delta-V, total mission duration, object magnitude, and Earth departure date in order to offer a broad range of potential mission targets. The database currently has over 1300 NEAs with ideal conditions (low Delta-V, high absolute magnitude) on record, just ~10% of the 13,000+ known NEOs. This number grows every day. Therefore, it is likely there are highly feasible targets currently undiscovered that may pass into telescopic range with time to prepare a rendezvous mission.

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[25] The orbital velocity achieved as time goes to infinity, $v_\infty = \sqrt{G/-a}$

[26] http://ssd.jpl.nasa.gov/?ephemerides

NHATS calculations are trusted by the scientific community and are diligently maintained throughout the year. They offer a valid comparison in order to determine the precision of the Shoemaker & Helin equations.

4 Methods

In the following sections, I will outline the process by which we organized and carried out the comparison of Delta-V approximations from the Shoemaker-Helin formulae and the NHATS Delta-V calculations.

4.1 Data Acquisition

Our first task was to acquire and organize the asteroid data from the NHATS table of objects[27] and JPL's small body database.

We wrote a web-scraping program in python that recorded the url of each object in the NHATS table, traversed each url, and stored the object-specific mission trajectory information in a csv file. Along with the total round-trip Delta-V, the trajectory data table included the object's: total mission duration, launch date, and the Delta-V of each trajectory step, and the dates of Earth Departure, NEA Arrival, NEA Departure, and Earth Return.

We are interested in the outbound Delta-V, which is the sum of the 'Earth Departure Delta-V' and the 'Delta-V to Arrive at NEA', because the Shoemaker-Helin equations are built to approximate this value.

[27] http://neo.jpl.nasa.gov/cgi-bin/nhats

We downloaded the 6 orbital parameters for our sample of NEAs from JPL's small body database[28]: semi-major axis (a), eccentricity (e), inclination angle (i), argument of perihelion (W), longitude of ascending node (N), mean anomaly at epoch (M), and absolute magnitude (H) of the NEA. With the semi-major axis (a) and eccentricity (e), the perihelion (q) and aphelion (Q) distances can be calculated using the following equations:

$$q = a(1 - e) \tag{16}$$

$$Q = a(1 + e) \tag{17}$$

NHATS provides the preliminary designation of each object. However, JPL's small body database includes objects both with and without a permanent. We wrote a program in Microsoft's Visual Basic[29] that crosschecked the NHATS' preliminary designations with JPL's small body database and created a new Excel spreadsheet containing both the JPL orbital elements and the NHATS trajectory calculations. We then wrote a MatLab script to calculate the Shoemaker-Helin outbound Delta-V for each object and exported those values to the excel spreadsheet that housed the ephemerides and NHATS Delta-V of each object.

We then subtracted simply the Shoemaker-Helin (SH) values from their NHATS counterparts – the sum of Earth Departure Delta-V and NEA Arrival Delta-V – so that we could compare the differences using a variety of analytical tools in MatLab.

[28] http://ssd.jpl.nasa.gov/dat/ELEMENTS.NUMBR
[29] Microsoft's in-house C-based language built for type-safe, object-orientated applications running on the .NET framework (https://msdn.microsoft.com/en-us/library/hh334523.aspx)

4.2 Comparing SH and NHATS Delta-V

We compared the ~1200 Shoemaker-Helin (SH) Delta-V estimates with their NHATS counterparts in MatLab. Our first analysis was: (1 – figure 5) the direct relationship between the two Delta-V: SH vs. NHATS, (2 – figure 6) the difference (NHATS – SH) vs. NHATS, (3 – figure 7) the difference (NHATS – SH) vs. SH, and (4 – figure 8) the percent difference (NHATS – SH / NHATS) vs. NHATS.

The residuals (NHATS – SH) have a mean of 0.962 km/s with a variance of 1.592 km/s and appear to have a few distinct populations: ~30% of the objects fell into a linear trend (i.e. SH estimates agree with NHATS), a larger group ~45% was systematically underestimated by the Shoemaker-Helin formulae, and the remaining data form two sparse clouds, one between 4-7 km/s where objects were overestimated, and another between 7.5-9 km/s where SH values were slightly underestimated.

As the Shoemaker-Helin value is an approximation of the minimum Delta-V and NHATS is a calculation of the optimal Delta-V, we would expect the SH values to generally be lower than their NHATS counterparts. The seemingly random spread of SH Delta-V values above and below the NHATS values is troublesome and may indicate a serious flaw in the Shoemaker-Helin derivation of the Delta-V figure of merit.

We attempted to identify a cause for these anomalies by plotting the (NHATS-SH) residuals against the some of the orbital elements associated with each object: (1 – figure 9) semi-major axis a, (2 – figure 10) eccentricity e, (3 – figure 11) inclination angle i, (4 – figure 12) perihelion distance q, and (5 – figure 13) aphelion distance Q.

We see the strongest correlation with semi-major axis. Between a =1.0-1.4 AU, there is a strong linear relationship between (NHATS – SH) and a. Between a =1.0-1.8 AU 88% of the Delta-V estimates are systematically underestimated by SH, which again is what we expected. Between a =0.8-1.0 AU 75% were systematically overestimated.

The noticeable differences across ranges of a led us to believe that there may be some class-dependent error resulting from the different formulae used for Amors, Apollos, and Atens in the Shoemaker-Helin method.

Separating our data into asteroid class type, we made three separate plots, one for each population (see figures 14-16). Apollo and Amor NEAs exhibited a linear growth in positive residuals across the range of NHATS Delta-V's with more scatter at low Delta-V's (4-7 km/s). The Atens residuals showed consistently higher SH values over the full range of Delta-V, but with scatter up to (NHATS – SH) = -3 km/s between 4-6.5 km/s and 3 km/s between 6.5-8 km/s.

Other orbital elements showed weaker correlations. With eccentricity we observed considerable variability across all Delta-V ranges, although outliers (with residuals greater than ±1 km/s) became more frequent for $e > 0.25$. Inclination angle was largely similar to e except for a more evenly distributed population from $12° < i < 16°$, where residuals were kept within ±1.5 km/s. Aphelion distance (Q) showed another linearly increasing trend: from 1-1.2 AU residuals are mostly underestimates and from 1.2-2.0 AU the residuals become increasingly positive and scattered.

In order to better understand the causes of outlier populations and the linear trend toward higher residuals, we used colormap[30] to color-code which data points on the (NHATS – SH) vs. NHATS Delta-V scatter plot had particular low and high values of the orbital parameters *a*, *e*, *q*, and *Q* (see figures 23-26). This allows us to observe how those parameters affect (NHATS – SH) residuals.

We found several interesting cases at large semi-major axes with large residuals (|NHATS-SH| > 2), as well as low residuals (|NHATS-SH| < 0.3). With these objects we created three-dimensional orbital diagrams for a visual comparison using each objects semi-major axis, eccentricity, and inclination angle (see figures 27-32). Adapting the ellipse drawing method known as "polar form relative to focal point"[31], we converted the two-dimensional polar coordinates into three-dimensional Cartesian coordinates[32] with the object's inclination angle mapped to the z-axis. Plotted with the Earth's orbit, we were able to observe the slight differences between object orbit trajectories as well as the more obvious class-based characteristics (i.e. duration of planetary crossings)[33].

Without a clear cause for the trends in the Delta-V residuals, we decided to attempt empirical corrections by fitting a linear curve to the NHATS-SH residuals using linear regression[34]. First, we recalculated the figure of merit correction using our sample of 1189 NEAs. We used Matlab's Curve Fitting application to find a linear[35] fit to the NHATS Delta-V vs. SH for each NEA class (figures 34-36). The linear correction

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[30] A built in MatLab function: http://www.mathworks.com/help/matlab/ref/colormap.html?refresh=true
[31] http://www.sage.unsw.edu.au/snap/gps/clynch_pdfs/ellipequ.pdf
[32] Using the MatLab function sph2cart
[33] See figures 27-32
[34] For more information regarding linear regression: http://www.stat.yale.edu/Courses/1997-98/101/linreg.htm
[35] Polynomial of degree = 1

marginally improved the figure of merit values in comparison to NHATS' calculations, reducing residuals to a mean of 0.76 km/s, but not to an accuracy that is useful (≤1 km/s). Next we fit a linear model to the comparison of NHATS-SH Delta-V and semi-major axis (a) – the strongest correlation we observed. Atens do not follow the linear progression with a of Apollos and Amors, so we focused our analysis on the objects with a >1 (figure 37).

We also tried a few other fitting techniques to see if there was a non-linear correlation between NHATS and SH Delta-V (figures 36-38). We examined the NHATS-SH residuals for each NEA class with respect to their NHATS counterparts and fit degree 2 polynomials to the data.

4.3 Modifying the Shoemaker-Helin Equations

The comparison between our implementation of the SH formulae and NHATS Delta-V made it clear that the Shoemaker-Helin estimates varied widely from the actual values not only with random error but also with several systematic trends that could not be accounted for with empirical corrections. The next logical option would be to modify the original equations with the goal of minimizing discrepancies that arose from each object's orbital elements. This could be pursued in further studies.

One approach would be to modify the equations' use of inclination angle i. The analysis of the entire population and the color mapping of each class both showed a weakness in the Shoemaker-Helin equations (figures 25, 28, 30), that high inclination angle i typically yields an overestimate of Delta-V.

A second technique would correct for the reduced SH Delta-V at high semi-major axis *a*. (NHATS – SH) residuals paek as *a* grows from 1.2-1.8 AU, meaning that Shoemaker-Helin increasingly underestimate Delta-V as *a* increases. Semi-major axis only appears in the second orbital maneuver calculation (U_R) but the aphelion distance (Q), which is related to the semi-major axis by equation 17, appears multiple times in each equation. Therefore, any small adjustment to the size of semi-major axis will have a profound effect on the resulting Delta-V calculation.

Another way is to account for the anomalies in Shoemaker's estimates after running the calculations. For example, writing a code that searches for abnormal orbital elements such as high inclination angle and eccentricity, then applying a numerical correction (i.e. subtracting 1 km/s from the final one-way Delta-V). A fourth option would be to generate numerical corrections via a function of semi-major axis, i.e. the correction grows linearly with *a*.

However, all of these quick fixes represent a false improvement. Trends that appear relevant with respect to the object data we have available today may be reversed or at least altered by the inclusion of further observations and newly discovered objects. Numerical corrections based on inconsistent (i.e. a significant portion objects with high semi-major axis are accurately estimated by Shoemaker equations) and hyper-specific (i.e. high inclination angle only affecting Apollos and Amors) biases would require updates and adjustments in the future. Furthermore, the SH Delta-V exhibited significant random error: residuals of ±3 km/s were 3 times more numerous than what would be expected for an accuracy of ±0.5 km/s. In combination with systematic error, this high magnitude random error presents severe difficulties for numerical correction.

5 Results and Conclusions

In his 1979 paper, Shoemaker & Helin claimed that their formulae provide a 'convenient approximate estimate of the minimum possible Delta-V' required to rendezvous with an NEA. We aimed to test the accuracy of his equations and to see whether or not his claim holds true to a useful level three and a half decades later.

Our initial findings showed that while each of the objects retained an outbound Delta-V considered low enough to be classified as an accessible NEA – defined by NHATS as less than 9 km/s – the estimates severely lacked evidence of reliable precision. The ideal scenario would have shown a linear 1:1 relation between the two values shifted just below the y = x line. In this picture, Shoemaker & Helin would consistently underestimate Delta-V – giving credence to the estimate being the absolute minimum value. Instead, figure 5 exhibits large scatter of data (σ = 3 km/s) without a clear trend except that the majority (73%) of SH Delta-V were less than their NHATS counterparts.

The plots suggest that multiple systematic causes of error are present in the Shoemaker-Helin calculations, along with some severe scattering towards higher Delta-V across the entire range of NHATS values. Interestingly enough, the most immediate visible correlation is a group of SH Delta-V extending from 4.0-7.5 km/s that directly mirror NHATS calculations (with a variance of ~0.5 km/s). This trend is accentuated by a dramatic gap between 7.5-9.0 km/s where SH approximations either severely drop to 4.5-5.5 km/s or are sparsely scattered between 6.0-8.0 km/s. Perhaps Shoemaker's method is lucky and accurately predicts Delta-V 25% of the time – after all a broken clock is right twice a day. More likely, the lack of moderate underestimates between

7.5-9.0 km/s gives the illusion that accurately estimated Shoemaker & Helin Delta-V's represent a system-wide accuracy rather than a result of random error.

A quantitative analysis of the Shoemaker-Helin Delta-V values shows an average difference from the NHATS values of 0.962 km/s with a variance of 1.592 km/s. For Aten asteroids the average difference is -0.313 km/s with a variance of 0.593 km/s, for Amors the average difference is 1.690 km/s with a variance of 1.365 km/s. and for Apollos the average difference is 1.184 km/s with a variance of 1.128 km/s. For each class, Shoemaker's equations make the worst underestimates (residuals between 2-5 km/s) when the SH Delta-V value is between 4.5 and 5.5 km/s. This phenomena can be explained by the fact that a large majority (54.5%) of the SH Delta-V values are estimated to be between 4.5-5.5 km/s, while NHATS is more evenly spread with only 15.7% of the Delta-V values between 4.5-5.5 km/s. We are at first consoled by the fact that Shoemaker & Helin wanted to find minimum values of Delta-V and therefore his calculations should generally be lower. However, we would expect to see an equivalent spread of objects shifted to a slightly lower range of Delta-V, perhaps between 3-8 km/s as opposed to NHATS 3-10 km/s.

Excluding all objects with SH Delta-V below 4.5 and above 5.5 km/s, we observe a similar percentage spread of NHATS Delta-V values as the original data set across the range of 3-10 km/s. In fact, for objects with the highest Delta-V values from NHATS calculations (1999 FN19 with 9.92 km/s, 2014 EO12 with 9.83 km/s, 2009 RG2 with 9.82 km/s, 2010 SH15 with 9.72 km/s, 2011 FU9 with 9.46 km/s, 2009 WG106 with 9.43 km/s, 2000 JX8 with 9.11 km/s, and 2006 SV5, 2012 BA102 and 2013 SU24 with 9.10 km/s) their coinciding SH values are limited to a range of 4.7-5.5

km/s. All ten of these objects are either Apollo or Amor asteroids (a > 1 AU) and represent some of the worst residuals out of the data set (4-5 km/s). They have standard and suitably random values for eccentricity and inclination angle, and they have relatively large semi-major axes (this is to be expected for high Delta-V objects).

With these statistics, we can conclude that the Shoemaker-Helin equations fail to perform accurate estimates at Delta-V above 7.5 km/s - the sweet spot being around 4-5 km/s. One reason is that the Shoemaker-Helin equations rely too much on inclination angle as an indicator of high Delta-V. Out of the ten objects with high NHATS Delta-V mentioned above, none have an inclination angle above 6°. Instead they have relatively large semi-major axes and aphelion distances, as well as low synodic periods. The Shoemaker-Helin equations are simply not built to account for high Delta-V objects with average semi-major axes. Shoemaker's equations also break down when calculating Delta-V for Atens. The worst overestimates (with residuals of -2.5 km/s) occur with asteroids that have low semi-major axes a (0.7-0.9 AU), but with average values for eccentricity e, inclination angle i and aphelion distance Q.

In conclusion, the combination of poor residuals at both low and high semi-major axis indicates that the Shoemaker-Helin equations are not accurate enough to provide accurate Delta-V values. If we ignore Atens, the Shoemaker-Helin equations do – in most cases – present the lowest possible Delta-V, but with random error so large that we could not rely on the formulae to discern whether the object would be a better target than another object with similar orbital parameters. It is not acceptable to neglect Aten asteroids because many of them have some of the lowest Delta-V of all NEAs

according to NHATS calculations, and are therefore good candidates for rendezvous missions.

What we can confirm is that the Shoemaker-Helin approximations provide evidence that many NEAs have low Delta-V. Their original intention was to convince their peers that asteroid rendezvous trips are comparable to lunar and Mars missions. This was a highly disputable fact at the time their paper was written because NEAs were only just being discovered in significant numbers. Shoemaker & Helin did not imply that their equations could replace calculations based on numerical approximations of orbital trajectories.

We can conclude that the Shoemaker-Helin approximations are not a reliable substitute for NHATS and other accurate Delta-V calculations, but do demonstrate the viability of NEAs as potential mission targets.

6 Figures and Tables

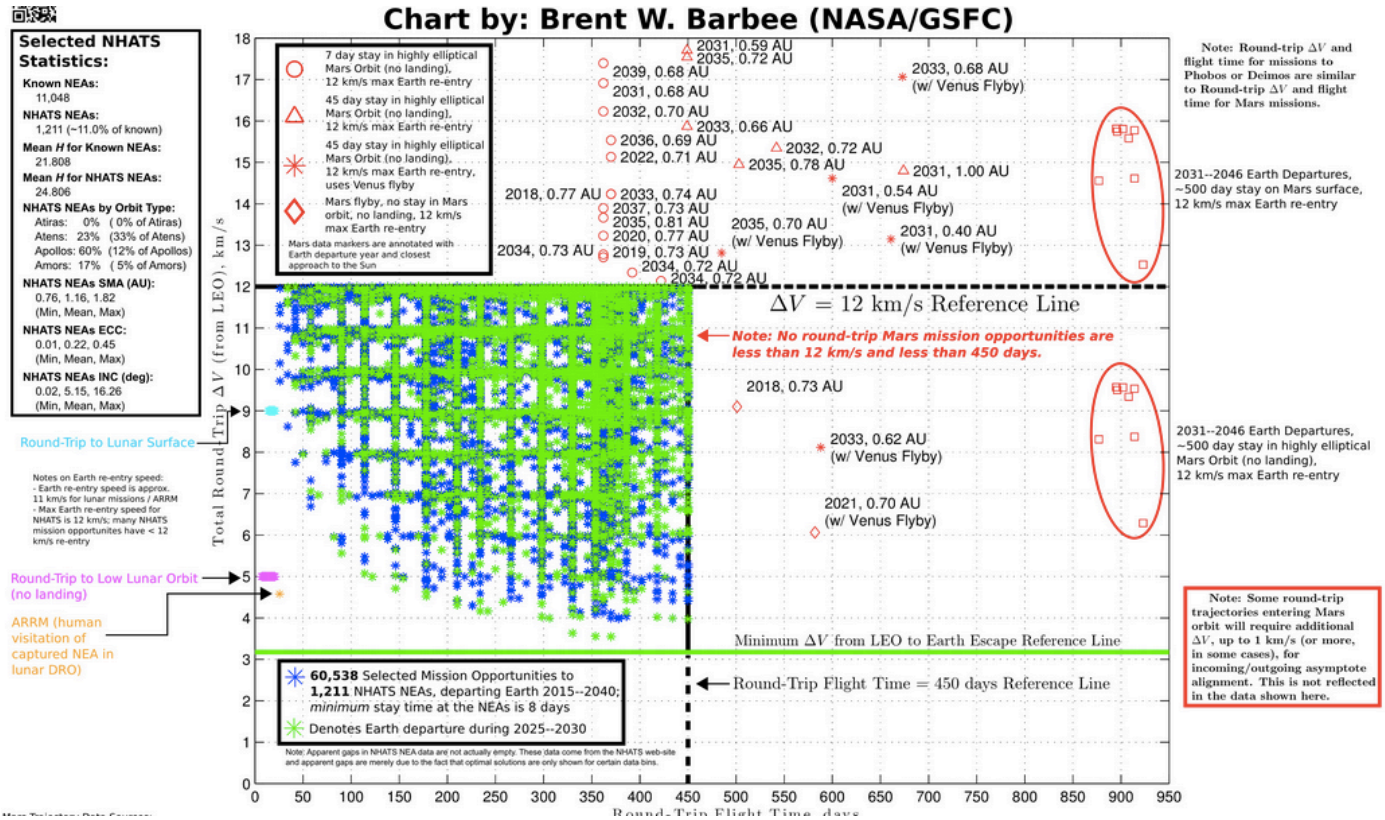

Figure 1: Brent Barbee illustrates the range of Total Round Trip Delta-V from LEO (km/s) compared to their Round Trip Flight Time (days). He also includes values for round trips to low lunar orbit, lunar surface, low Mars orbit, surface of Mars, and Venus flyby.

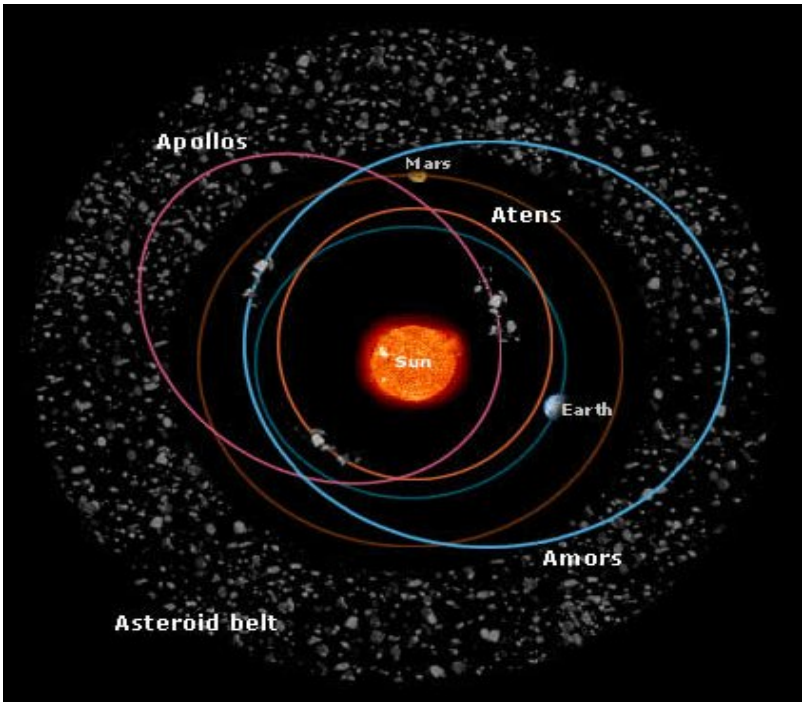

Figure 2: Illustration of Earth, Mars, and Main Belt orbits with the three NEA classes: Atens, Apollos, and Amors.

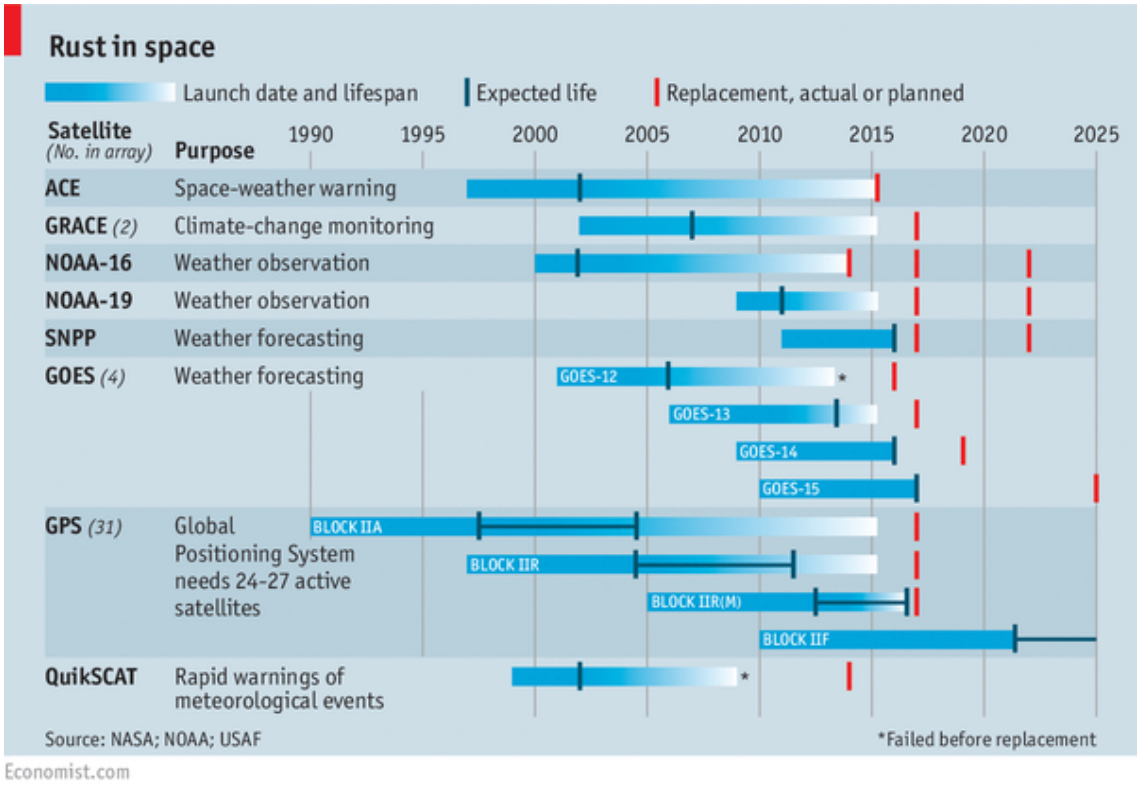

Figure 4: Graphical representation of a study on the replacement of obsolete satellites in Earth's orbit completed by The Economist.

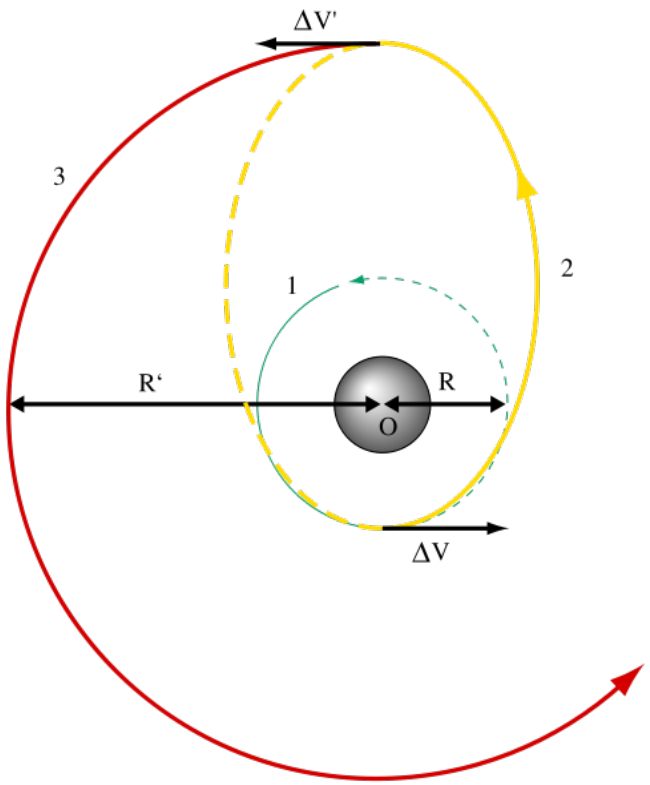

Figure 3: Hohmann Transfer Orbit. The sphere labeled O represents the Sun with the Earth's orbit designated as (1) in green. R = 1 AU and R' = a_{nea}. The initial maneuver into the Hohmann transfer (2) orbit occurs at Earth's perigee and is denoted by ΔV. The second and final maneuver into the target object's orbit (3) is denoted by ΔV'.

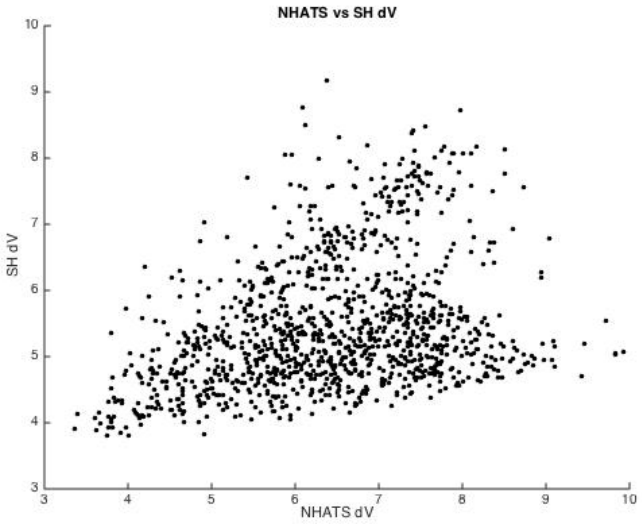

Figure 6: Delta-V approximations from Shoemaker's formulae plotted with their NHATS counterparts (km/s).

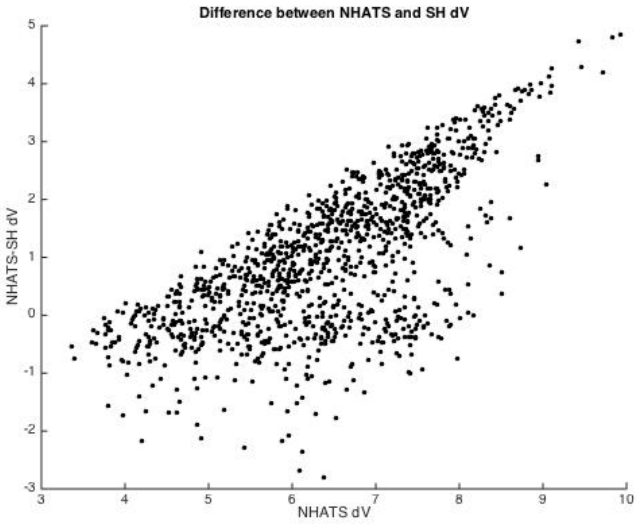

Figure 7: Residuals between NHATS and Shoemaker Delta-V (NHATS-SH) plotted with NHATS (km/s).

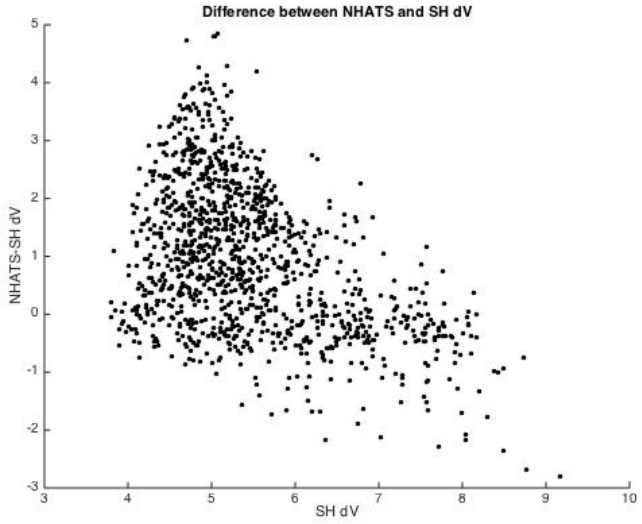

Figure 8: Residuals between NHATS and Shoemaker Delta-V (NHATS-SH) plotted with SH (km/s).

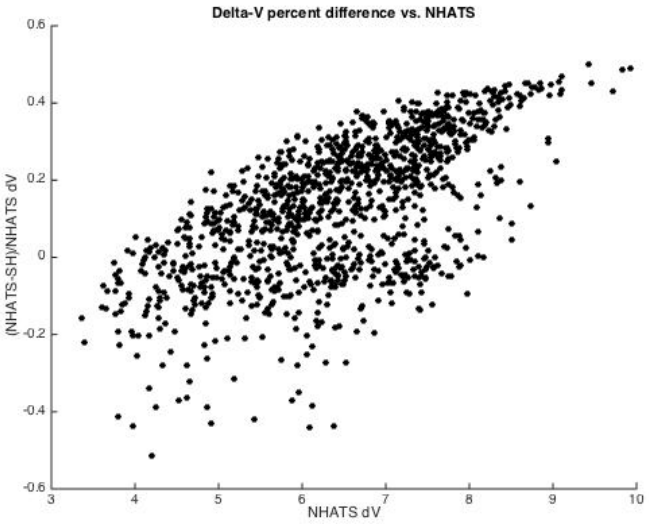

Figure 5: Percent difference between NHATS and Shoemaker Delta-V (NHATS-SH)/NHATS plotted with NHATS (km/s)

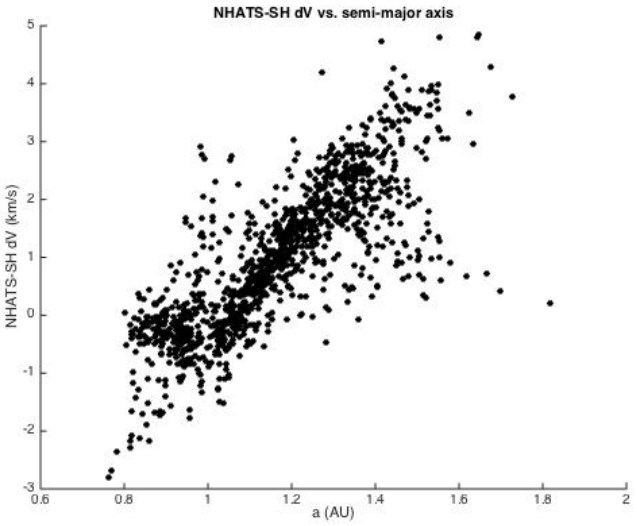

Figure 12: Residuals between NHATS and Shoemaker Delta-V plotted with semi-major axis (a).

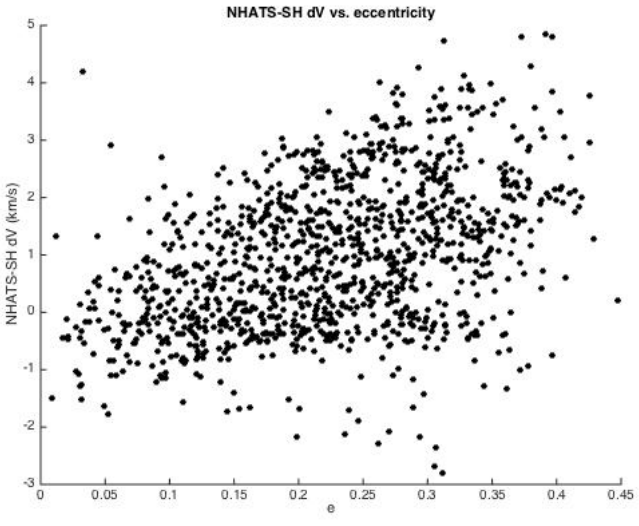

Figure 13: Residuals between NHATS and Shoemaker Delta-V plotted with eccentricity (e).

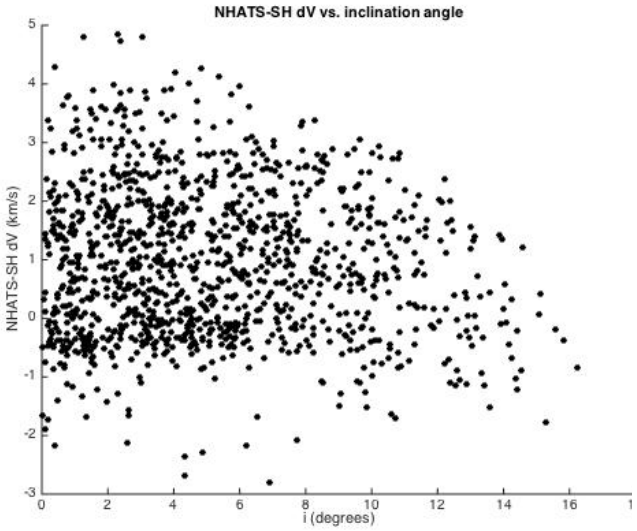

Figure 11: Residuals between NHATS and Shoemaker Delta-V plotted with inclination angle (i).

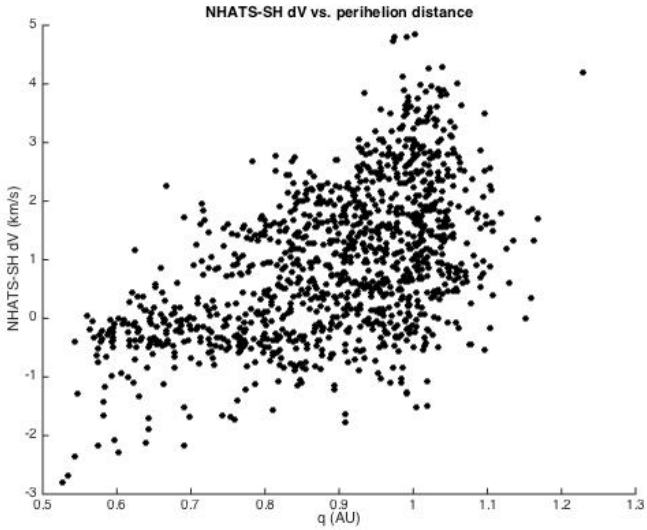

Figure 10: Residuals between NHATS and Shoemaker Delta-V plotted with perihelion distance (q).

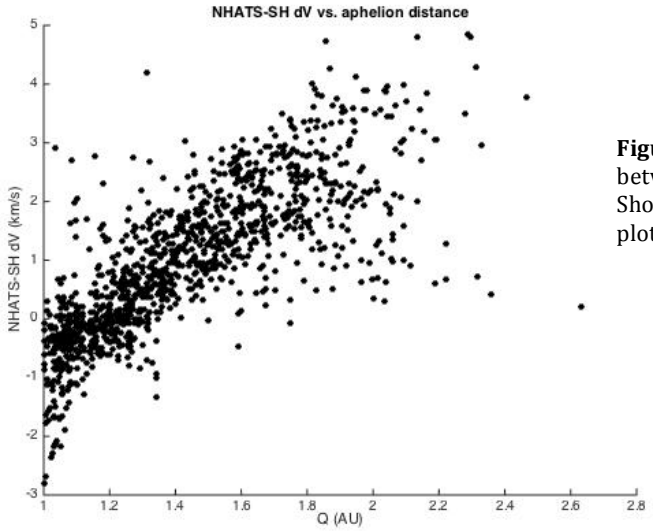

Figure 9: Residuals between NHATS and Shoemaker Delta-V plotted with aphelion (Q).

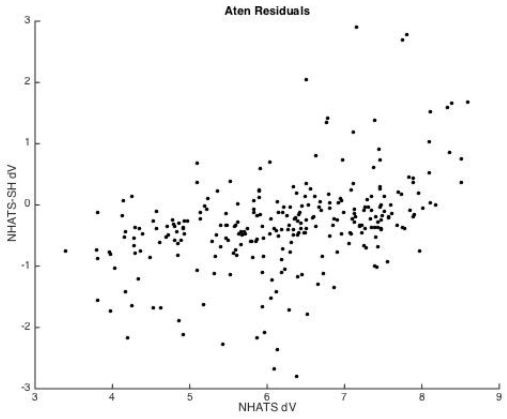

Figure 18: Residuals for Aten NEAs (Q > 0.983 AU) plotted with NHATS Delta-V.

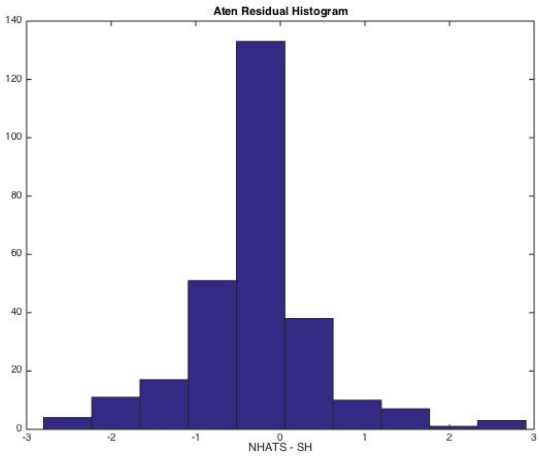

Figure 14: Histogram of Aten Residuals.

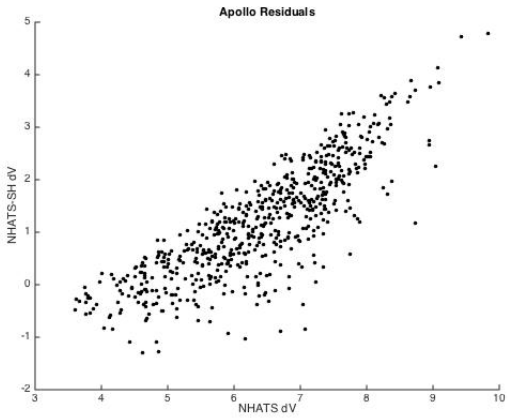

Figure 19: Residuals for Apollo NEAs (q < 1.017 AU) plotted with NHATS Delta-V.

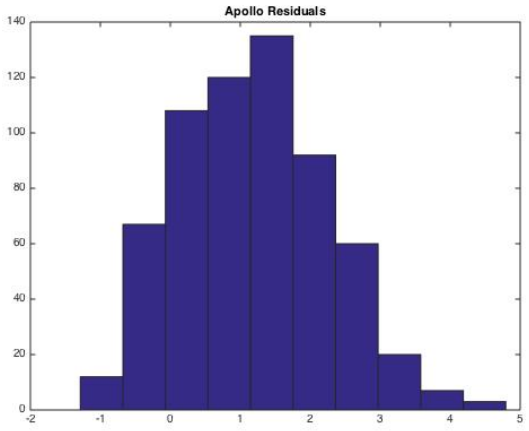

Figure 17: Histogram of Apollo Resdiuals.

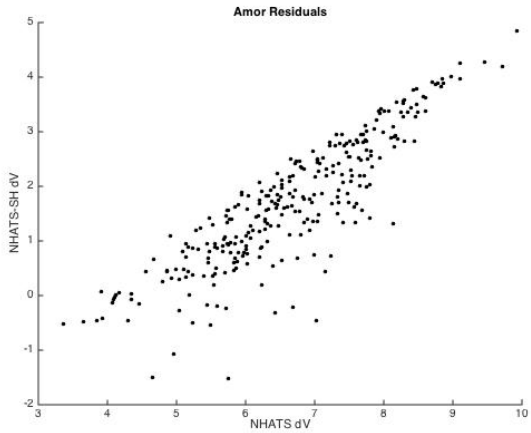

Figure 15: Residuals for Amor NEAs (1.017 AU > q > 1.3 AU) plotted with NHATS Delta-V.

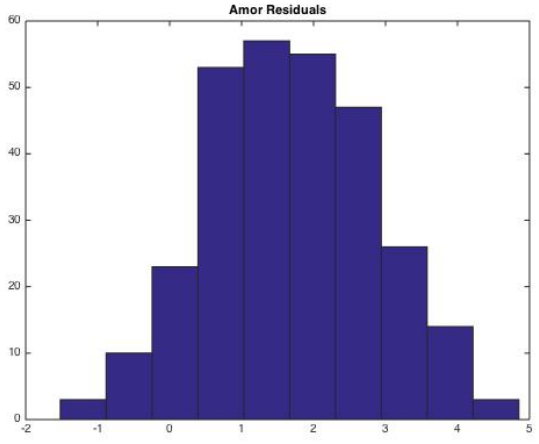

Figure 16: Histogram of Amor Residuals

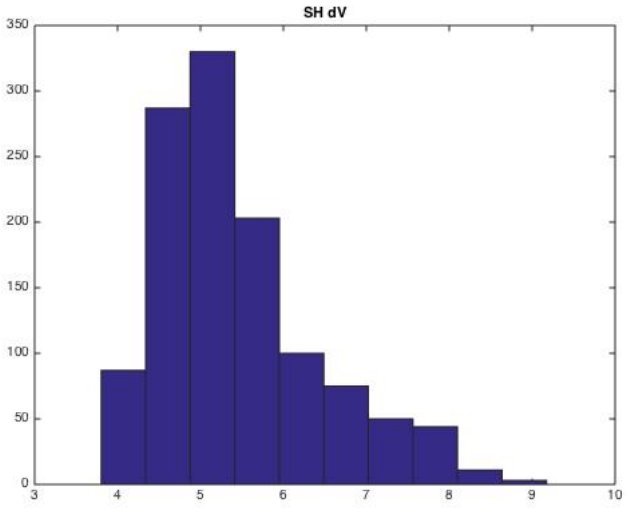

Figure 20: Histogram of Shoemaker Delta-V.

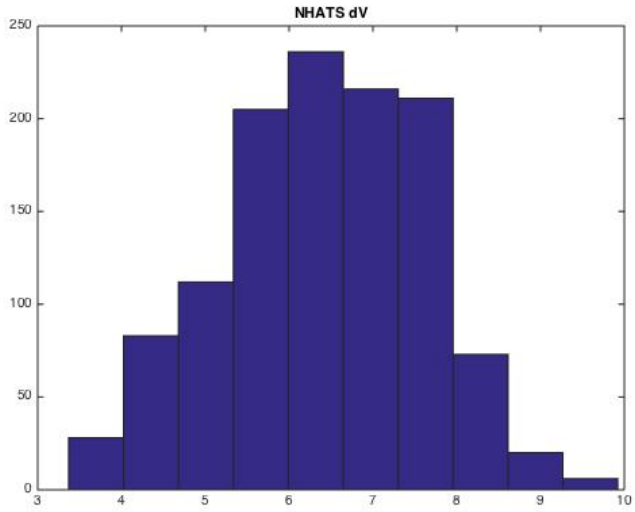

Figure 21: Histogram of NHATS Delta-V

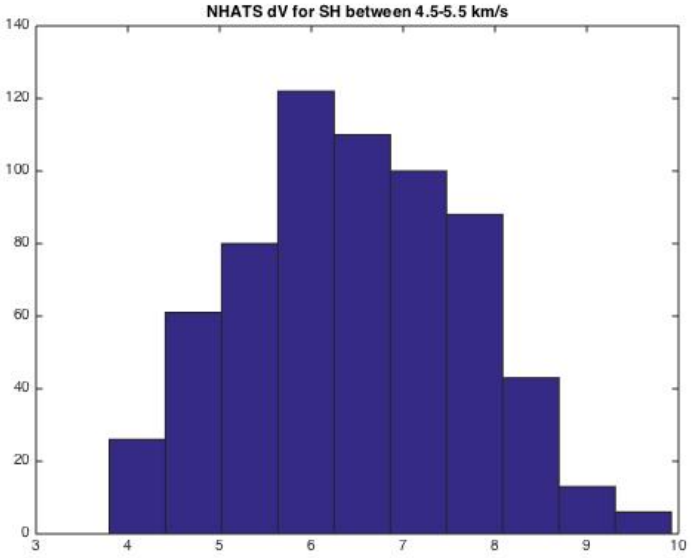

Figure 22: Histogram of NHATS Delta-V that correspond to Shoemaker Delta-V between 4.5-5.5 km/s.

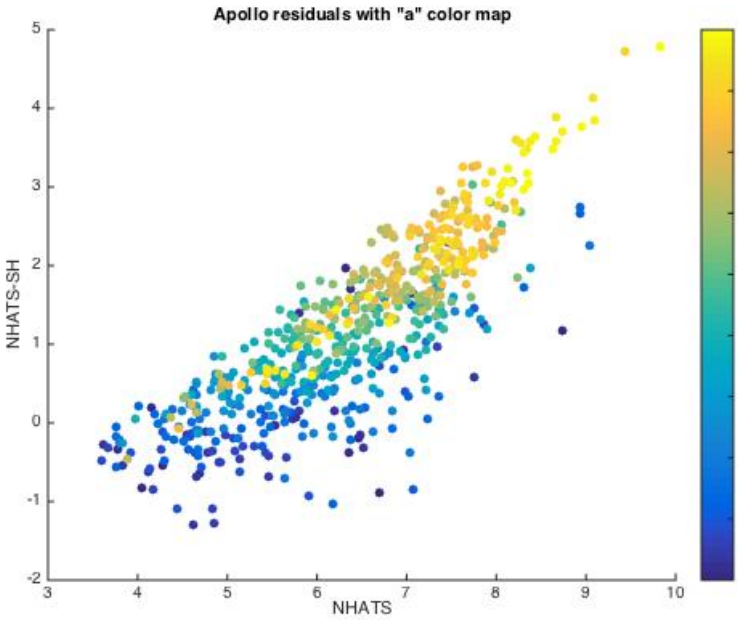

Figure 26: Color map of Apollo residuals with respect to semi-major axis (*a*). Yellow indicates a relatively high semi-major axis (1.5-1.7 AU), while blue/purple indicate a low semi-major axis (1-1.02 AU).

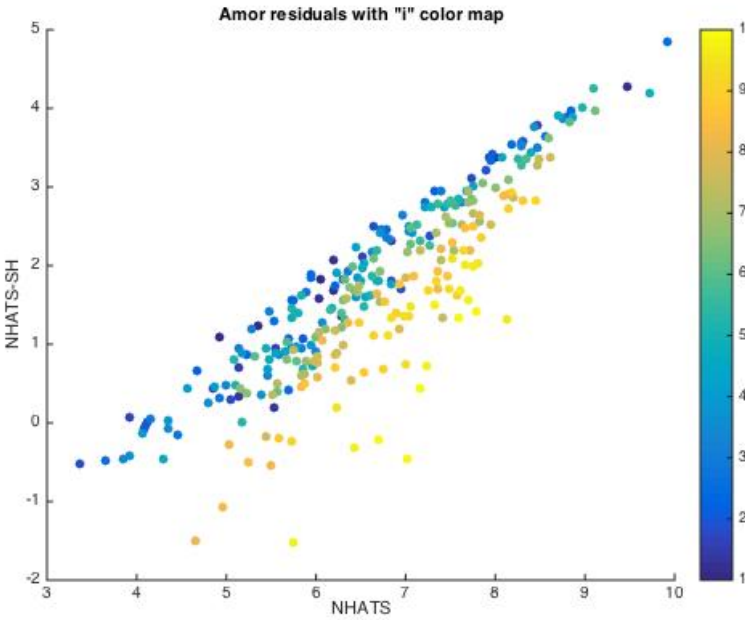

Figure 24: Color map of Amor residuals with respect to inclination angle (*i*). Yellow indicates a relatively high angle (11-15°), while blue/purple indicate a low angle (0-1°).

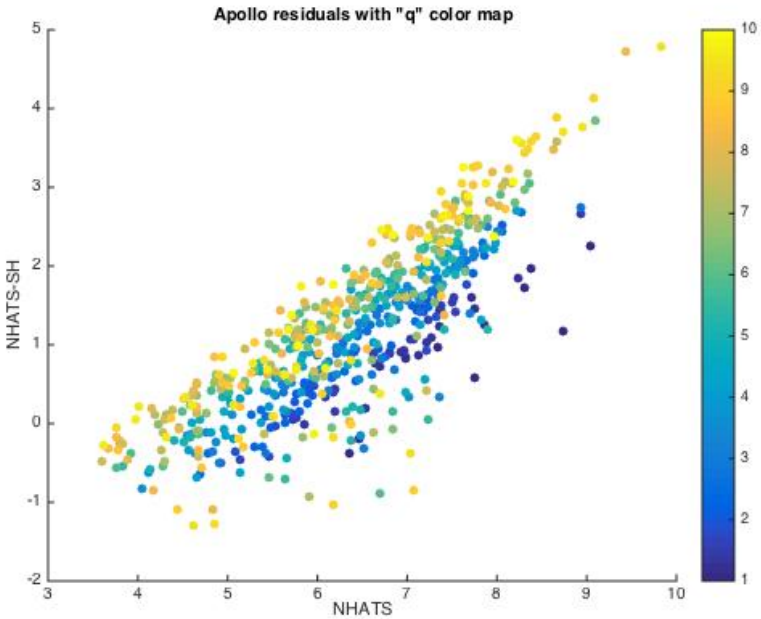

Figure 25: Color map of Apollo residuals with respect to perihelion distance (*q*). Yellow indicates a relatively high distance (0.9-1.0 AU), while blue/purple indicate a low distance (0.6-0.7 AU).

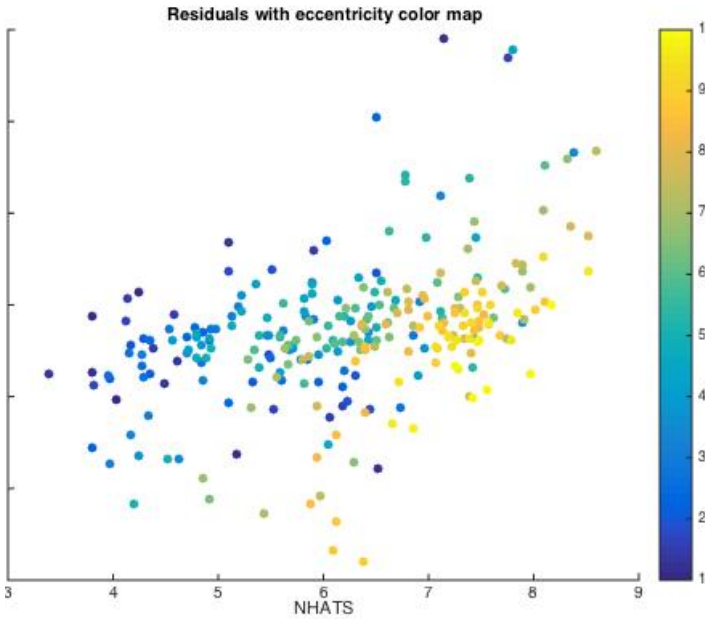

Figure 23: Color map of Aten residuals with respect to eccentricity (*e*). Yellow indicates a relatively high eccentricity (0.3-0.4), while blue/purple indicate a low eccentricity (0.02-1.0).

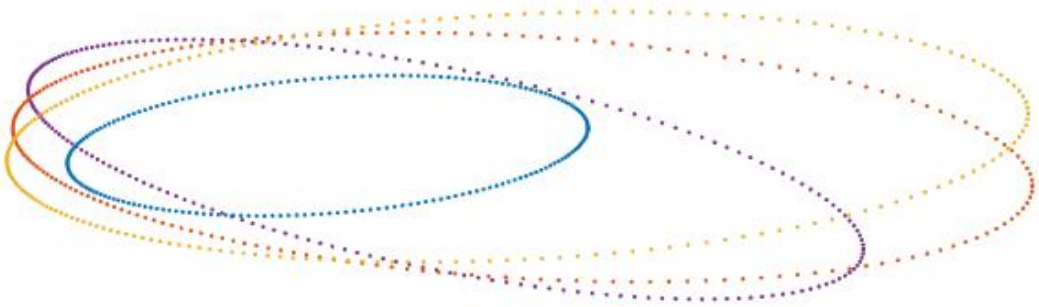

Figure 28: Orbital diagram of Earth (blue), Amor NEA 2006 SV5 (purple, NHATS-SH = 4.26 km/s), Amor NEA 1999 FN19 (red, NHATS-SH = 4.85 km/s), and 2011 FU9 (yellow, NHATS-SH = 4.28 km/s). The y-axis (radians) is reduced by a factor of 2 in order to accentuate differences in inclination angle.

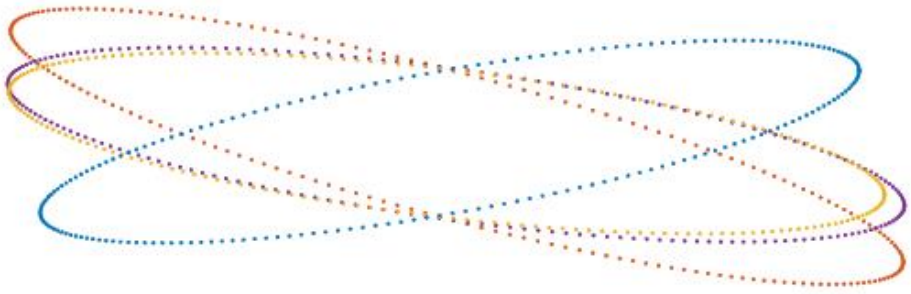

Figure 27: Orbital diagram of Earth (blue), Amor NEA 1992 JD (red, NHATS-SH = -1.52 km/s), Amor NEA 2014 MP (purple, NHATS-SH = -1.07 km/s), and 2014 TW (yellow, NHATS-SH = -1.50 km/s). The y-axis (radians) is reduced by a factor of 2 in order to accentuate differences in inclination angle.

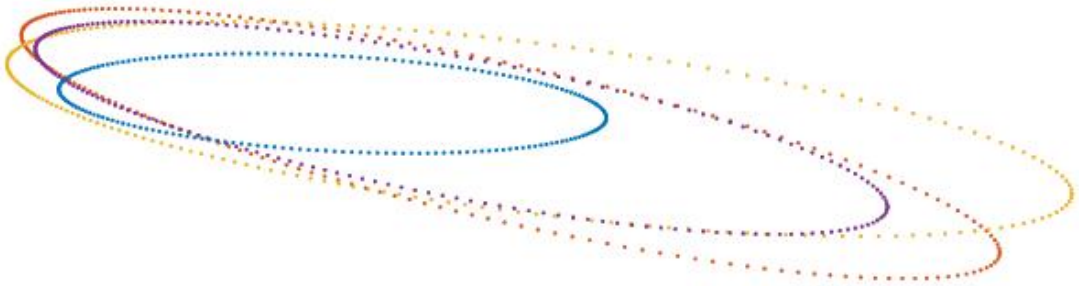

Figure 30: Orbital diagram of Earth (blue), Apollo NEA 2009 RG2 (red, NHATS-SH = 4.79 km/s), Apollo NEA 2009 WG106 (purple, NHATS-SH = 4.73 km/s), and 2014 EO12 (yellow, NHATS-SH = 4.79 km/s). The y-axis (radians) is reduced by a factor of 2 in order to accentuate differences in inclination angle.

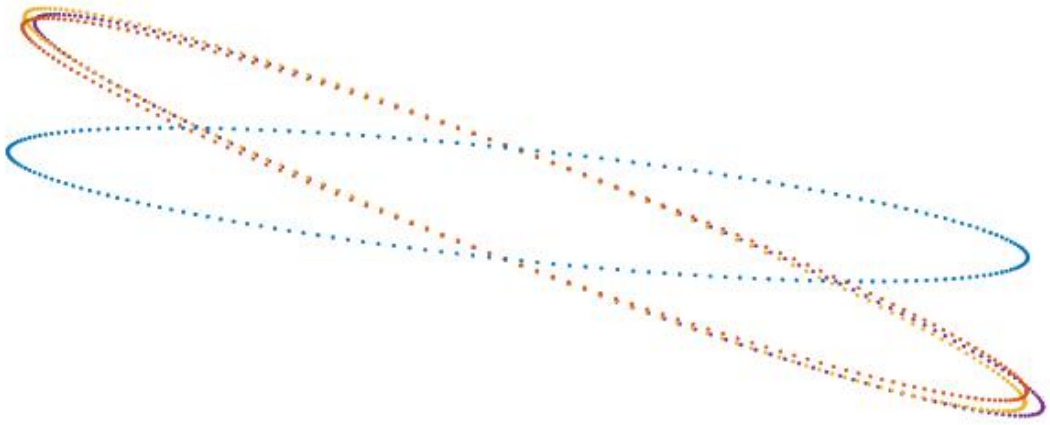

Figure 29: Orbital diagram of Earth (blue), Apollo NEA 2013 HO (yellow, NHATS-SH = -1.27 km/s), Apollo NEA 2014 GA (purple, NHATS-SH = -1.09 km/s), and 2009 UY19 (red, NHATS-SH = -1.29 km/s). The y-axis (radians) is reduced by a factor of 2 in order to accentuate differences in inclination angle.

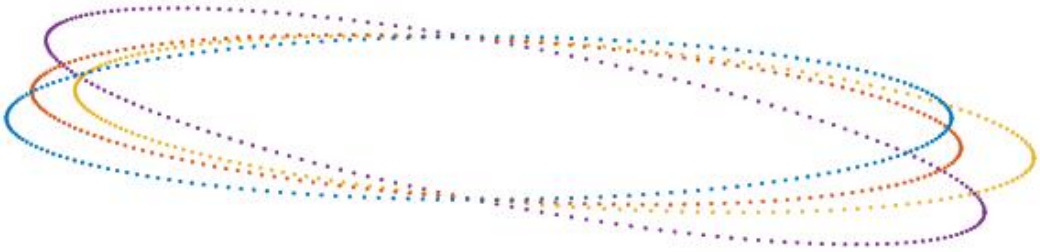

Figure 32: Orbital diagram of Earth (blue), Aten NEA 2009 SH2 (purple, NHATS-SH = 2.90 km/s), Aten NEA 2006 SU217 (yello, NHATS-SH = 2.77 km/s), and 2010 JW34 (red, NHATS-SH = 2.90 km/s). The y-axis (radians) is reduced by a factor of 2 in order to accentuate differences in inclination angle.

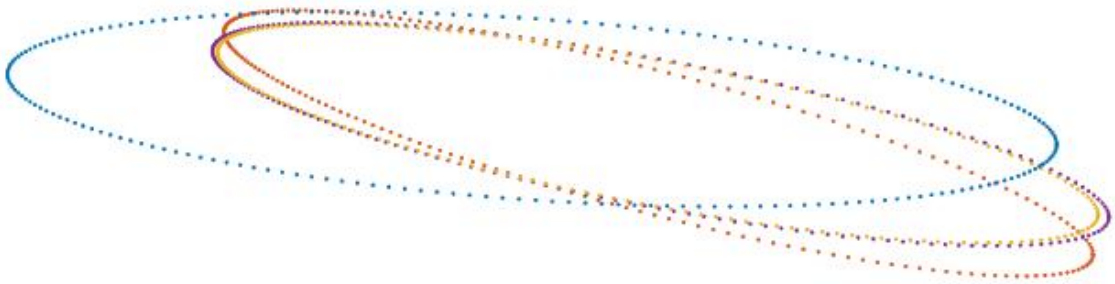

Figure 31: Orbital diagram of Earth (blue), Aten NEA 2011 YD29 (red, NHATS-SH = -2.80 km/s), Aten NEA 2012 BT1 (purple, NHATS-SH = -2.37 km/s), and 2002 JX8 (yellow, NHATS-SH = -2.68 km/s). The y-axis (radians) is reduced by a factor of 2 in order to accentuate differences in inclination angle.

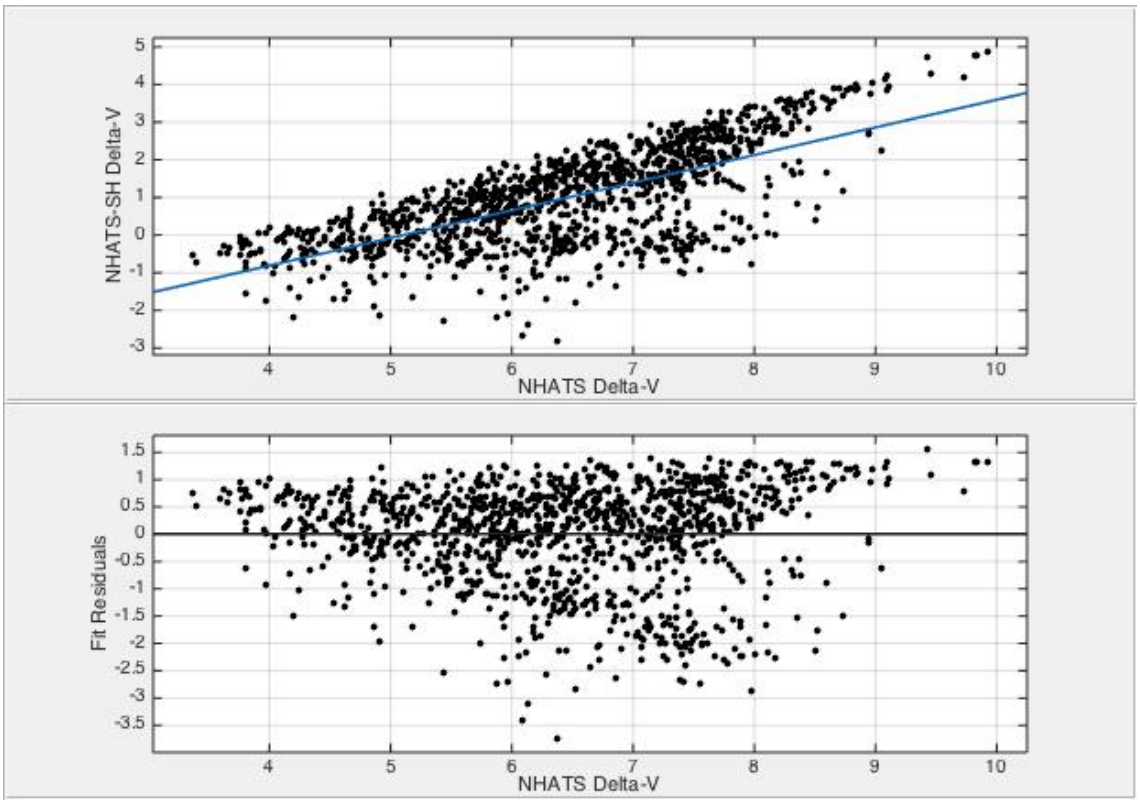

Figure 33: Top – Linear fit of the NHATS-SH residuals vs. NHATS Delta-V in km/s. Bottom – The corrected residuals of the fit in km/s normalized to 0.

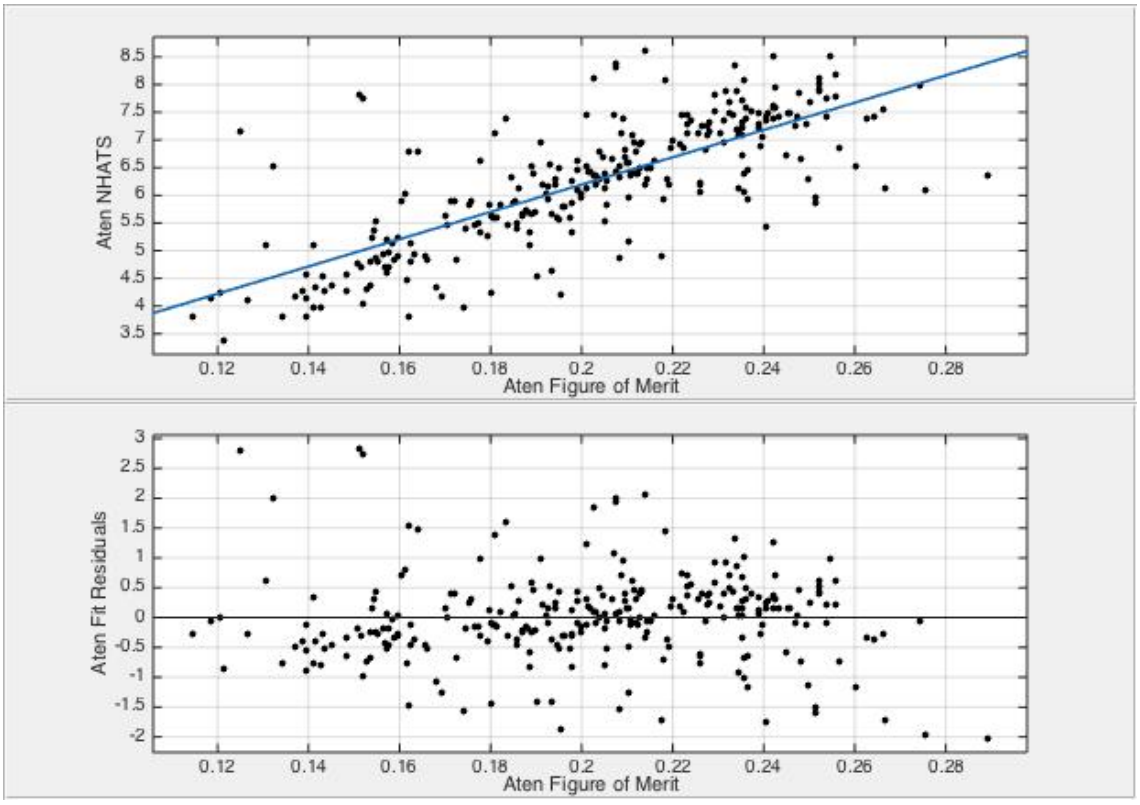

Figure 34: Top – Linear fit of the Aten NHATS Delta-V (km/s) vs. Aten Figure of Merit (dimensionless). Bottom – Corrected residuals of the fit in km/s normalized to 0.

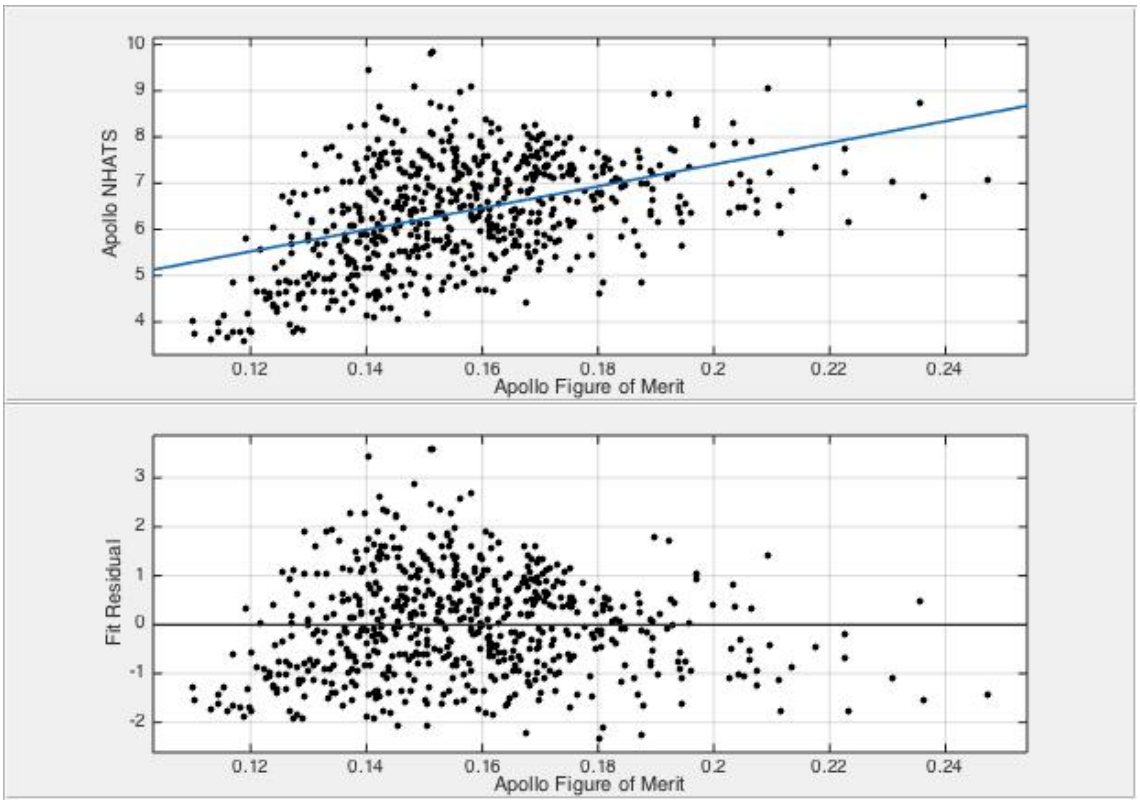

Figure 36: Top – Linear fit of the Apollo NHATS Delta-V (km/s) vs. Apollo Figure of Merit. Bottom – The corrected residuals of the fit in km/s normalized to 0.

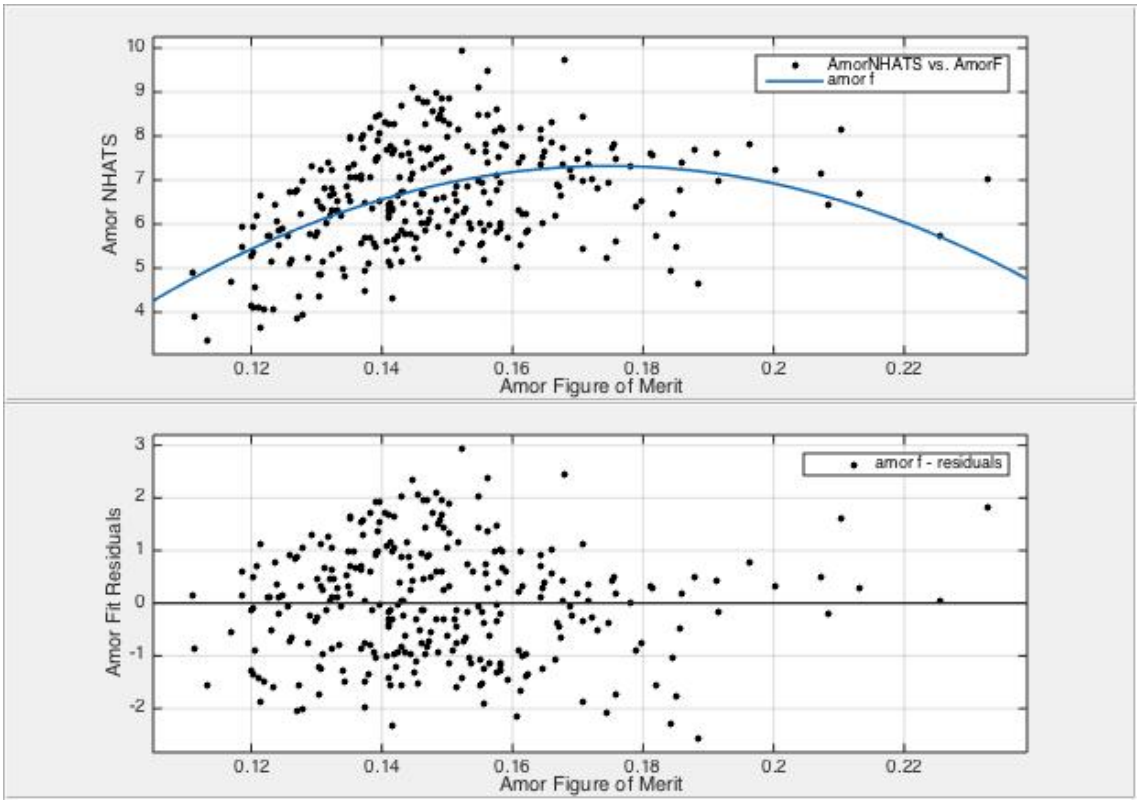

Figure 35: Top – Polynomial (degree 2) fit of the Amor NHATS Delta-V (km/s) vs. Apollo Figure of Merit. Bottom – The corrected residuals of the fit in km/s normalized to 0.

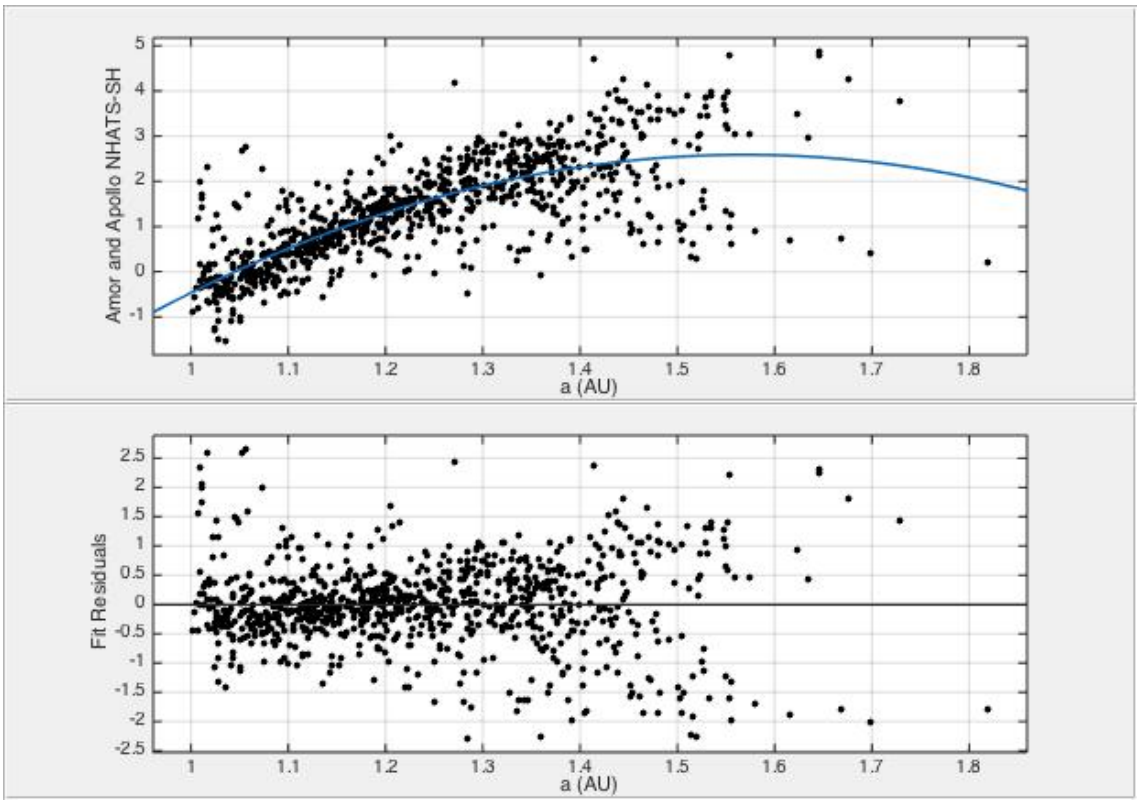

Figure 38: Top – Polynomial (degree 2) fit of Amor & Apollo NHATS –SH Delta-V (km/s) vs. semi-major axis (AU). Bottom – The corrected residuals of the fit in km/s normalized to 0.

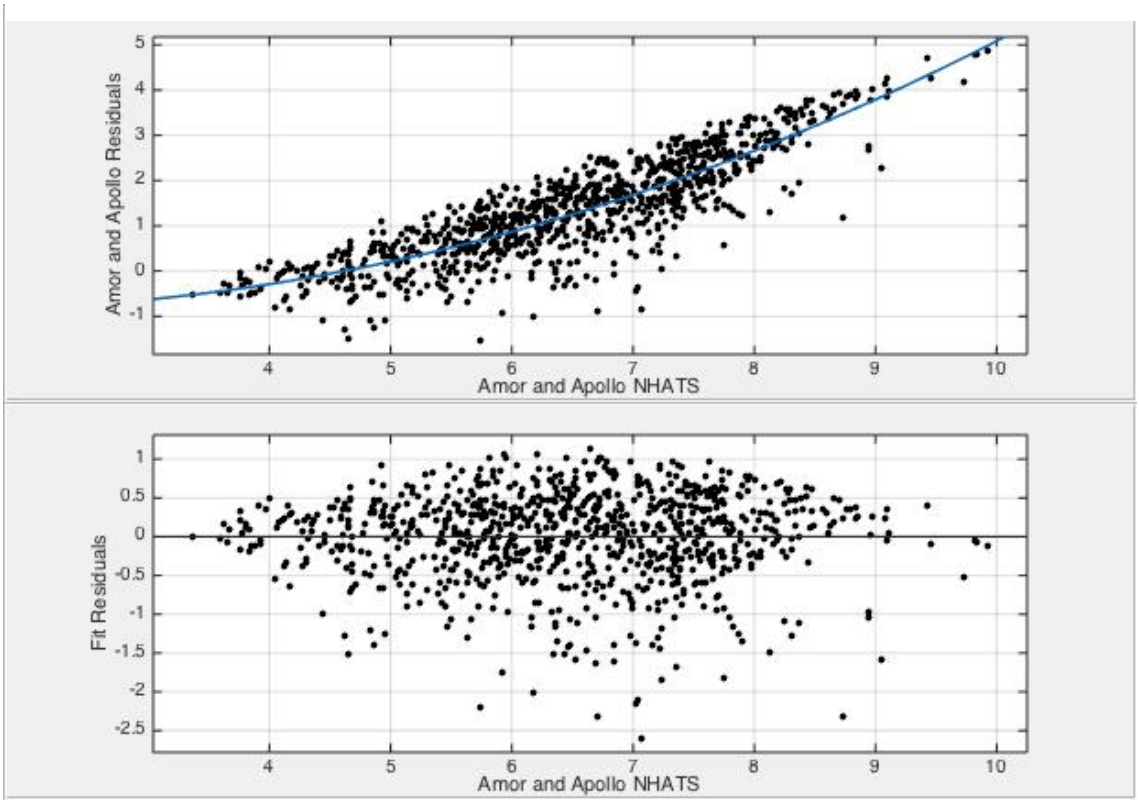

Figure 37: Top – Polynomial (degree 2) fit of Amor & Apollo NHATS-SH Delta-V (km/s) vs. NHATS Delta-V (km/s). Bottom – Corrected residuals of the fit in km/s normalized to 0.

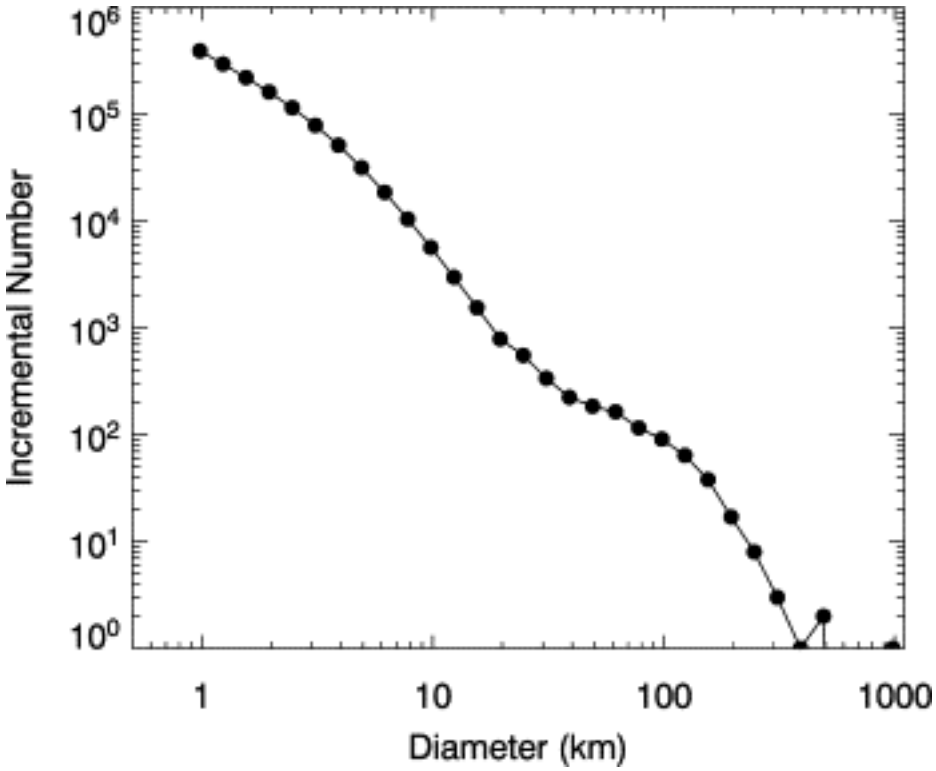

Figure 39: The size-frequency distribution of all asteroids. Figure 1 from Bottke, et al., (2005)

		Orbital Parameters										NHATS		SH
Designation	Class	a	e	i	w	N	M	q	Q	P	S	Roundtrip dV	Outbound dV	Outbound dV
1991 VG	Apollo	1.0269631	0.04914736	1.44542	24.56785	73.97851	17.7292786	0.976490575	1.077435625	1.040716065	25.56032996	4.132	3.663	3.980535778
1992 JD	Amor	1.0362662	0.03148258	13.56464	290.30026	222.44387	233.8138799	1.003641866	1.068890534	1.054889573	19.21839654	8.463	5.744	7.263000727
1993 DA	Aten	0.9360948	0.09303472	12.38963	354.0255	329.06216	220.6693119	0.849005482	1.023184118	0.905690368	9.603370836	9.029	6.186	7.279980335
1993 KA	Amor	1.255667	0.19766276	6.04682	342.04625	235.80633	130.5006787	1.007468395	1.503865605	1.407057097	3.456657816	7.545	6.643	4.544806564
1994 CJ1	Amor	1.4904279	0.32534654	2.30657	65.25745	172.07856	106.0232018	1.00552234	1.97533346	1.819560321	2.220166441	11.928	8.282	4.727034303
1994 EU	Apollo	1.3738945	0.27632701	6.43974	145.43549	351.68813	19.9155875	0.994250341	1.753538659	1.610386338	2.638306656	11.362	7.443	4.801661207
1994 UG	Apollo	1.2383503	0.29242483	5.20569	225.54418	13.69011	350.3917561	0.876225924	1.600474676	1.378050936	3.645146206	10.074	6.893	5.260522341
1996 BG1	Aten	0.8971067	0.27981039	3.83049	150.69833	139.49957	271.6753016	0.646086924	1.148126476	0.849701041	5.653406027	9.59	6.696	6.785590033
1996 FT1	Apollo	1.4568874	0.39961585	2.70541	93.68862	12.46869	35.965586	0.874692103	2.039082697	1.758486267	2.318415433	11.488	7.458	5.503768339
1997 CD17	Apollo	1.1226037	0.14154264	15.09793	221.47266	320.4559	324.6355648	0.963707409	1.281499991	1.189432234	6.278932618	11.453	7.215	6.788390793
1997 UR	Amor	1.4592501	0.31206275	2.26391	200.33589	214.00344	246.8336834	1.003872501	1.914627699	1.762765725	2.31101853	9.779	8.186	4.649389751
1997 XR2	Apollo	1.077044	0.20127331	7.17253	84.63594	250.79564	153.796185	0.860263789	1.293824211	1.11776413	9.49155003	7.753	5.653	5.493380117
1997 YM9	Apollo	1.095914	0.10394218	7.84298	51.71687	94.74522	246.3333538	0.98200231	1.20982569	1.147267557	7.79036186	7.179	5.622	4.993808839
1998 HD14	Aten	0.9632964	0.31269819	7.80926	260.82164	183.90931	300.8870396	0.662075359	1.264517441	0.945452917	17.33278585	11.199	7.089	7.560683041
1998 HM1	Apollo	1.4073345	0.35926148	3.24093	69.42922	202.46447	329.4247989	0.901733425	1.912935575	1.66953682	2.493569838	11.231	7.258	5.2352944
1998 KY26	Apollo	1.232846	0.20191769	1.48044	209.37257	84.36215	359.5729719	0.983912584	1.481779416	1.368873278	3.710958098	7.67	4.507	4.184198717
1998 MW5	Apollo	1.0232183	0.36275504	6.29666	26.61845	80.41087	108.8203012	0.652040705	1.394395895	1.035028833	29.54791082	11.251	7.752	7.178823003
1998 VD32	Apollo	1.1002915	0.3119392	1.93813	152.0254	1.05393	262.8255912	0.75706745	1.44351555	1.154148355	7.487257031	9.342	6.811	5.915084522
1998 XN17	Aten	0.9825027	0.2101709	7.24212	226.49207	85.93963	263.3673411	0.776009223	1.188996177	0.973869195	37.26900905	9.236	7.384	5.999390389
1999 AO10	Aten	0.9114329	0.11092462	2.62359	7.67464	313.26441	240.9680946	0.810332552	1.012533248	0.870135829	6.700353343	5.778	3.802	5.366509442
1999 CG9	Apollo	1.0619235	0.06364818	5.15708	315.69921	138.62807	215.1893316	0.994334002	1.129512998	1.094308689	11.60347686	5.215	4.316	4.499228088
1999 FA	Apollo	1.0781117	0.13273499	12.02802	296.93125	166.13028	75.9050561	0.935008554	1.221214846	1.119426642	9.373341021	8.802	6.161	6.205656431
1999 FN19	Amor	1.6461357	0.3908991	2.30026	35.86887	191.04841	138.5273572	1.002662736	2.289608664	2.112022062	1.899262734	11.83	9.922	5.068736042
1999 NW2	Apollo	1.116051	0.10870525	8.68023	52.94348	289.56743	336.5478093	0.994730397	1.237371603	1.179033273	6.585553913	7.219	5.764	5.084130878
1999 RA32	Apollo	1.0264303	0.09028343	10.52026	9.10045	167.75325	40.8986175	0.933760652	1.119099948	1.039906268	26.05872033	7.205	5.461	6.136797307
1999 SF10	Apollo	1.2782665	0.25292232	1.21047	27.91813	25.88957	153.3050653	0.954964371	1.601568629	1.445213837	3.246111681	7.545	6.859	4.493776642
1999 SH10	Apollo	1.0978696	0.13057104	9.5886	118.90377	178.54869	127.7463922	0.954519625	1.241219575	1.150339783	7.651599343	8.634	6.071	5.464630996
1999 SO5	Amor	1.085992	0.06519316	13.36516	359.78438	196.10685	319.1397016	1.01519275	1.15679125	1.131722471	8.591719125	9.363	6.428	6.752021552
1999 VW25	Aten	0.9287928	0.11221489	10.79657	354.67713	232.25298	125.3307059	0.824568418	1.033017182	0.895113815	8.53414411	8.353	5.958	6.805353834
1999 VX25	Aten	0.8997476	0.13958918	1.6635	151.7068	55.30445	85.5546202	0.77415257	1.02534263	0.853455822	5.823880779	5.898	4.329	5.541641247
2000 AC6	Aten	0.8532631	0.2863584	4.70829	187.91602	101.66547	154.185019	0.608924044	1.097602156	0.788178251	3.720950547	10.846	7.259	7.295467352
2000 AE205	Amor	1.1644924	0.13759346	4.45914	150.2938	271.65648	351.6814	1.004265862	1.324718938	1.256622952	4.896767583	8.004	5.845	4.228863733
2000 AF205	Apollo	1.0340296	0.27679519	2.40877	127.31229	220.11599	159.2230739	0.74781518	1.32024402	1.051476223	20.42644467	9.24	6.695	5.970830146
2000 AG6	Apollo	1.0173038	0.18961384	2.43819	276.49707	283.01843	127.6496612	0.82440892	1.21019868	1.026067661	39.36170754	6.167	5.069	5.254929243
2000 CE59	Apollo	1.1375844	0.16664301	12.26476	307.55012	318.70654	331.2106151	0.948013911	1.327154889	1.213320238	5.68778775	10.407	7.116	5.993642184
2000 JX8	Amor	1.5345269	0.33185427	5.98405	188.93546	41.89959	356.6401118	1.025287596	2.043766204	1.900910891	2.109987691	11.473	9.112	5.146943438
2000 LG6	Aten	0.9175577	0.11077538	2.83327	8.15494	72.53307	3.2365452	0.815914897	1.019200503	0.878921476	7.259102963	5.785	4.91	5.291255378
2000 OK8	Aten	0.9849861	0.2211859	9.98401	166.17021	304.60725	97.6470758	0.767121063	1.202851137	0.977563894	43.57101458	11.099	6.181	6.588130628
2000 SG344	Aten	0.9775362	0.06689972	0.11134	275.13193	192.08365	156.013248	0.912139302	1.042933098	0.966494248	28.84562163	3.55	3.39	4.137480504
2000 SL10	Apollo	1.3720261	0.33876695	1.46333	78.51709	208.80104	340.7094622	0.907229003	1.836823197	1.607102437	2.647168484	9.863	6.364	5.060558746
2000 SZ162	Aten	0.9299344	0.16742849	0.89194	131.38168	14.78638	173.2208065	0.774236888	1.085631912	0.896764629	8.686602465	5.378	4.837	5.269686512
2000 TE2	Amor	1.3206383	0.21399404	6.21998	9.9709	9.13273	120.1299567	1.038029575	1.603247025	1.517664698	2.931752356	11.43	7.867	4.815532297
2000 TL1	Apollo	1.3372558	0.30009271	3.60535	279.31992	27.25134	96.3920152	0.935955083	1.738556517	1.546399624	2.830162315	10.037	6.589	4.865354472
2000 UK11	Aten	0.8829513	0.24876628	0.78562	293.7564	237.17369	244.1634366	0.66330279	1.10259981	0.829669501	4.870939176	7.685	5.32	6.4340318
2000 WG10	Apollo	1.1644477	0.20548348	6.28813	74.37094	49.24413	22.6457567	0.925172934	1.403722466	1.256550598	4.897866575	9.345	7.143	4.930401847
2000 WN148	Amor	1.2657208	0.17352252	12.43438	177.55393	248.83358	302.9260585	1.046089737	1.485351863	1.423989791	3.358547357	11.858	7.605	5.931179636
2000 WP19	Aten	0.8541815	0.28860794	7.6816	222.09242	55.75677	36.5916662	0.607657937	1.100705063	0.789451114	3.749490808	11.228	7.52	7.623545476
2000 YS134	Aten	0.8570933	0.22491082	3.49088	189.48404	97.34324	12.8548183	0.664323743	1.049862857	0.793491265	3.842410177	9.173	6.667	6.700751956
2001 AV43	Apollo	1.2837436	0.24083476	0.2019	51.24451	20.53936	251.7849134	0.974573518	1.592913682	1.454512431	3.200159847	7.141	3.878	4.339279759
2001 BA16	Aten	0.9404641	0.13796204	5.77341	243.18905	115.47708	188.3642488	0.810715754	1.070212446	0.912038839	10.36865394	6.13	4.841	5.475411647
2001 BB16	Aten	0.8545851	0.17261296	2.0277	195.57526	122.56372	1.2112285	0.707072636	1.002097564	0.790010702	3.762147455	7.232	6.258	6.436577385
2001 CQ36	Aten	0.9382966	0.17759771	1.26109	344.32683	30.77147	174.2720664	0.771657273	1.104935927	0.908887674	9.975463462	5.824	4.916	5.285969682
2001 EC16	Apollo	1.3454579	0.36393846	4.71173	70.4705	175.57118	252.7269966	0.855794024	1.835121776	1.560648753	2.783647953	11.349	7.58	5.553933206
2001 FO127	Aten	0.8888674	0.15887996	7.29288	200.85366	189.18924	285.5930753	0.747644183	1.030090617	0.838022092	5.173681402	8.215	5.957	6.494938294
2001 FR85	Aten	0.9828118	0.02790419	5.2449	233.64944	183.06123	147.6492329	0.955387233	1.010236367	0.974328807	37.95416978	4.292	4.032	5.056219443
2001 GP2	Apollo	1.0377739	0.07393323	1.27908	111.32707	196.83521	233.5981724	0.961047924	1.114499876	1.057192604	18.48477843	4.012	3.598	4.068865101
2001 KM20	Apollo	1.1840271	0.20947915	3.73071	251.59053	56.24445	139.402552	0.93599811	1.43205609	1.288375519	4.46770074	7.511	5.746	4.595620133
2001 KW18	Amor	1.2425685	0.15785025	7.21946	181.43992	61.82205	357.4450618	1.046428752	1.438708248	1.385098024	3.596741449	8.828	7.342	4.926342431
2001 QC34	Apollo	1.1283697	0.18756549	6.2362	215.32394	271.66837	252.6097886	0.916726484	1.340012916	1.198607866	6.035047311	7.734	5.578	4.965950864
2001 QE71	Apollo	1.0781072	0.15864154	3.03456	96.26051	148.42672	23.82332	0.907074614	1.249139786	1.119419633	9.373832447	5.664	4.685	4.642773524
2001 QJ142	Apollo	1.0621442	0.08619686	3.10329	63.95639	184.39711	125.7255954	0.970590705	1.153697695	1.094649852	11.56525682	5.442	4.618	4.203001082
2001 SZ169	Amor	1.3341895	0.22978768	6.32849	189.73331	178.73124	201.2579217	1.02760919	1.64076981	1.54108388	2.848142288	10.642	6.723	4.798607537
2001 TD	Aten	0.9539872	0.16605486	9.01943	241.40249	13.18822	150.1379808	0.795572989	1.112401411	0.931780938	13.65865943	8.22	6.136	6.079598697
2001 UP	Aten	0.8833727	0.28713165	7.69651	133.37069	25.49811	184.1517834	0.629728439	1.137016961	0.830263528	4.891485701	10.336	7.146	7.342391851
2001 VC2	Apollo	1.0408585	0.13202618	12.51089	103.86484	67.13859	359.125022	0.903437928	1.178279072	1.061909582	17.15258839	9.876	6.979	6.586696555

2001 VE2	Apollo	1.1059109	0.18115787	4.39379	73.87367	47.11614	32.5877942	0.905566437	1.306255363	1.16300132	7.134919627	6.074	4.963	4.804439159
2001 WH49	Apollo	1.4638943	0.31993758	4.73661	141.87166	238.41596	22.1689854	0.9955395	1.9322491	1.771187668	2.296701234	11.522	7.878	4.835233259
2001 WJ4	Apollo	1.255739	0.21652558	7.90629	18.71253	57.18859	88.3150288	0.983839385	1.527638615	1.40717812	3.45592764	9.578	6.19	4.863749001
2001 XU4	Apollo	1.0193386	0.16358143	12.68305	69.78359	259.35172	315.8326103	0.852593734	1.186083466	1.029147694	35.30803104	10.301	6.522	6.838761288
2002 AL31	Apollo	1.1768625	0.24758311	7.61178	247.09725	297.75429	351.2355437	0.885491222	1.468233778	1.276699202	4.614032834	9.187	6.295	5.391406545
2002 AO11	Aten	0.9169862	0.16239092	13.05661	306.04132	295.09382	146.2282742	0.768075967	1.065896433	0.87810045	7.203475747	10.425	6.955	7.435690841
2002 BF25	Apollo	1.07327	0.22182842	6.2758	77.99627	305.9417	280.3883594	0.835188212	1.311351788	1.111894252	9.937009542	8.716	6.152	5.548429754
2002 CW11	Aten	0.8657175	0.22505446	3.12642	210.35867	137.60848	112.9094277	0.670883916	1.060551084	0.805497682	4.1413269	8.347	6.42	6.549789247
2002 DQ3	Amor	1.3872059	0.25486259	5.05069	160.26413	340.58751	305.7605492	1.033659011	1.740752789	1.633847022	2.577667742	11.563	7.558	4.791168601
2002 EM7	Aten	0.9208087	0.36328711	1.55862	58.93895	345.98619	236.0843731	0.586290769	1.255326631	0.883596773	7.590827098	10.999	7.253	7.911652567
2002 FB	Apollo	1.2053565	0.18664903	7.04135	143.39867	355.73394	245.6898109	0.980377878	1.430335122	1.32334558	4.092666362	10.927	7.738	4.713628196
2002 GR	Apollo	1.2013742	0.20743888	7.32417	313.73983	183.81144	263.4805634	0.952162481	1.450585919	1.316792825	4.156637146	8.845	6.398	4.92461488
2002 JR100	Aten	0.9243997	0.29842543	3.72586	253.89399	202.86029	158.7196802	0.648535322	1.200264078	0.888770628	7.990431077	8.536	6.309	6.92490155
2002 JU15	Apollo	1.184667	0.21395735	10.72641	302.84403	223.22255	317.1793167	0.931198788	1.438135212	1.289420102	4.455185022	10.338	7.373	5.639157216
2002 JX8	Aten	0.770026	0.30520699	4.31483	338.13671	68.61046	32.5603636	0.535008682	1.005043318	0.67570648	2.083626221	11.086	6.088	8.7693038
2002 LT38	Aten	0.8448394	0.31382191	6.20207	162.73772	259.50371	233.1728611	0.579710286	1.109968514	0.776535365	3.474981019	10.784	7.569	7.779170426
2002 NW16	Amor	1.1090384	0.03053165	14.16479	317.70013	301.58437	269.3586565	1.075177628	1.142899172	1.167938233	6.954570212	10.633	7.027	7.48189079
2002 RQ25	Apollo	1.111869	0.30639997	4.56211	225.46914	10.69175	247.5207676	0.771192372	1.452545628	1.17241248	6.80004417	10.712	7.528	5.934347074
2002 SR	Apollo	1.1794308	0.1959321	6.68881	285.1141	160.91399	129.77394	0.948342447	1.410519153	1.280880746	4.560229797	7.513	6.006	4.84264098
2002 TD60	Amor	1.2020594	0.08254185	7.41152	343.83277	62.66539	61.89476	1.102839193	1.301279607	1.317919529	4.145450056	9.049	6.24	5.361461225
2002 TS69	Amor	1.1758666	0.12984173	8.45393	195.39933	200.69505	179.2841525	1.023190046	1.328543154	1.275078967	4.635319746	8.34	6.206	5.04238463
2002 TX59	Amor	1.2237431	0.14604627	12.99384	132.6015	188.61639	38.5969523	1.045019985	1.402466215	1.353740382	3.826931984	11.616	7.691	6.139921949
2002 TY59	Apollo	1.0187146	0.23363044	6.61234	259.19025	9.80938	16.8259935	0.78071186	1.25671734	1.028202832	36.45743235	9.134	6.197	6.03668255
2002 TZ66	Aten	0.9297042	0.12069968	8.47887	223.14228	12.98754	333.2937485	0.817489201	1.041919199	0.896431666	8.655460907	6.659	5.098	6.16252914
2002 VU114	Apollo	1.1806037	0.28572292	2.77776	151.11852	352.8536	83.7738203	0.843278163	1.517929237	1.282791903	4.53616914	8.788	6.281	5.277563206
2002 VX91	Aten	0.9839288	0.20129364	2.34138	78.73212	216.43931	220.4920327	0.78587019	1.18198741	0.975990317	40.64986322	9.095	6.785	5.362100959
2002 XY38	Aten	0.9105654	0.21750264	2.10311	119.24508	159.51023	79.9989126	0.712515022	1.108615778	0.868893835	6.627406372	7.095	5.59	5.923097568
2003 BN4	Amor	1.2694743	0.17095861	5.59063	193.23139	307.60959	99.0561286	1.052446738	1.486501862	1.430328755	3.323804737	9.76	6.332	4.748345074
2003 BS35	Apollo	1.2553851	0.20689306	8.49105	27.13184	127.45055	346.009005	0.995654635	1.515115565	1.406583293	3.459520638	10.079	7.24	4.89055242
2003 CA4	Aten	0.9201774	0.11965948	7.4842	173.07681	139.89942	333.0282191	0.810069451	1.030285349	0.882688247	7.524295071	7.284	5.49	6.073063651
2003 DW10	Apollo	1.446055	0.36077118	2.19495	221.04653	342.18637	257.0510876	0.924360031	1.967749969	1.738910449	2.353343969	10.762	7.699	5.103520995
2003 DY15	Apollo	1.2299936	0.32818051	6.30772	253.05228	342.88785	184.629678	0.826333673	1.633653527	1.364125343	3.746307057	10.678	7.229	5.741153308
2003 EM1	Aten	0.9575408	0.05185818	15.26648	23.81806	346.02408	351.0861551	0.907884477	1.007197123	0.936992106	14.87102715	10.113	6.524	8.306323528
2003 EZ16	Amor	1.1757583	0.13964554	5.80352	71.45864	341.9549	180.1060259	1.011568897	1.339947703	1.274902814	4.637649189	7.586	5.317	4.473523188
2003 FF5	Apollo	1.3693747	0.30381076	6.34174	54.162	192.85747	76.0309589	0.953343932	1.785405468	1.602446171	2.659899338	11.061	7.491	5.034053455
2003 GA	Amor	1.2814966	0.19122609	3.84178	66.78563	192.93404	334.9404839	1.036441016	1.526552184	1.450695245	3.218794212	9.419	6.531	4.499109202
2003 GD42	Apollo	1.2940691	0.22845467	12.23102	156.1971	18.14252	347.8458209	0.998432971	1.589705229	1.472096231	3.118212209	11.731	7.96	5.588486491
2003 GX	Amor	1.3300655	0.20725598	10.85263	168.0493	19.60543	224.8435806	1.054401471	1.605729529	1.533944134	2.872855111	11.772	8.444	5.625532667
2003 HT42	Aten	0.8148487	0.26146059	4.88375	352.28334	38.81598	116.7317943	0.601797878	1.027899522	0.735555531	2.781512254	9.816	5.431	7.712247655
2003 JO14	Apollo	1.2246646	0.34048102	7.10002	95.77935	49.98661	242.3210979	0.807689548	1.641639652	1.355269755	3.814762544	11.594	7.32	5.962228069
2003 JX2	Apollo	1.115669	0.2435927	9.687	276.4232	219.27035	2.8211147	0.843900176	1.387437824	1.178427989	6.604501885	10.138	6.604	5.990981804
2003 LH	Aten	0.9606	0.14976682	10.79788	238.26298	247.2837	194.9809246	0.816733993	1.104466007	0.941486015	16.08993167	8.044	5.787	6.373399198
2003 LN6	Aten	0.8565295	0.21039263	0.63593	210.74443	215.5291	16.8847064	0.676322006	1.036736994	0.79270845	3.824123327	6.454	6.03	6.495620796
2003 MM	Apollo	1.0533469	0.25639929	8.54213	19.80804	127.66836	312.3260576	0.783269503	1.323424297	1.081078256	13.33376314	10.988	8.937	6.267259051
2003 OT13	Apollo	1.1735845	0.17185152	13.11977	242.47571	135.59533	283.5230376	0.97190222	1.37526678	1.271368794	4.685022085	11.375	7.42	6.033549347
2003 QB30	Apollo	1.2306545	0.41757191	0.64129	107.67551	315.00118	52.6728149	0.71676775	1.74454125	1.365224949	3.738038581	11.884	8.245	6.407470373
2003 QU5	Apollo	1.4360312	0.32612568	2.1403	85.35404	287.99143	181.1105779	0.967704548	1.904357852	1.720861085	2.38722983	10.633	6.359	4.773697394
2003 RU11	Aten	0.8887541	0.18240599	4.6641	316.68407	178.25939	16.3434555	0.726640029	1.050868171	0.837861868	5.167580629	6.265	5.705	6.142919901
2003 SM84	Amor	1.1255443	0.08204217	2.7953	87.46186	186.70321	216.6611326	1.033202203	1.217886397	1.194108774	6.151750637	6.36	5.141	4.196005863
2003 SW130	Aten	0.8838359	0.30436109	3.67113	47.76421	176.41398	278.4986027	0.614830642	1.152841158	0.830916641	4.914242579	10.004	6.912	7.152984151
2003 WE	Apollo	1.198943	0.2418972	5.37156	285.21503	58.42146	198.4139283	0.908922045	1.488963955	1.312797692	4.196954532	8.235	6.139	4.972238517
2003 WT153	Aten	0.8937908	0.17774243	0.37108	148.69701	55.78384	268.7454207	0.734926251	1.052655349	0.844994379	5.451378955	6.073	5.824	5.760263181
2003 XH10	Apollo	1.3216384	0.24361723	9.63999	12.34097	70.60669	83.4680578	0.999664514	1.643612286	1.519388982	2.925339263	10.587	8.183	5.119780434
2003 YG136	Aten	0.9685773	0.35469743	2.73556	127.93504	86.53725	96.554818	0.625025421	1.312129179	0.953238182	20.38496846	10.671	7.283	7.980658481
2003 YN1	Amor	1.3356283	0.24326377	5.24443	147.97502	274.21273	54.8834366	1.010718324	1.660538276	1.543577427	2.839664325	10.574	7.12	4.607671259
2003 YS17	Aten	0.9307656	0.31320599	6.52144	134.66875	99.00625	327.2094805	0.639244239	1.222286961	0.897967226	8.8007724	11.152	7.507	7.371683872
2003 YS70	Apollo	1.287494	0.23665437	0.35314	195.73869	271.48291	170.8175327	0.982802919	1.592185081	1.460891024	3.169710295	7.458	4.365	4.285552906
2003 YX1	Aten	0.8795998	0.26709358	5.75727	223.12513	89.67438	217.1229153	0.64466434	1.11453526	0.824950106	4.712657001	9.352	6.496	6.950571948
2004 AD	Apollo	1.2587694	0.26279437	7.30578	302.3973	110.57434	295.2964362	0.927971889	1.589566911	1.412274981	3.425565574	9.487	6.612	5.136417555
2004 BE86	Amor	1.4405389	0.23725915	3.78199	14.71809	154.77494	80.8932624	1.098757865	1.782319935	1.728970111	2.371798357	11.578	6.846	5.090693598
2004 BH11	Apollo	1.2647626	0.32694474	4.33899	83.04893	309.77771	49.901312	0.851255121	1.678270079	1.422373073	3.36757517	9.832	6.795	5.431992372
2004 BV18	Apollo	1.3344951	0.25434541	2.17195	170.84861	302.08004	25.5210634	0.995072397	1.673917803	1.541613395	2.846335429	8.22	4.598	4.365918944
2004 BW18	Amor	1.3726956	0.25312605	5.11361	200.96902	302.9859	261.4963593	1.025230585	1.720160615	1.608278893	2.643982737	10.218	6.161	4.731150723
2004 BY1	Aten	0.8841761	0.22199827	3.60959	28.2098	298.83006	174.6727296	0.687890535	1.080461665	0.831396433	4.931072634	8.588	6.299	6.328118914
2004 CC	Apollo	1.4307466	0.30915034	7.60601	199.19509	324.31584	346.9132374	0.988430802	1.873062398	1.711370667	2.405736906	11.828	7.383	5.081529405
2004 CO49	Apollo	1.3756409	0.38857074	4.26254	315.82639	115.2129	289.7688102	0.841107098	1.910174702	1.613457832	2.630103894	11.358	7.641	5.688888549
2004 DA53	Aten	0.8834538	0.3298506	5.13171	49.97471	336.5778	86.3416468	0.592046034	1.174861566	0.830377867	4.895457035	10.574	7.399	7.588122061

2004 EK1	Apollo	1.2502544	0.25098597	11.63997	300.40025	166.95431	286.3446525	0.936458087	1.564050713	1.397969149	3.512757588	11.168	7.304	5.772859726
2004 EL20	Aten	0.8146675	0.26864596	7.58667	337.62531	356.11648	70.3687576	0.595810367	1.033524633	0.735310194	2.778007222	10.568	7.903	8.065320633
2004 EO20	Amor	1.219484	0.05518686	4.54177	84.21425	179.84571	263.1718388	1.152184507	1.286783493	1.346679224	3.884510902	8.697	5.178	5.170197628
2004 ER21	Aten	0.8996444	0.1713247	7.9437	343.3645	357.34572	45.2181754	0.745513093	1.053775707	0.853308991	5.817050369	8.695	6.455	6.47388606
2004 EU22	Apollo	1.1750879	0.16237059	5.33996	328.4645	175.76289	175.3012773	0.984288184	1.365887616	1.273812574	4.652133232	7.733	5.572	4.423973288
2004 FH	Aten	0.8180456	0.28918846	0.02105	35.09462	292.46446	50.8815389	0.581476253	1.054614947	0.739888487	2.844504953	9.934	5.936	7.596195995
2004 FJ31	Apollo	1.273332	0.32367296	1.95325	203.78138	58.53927	321.7666301	0.861188862	1.685475138	1.436853467	3.289097091	10.055	7.002	5.249084277
2004 FK2	Amor	1.3328581	0.23128343	11.44164	19.40321	177.86254	337.0429536	1.024590107	1.641126093	1.538777663	2.85605319	11.461	7.062	5.573013305
2004 FM32	Apollo	1.098368	0.16188706	3.76029	298.35809	184.46049	155.2767656	0.920556434	1.276179566	1.151123201	7.617117625	6.318	5.01	4.621652797
2004 FN8	Apollo	1.1693314	0.14482929	5.26524	159.79842	4.10283	184.1426664	0.999977964	1.338684836	1.26446385	4.781235122	7.845	5.704	4.316267443
2004 GB19	Apollo	1.3566839	0.36598367	1.28249	327.55636	162.74125	301.1141981	0.860159747	1.853208053	1.580221647	2.723479303	11.033	7.892	5.391411345
2004 HL	Amor	1.5535848	0.34608931	3.40157	170.39523	29.34099	182.2237149	1.015905709	2.091263891	1.936432867	2.067882211	11.002	5.948	4.958821906
2004 HQ1	Apollo	1.1095407	0.2706469	4.41819	93.37081	29.5072	91.8025207	0.809246949	1.409834451	1.168731788	6.926565546	8.479	5.94	5.587397114
2004 HT59	Aten	0.9801666	0.2233661	11.12499	112.17047	214.67475	255.1108738	0.761230609	1.199102591	0.970397903	32.78139019	11.639	7.079	6.835226136
2004 HX53	Apollo	1.1922687	0.33387778	3.55896	241.70978	64.44745	1.847506	0.794196673	1.590340727	1.3018508	4.312894983	10.206	7.185	5.75480467
2004 JN1	Apollo	1.0850725	0.17551859	1.49928	2.11137	143.9723	191.2516744	0.894622105	1.275522895	1.130285446	8.675454425	6.233	4.997	4.654476153
2004 JX20	Aten	0.9018334	0.26600758	10.52115	349.08361	101.88749	241.5403607	0.66193888	1.14172792	0.85642527	5.965013989	11.72	7.887	7.443641196
2004 KG17	Amor	1.5130643	0.32252008	0.47016	147.9502	103.1164	359.0748431	1.025070681	2.001057919	1.861170142	2.16121072	9.95	5.132	4.790798537
2004 MO3	Apollo	1.2324775	0.33591847	2.55166	297.81993	252.67395	278.7642624	0.818465544	1.646489456	1.368259586	3.715475819	10.138	6.868	5.557152451
2004 MO4	Amor	1.6985271	0.38810354	2.2188	188.4639	106.41551	251.4149278	1.03932272	2.35773148	2.213648802	1.823961593	11.704	5.701	5.278059009
2004 MR1	Apollo	1.5227564	0.37313777	1.7867	220.91078	88.12143	188.1539997	0.954558473	2.090954327	1.879081644	2.137550768	11.476	8.1	5.036214179
2004 OW10	Apollo	1.2234442	0.24899033	1.50293	131.01112	102.52302	284.8950105	0.918818425	1.528069975	1.353244434	3.830900935	8.372	5.864	4.676346516
2004 PB97	Amor	1.2348963	0.16276252	10.96914	160.53433	140.71929	202.4725843	1.033901466	1.435891134	1.37228948	3.686081808	10.333	7.248	5.564580969
2004 PG20	Amor	1.4408639	0.26695845	5.20261	339.91365	320.27243	0.8232805	1.056213107	1.825514693	1.729555253	2.370698101	11.802	8.282	5.009028156
2004 PJ2	Apollo	1.4180499	0.34203439	2.5832	281.73931	317.14542	82.973692	0.933028067	1.903071733	1.688640769	2.452135924	11.637	7.63	4.99879461
2004 QA22	Aten	0.9512059	0.12220047	0.57692	28.76664	175.0264	150.3884492	0.834968092	1.067443708	0.927709071	12.83299418	4.629	3.961	4.727436579
2004 QD14	Aten	0.9420691	0.33789724	6.24892	109.28688	75.32464	202.7326368	0.623746551	1.260391649	0.914374569	10.6787733	11.434	7.393	7.768738976
2004 RO111	Aten	0.960836	0.32824063	5.33169	280.91434	199.35603	213.536455	0.645450586	1.276221414	0.941832993	16.19187641	10.59	7.59	7.581987517
2004 RW2	Apollo	1.4254683	0.30552975	8.35654	46.05053	334.22673	350.3768635	0.989945327	1.860991273	1.701909042	2.424686021	11.906	7.462	5.154727795
2004 RX10	Aten	0.9198216	0.35140863	5.95634	333.97274	173.74884	73.9831141	0.596588352	1.243054848	0.88217634	7.487259677	11.697	7.843	7.9313805
2004 SR	Apollo	1.1468597	0.16021075	8.6297	297.5514	354.8304	164.7095566	0.963120447	1.330598953	1.228189664	5.382319436	8.13	6.224	5.10561946
2004 SU55	Amor	1.3756597	0.23703239	1.15421	200.4699	178.25011	107.7535068	1.049583793	1.701735607	1.613490907	2.63001601	10.504	7.736	4.614009638
2004 UR	Apollo	1.5590572	0.40566124	2.43961	56.65252	28.67359	48.2925107	0.926608123	2.191506277	1.946673307	2.056330618	11.594	8.362	5.319911713
2004 UT1	Aten	0.9647361	0.22134966	4.51448	294.43565	211.83809	156.9987209	0.751192092	1.178280108	0.947573256	18.07423438	6.721	5.344	5.834977287
2004 VJ1	Aten	0.9436608	0.16403511	1.29301	332.46023	233.44523	205.6162899	0.788867297	1.098454303	0.916692909	11.00378012	6.033	5.226	5.124263543
2004 WC1	Aten	0.8572586	0.17130685	10.30477	179.42657	54.79006	66.113778	0.71040433	1.00411287	0.793720827	3.847799141	9.966	6.905	7.681559957
2004 WH1	Apollo	1.1980651	0.20341644	2.66037	219.25014	238.91508	213.2159115	0.954358962	1.441771238	1.311356055	4.211757037	7.943	5.744	4.400822875
2004 XD51	Apollo	1.2433153	0.24107441	6.80809	54.23687	83.67161	37.9921659	0.943583798	1.543046802	1.386346904	3.588347385	9.044	6.432	4.948454593
2004 XG	Aten	0.8371564	0.29841645	1.20231	1.03776	285.02804	144.0116212	0.587335159	1.086977641	0.765966723	3.272896635	9.803	7.129	7.412800047
2004 XG29	Apollo	1.4097109	0.31328157	0.15387	110.1403	302.61086	3.7175279	0.968074456	1.851347344	1.67376733	2.48419188	11.44	7.037	4.668874734
2004 XK3	Apollo	1.2278276	0.26048862	1.48184	304.65829	57.91607	194.3368797	0.907992483	1.547662717	1.360523624	3.773743335	8.382	5.841	4.771435976
2004 YC	Aten	0.8681864	0.31393123	6.08045	47.45236	263.34504	222.3999352	0.595635576	1.140737224	0.80894588	4.23411901	11.065	7.335	7.560712968
2005 AJ3	Amor	1.2747684	0.200978	7.53917	215.88006	281.90474	297.9038516	1.018567997	1.530968804	1.439285446	3.276424153	9.125	5.757	4.834264249
2005 AZ28	Apollo	1.4657801	0.34086827	1.60942	100.78047	313.84282	32.517284	0.966142173	1.965418027	1.774611256	2.290970138	10.575	5.448	4.830590868
2005 BG28	Apollo	1.0255326	0.22684016	6.12316	80.86991	313.50268	245.5723996	0.792900621	1.258164579	1.038542337	26.94549459	7.599	5.457	5.872187259
2005 EH94	Apollo	1.2154996	0.26619422	6.17092	254.93612	348.95496	311.5023379	0.891940632	1.539058568	1.340084643	3.940444445	9.164	6.533	5.203823153
2005 ER70	Apollo	1.2248128	0.22302949	6.83715	236.26341	349.5582	32.6765494	0.951643426	1.497982174	1.35551577	3.812814745	9.431	6.431	4.877896217
2005 ER95	Amor	1.2232371	0.15895986	3.34159	8.48131	175.89141	63.4920833	1.028791502	1.417682698	1.352900841	3.833657175	7.33	4.348	4.318695813
2005 ES1	Apollo	1.35663	0.29579423	1.86	315.15932	164.68699	24.3284582	0.955346674	1.757913326	1.580127476	2.723759071	8.515	7.13	4.678549596
2005 EZ169	Amor	1.3167717	0.21526346	2.744	353.54379	175.86179	163.323616	1.033318868	1.600224532	1.51100439	2.956930349	10.882	6.816	4.473337191
2005 FG	Apollo	1.121791	0.21286495	3.88238	272.62066	355.65399	1.3505918	0.883001015	1.360580985	1.188140848	6.315166858	6.994	5.525	4.942981029
2005 FJ	Amor	1.0906008	0.06507902	10.03127	317.0978	173.91868	38.2721591	1.019625569	1.161576031	1.13893442	8.197640465	7.305	5.588	5.773652265
2005 FN	Aten	0.9333262	0.33013317	3.74835	120.83198	177.35477	200.9409098	0.625204263	1.241448137	0.901675327	9.170387248	11.756	7.349	7.432407337
2005 GE60	Aten	0.958856	0.24591534	5.56915	112.71319	229.92752	344.2116061	0.723058601	1.194653399	0.938923232	15.37283767	8.287	5.932	6.276525104
2005 GN22	Amor	1.2844491	0.20550274	2.19776	17.9968	187.92488	226.1438838	1.020491291	1.548406909	1.455711618	3.194370212	8.581	6.778	4.312348762
2005 HB4	Amor	1.3547056	0.22801399	2.52706	153.2475	83.84602	22.302343	1.045813771	1.663597429	1.576766517	2.733803836	10.758	7.037	4.601297801
2005 JT1	Apollo	1.4191165	0.3021417	1.56274	195.575	65.3462	224.7713155	0.990342228	1.847890772	1.690546319	2.448128782	10.371	7.605	4.562658358
2005 KA	Aten	0.8399999	0.21448095	2.90804	181.39547	226.28629	340.6877886	0.659835923	1.020163877	0.769872579	3.345418711	7.738	6.966	6.892551432
2005 LC	Amor	1.1338623	0.10244555	2.79898	147.06339	69.82002	347.0942931	1.017703153	1.250021447	1.207370258	5.822292306	6.153	5.287	4.097350602
2005 LU3	Apollo	1.0569051	0.30825313	5.5794	71.84115	80.74136	336.67338	0.731110795	1.382699405	1.086560694	12.55258766	11.672	6.544	6.351987757
2005 ML13	Apollo	1.1480812	0.24629806	6.83674	220.62279	140.7688	185.6572221	0.865311028	1.430851372	1.230152371	5.344947633	9.508	6.69	5.416031502
2005 ND63	Apollo	1.3584365	0.30159537	8.50686	313.26413	289.39035	4.5617821	0.948738341	1.768134659	1.583284694	2.714428667	11.528	7.788	5.299611986
2005 OH3	Amor	1.236565	0.16827738	4.79174	185.44147	128.65489	285.3445066	1.028479082	1.444650918	1.375071956	3.666155077	7.446	6.681	4.481693281
2005 QP11	Aten	0.9755286	0.17562425	3.95446	119.8681	334.84512	126.048172	0.804202121	1.146855079	0.963518393	26.41107317	5.804	4.716	5.209018025
2005 QP87	Amor	1.232877	0.1754034	0.26758	7.12616	327.65636	280.3857077	1.016626182	1.449127818	1.368924909	3.7105787	7.075	6.201	4.123334501
2005 RK3	Amor	1.2470001	0.18512142	3.72543	18.26737	342.70382	219.4499498	1.016153671	1.477846529	1.39251452	3.54767645	9.077	6.228	4.323182334
2005 RZ2	Apollo	1.1067299	0.10349123	13.16116	280.15159	155.00764	259.6953801	0.992193061	1.221266739	1.164293478	7.086668865	9.7	6.169	6.332747097
2005 SL	Apollo	1.1261284	0.29879917	6.16763	289.91124	176.1559	179.916813	0.789642169	1.462614631	1.195038417	6.127195025	10.599	7.24	5.925051095
2005 SQ9	Apollo	1.4435441	0.35659579	4.04325	280.38939	6.81349	150.038547	0.928782351	1.958305849	1.734383304	2.361686731	11.517	7.68	5.156773913

2005 TA	Apollo	1.2806833	0.2501384	2.78066	34.39996	14.00388	97.8099736	0.960335228	1.601031372	1.449314441	3.225612863	7.752	4.653	4.521676863
2005 TC51	Apollo	1.0083302	0.30578087	5.67363	288.01159	199.3474	305.2519733	0.700002114	1.316658286	1.012521286	80.86400074	10.505	6.461	6.653072373
2005 TE49	Aten	0.9479167	0.36463522	4.77677	304.77985	195.16268	250.5346231	0.602272886	1.293560514	0.922901309	11.97038877	11.753	8.175	8.172519795
2005 TF45	Amor	1.15629	0.07420041	6.82018	37.21763	197.17089	273.186502	1.070492808	1.242087192	1.243369342	5.108980995	7.731	5.894	5.107251702
2005 TG50	Aten	0.9234974	0.13459503	2.40148	200.9377	344.38867	310.8458443	0.79919924	1.04779556	0.887469662	7.886492444	6.449	4.975	5.229877681
2005 TH50	Aten	0.8378166	0.22494704	0.73028	18.16677	196.8354	153.6983285	0.649352236	1.026280964	0.766872989	3.289507241	7.246	6.503	6.884644231
2005 UE1	Aten	0.8930187	0.17004757	5.6514	139.66579	32.60478	164.3988947	0.74116304	1.04487436	0.843899695	5.406137377	7.751	5.677	6.170152651
2005 UG5	Apollo	1.0555274	0.18866896	2.84426	112.04246	35.77373	50.027226	0.856382143	1.254672657	1.084436851	12.84317024	6.911	5.436	5.024958373
2005 UV64	Aten	0.958263	0.11611935	5.41525	313.94452	216.06233	133.3854431	0.846990123	1.069535877	0.938052358	15.14266451	6.079	4.853	5.148563923
2005 UW5	Apollo	1.3968587	0.39489868	2.93978	63.08411	35.17874	158.147588	0.845241043	1.948476357	1.650930213	2.536262996	11.29	7.625	5.627785337
2005 VL1	Aten	0.8916903	0.22573139	0.24757	226.0012	40.31147	46.7057218	0.690407809	1.092972791	0.842017395	5.329810798	7.272	5.739	6.130274066
2005 VN5	Aten	0.9444435	0.23302013	2.08689	115.0775	49.33532	228.7285097	0.724369153	1.164517847	0.917833644	11.17043137	6.516	5.282	5.879389757
2005 WA	Apollo	1.121799	0.22779741	8.16016	113.19393	227.87205	274.9749019	0.866256093	1.377341907	1.188153558	6.314807818	9.017	6.219	5.590152309
2005 WF55	Amor	1.501969	0.32522017	2.26172	181.99778	244.83289	324.5593733	1.013498386	1.990439614	1.840735778	2.189434334	10.452	5.73	4.773019933
2005 YA37	Apollo	1.2800527	0.22778063	2.24018	88.69149	93.08867	358.7844441	0.98848149	1.57162391	1.448244124	3.230927183	8.68	4.91	4.287332592
2005 YR3	Aten	0.8198426	0.27352293	3.28092	218.06548	75.28048	182.2681313	0.59559685	1.04408835	0.742327794	2.88089975	10.015	7.23	7.562584121
2005 YY1	Apollo	1.1640425	0.25225628	8.34211	279.1713	84.07724	108.1908417	0.870405469	1.457679531	1.25589478	4.907856183	9.904	6.625	5.594379338
2006 AN	Apollo	1.0941642	0.22051838	7.40728	273.39597	277.62878	225.7771146	0.852880883	1.335447517	1.144520963	7.919411425	10.301	7.343	5.57272545
2006 BA	Apollo	1.1205954	0.21795121	3.54877	250.75038	298.62128	128.804028	0.876360277	1.364830523	1.186241881	6.369361573	6.986	5.408	4.968443963
2006 BJ55	Apollo	1.0284412	0.12833868	5.91001	288.80346	307.46452	90.0542449	0.896452414	1.160429986	1.042963715	24.27545441	6.519	4.981	5.126218431
2006 BL55	Amor	1.4615166	0.31208245	3.90137	25.06497	130.85245	348.2712279	1.005402919	1.917630281	1.766874198	2.303994844	10.736	5.665	4.758134263
2006 BO7	Apollo	1.4359491	0.40341948	0.34184	247.93009	294.84166	31.3308968	0.856659261	2.015238939	1.72071351	2.387513881	11.308	7.735	5.55079705
2006 BP147	Apollo	1.2873921	0.24053496	5.60067	123.0566	310.81238	36.2630692	0.977729293	1.597054907	1.460717592	3.170527059	9.606	6.534	4.645593128
2006 BQ7	Amor	1.3480059	0.25788276	4.98178	155.05963	302.14518	15.6659194	1.000378418	1.695633382	1.565084137	2.769647978	8.864	7.356	4.57071287
2006 BR98	Amor	1.1970752	0.16201877	10.01758	7.30216	129.84449	268.9264579	1.003126549	1.391023852	1.309731131	4.228606687	9.607	6.478	5.194116916
2006 BU7	Amor	1.1757397	0.10764665	8.2504	348.42664	121.86995	356.3100624	1.04917526	1.30230414	1.274872562	4.63804955	8.511	5.977	5.195012662
2006 BV39	Apollo	1.145367	0.27148529	0.74023	74.88193	127.21585	39.4800174	0.834416708	1.456317292	1.225792611	5.428842882	8.304	6.281	5.23883549
2006 BW7	Apollo	1.4779046	0.40959315	1.3715	116.95179	305.48867	27.0047295	0.872564999	2.083244201	1.796675317	2.255216497	11.744	7.593	5.519807294
2006 BX7	Apollo	1.1392783	0.28205897	4.89933	77.52042	313.32533	166.2949138	0.817934636	1.460621964	1.216031257	5.62895979	9.716	6.168	5.580620216
2006 BZ147	Apollo	1.0235019	0.09856724	1.40961	94.81644	139.83037	104.9713208	0.922618143	1.124385657	1.035459173	29.20144734	4.11	3.831	4.369404247
2006 CK	Apollo	1.0827796	0.2143136	5.1738	264.6272	310.93345	246.7860492	0.850725206	1.314833994	1.126704678	8.892368448	8.336	6.452	5.297979908
2006 CL9	Amor	1.3462415	0.23676988	2.93587	9.94634	139.31017	228.2157498	1.027492062	1.664990938	1.562012343	2.779320352	8.957	4.992	4.518624107
2006 CT	Apollo	1.0968911	0.23070197	2.74143	82.59678	285.52968	1.5908968	0.843836162	1.349946038	1.148802228	7.720329498	8.058	6.631	5.162010409
2006 DM	Amor	1.3550784	0.21191669	7.07254	177.7434	333.9659	207.2917525	1.067914671	1.642242129	1.577417425	2.731849363	11.361	7.632	5.119357563
2006 DN	Apollo	1.3806428	0.27602754	0.26623	101.2445	96.56282	126.3234031	0.999547364	1.761738236	1.622265748	2.607030443	10.372	7.626	4.378437578
2006 DQ14	Apollo	1.0277278	0.05295441	6.29615	292.48469	155.32719	218.3353698	0.973305081	1.082150519	1.041878693	24.87849122	4.56	4.165	5.011514164
2006 DX	Apollo	1.1424184	0.16677075	6.23621	83.27405	331.4043	79.7487389	0.951896427	1.332940373	1.221062191	5.523613899	7.392	5.484	4.74355992
2006 EC	Apollo	1.1377134	0.21756939	7.58677	245.672	347.48115	32.7444895	0.89018179	1.38524501	1.213526627	5.683256677	10.2	6.091	5.341488252
2006 EW52	Amor	1.2459301	0.09582148	8.89428	304.98436	343.56412	351.9967134	1.126543234	1.365316966	1.390722615	3.559360431	10.432	6.932	5.742989685
2006 EY	Amor	1.4284213	0.27633732	3.92137	218.70214	349.78003	23.0875049	1.033695186	1.823147414	1.707200292	2.414026565	11.417	8.704	4.785826911
2006 FH36	Aten	0.9550047	0.19850369	1.58687	154.71538	280.74727	205.7625778	0.765432743	1.144576657	0.933272058	13.98622576	5.997	4.928	5.394737208
2006 GB	Aten	0.9590642	0.17939713	10.06159	242.83159	183.83397	189.6094274	0.787010835	1.131117565	0.939229057	15.45523255	8.124	5.59	6.332907027
2006 GB1	Apollo	1.1341041	0.28864407	0.83363	220.72377	76.42692	358.7063663	0.806751677	1.461456523	1.207756492	5.813327316	8.715	6.422	5.470840251
2006 GU2	Apollo	1.0799742	0.25574103	3.37234	266.31485	197.10799	326.2353929	0.803780486	1.356167914	1.122328705	9.174696179	8.921	5.645	5.535113974
2006 HC	Amor	1.1114907	0.07462319	7.85692	192.71715	31.64221	122.5123723	1.028547718	1.194433682	1.171814182	6.820241305	7.109	5.517	5.155803069
2006 HE2	Apollo	1.0650418	0.15675986	1.18138	90.28864	200.40608	245.9416654	0.898085997	1.231997603	1.099132323	11.0875272	4.993	4.606	4.590918322
2006 HU50	Apollo	1.2875591	0.24680766	5.90427	214.34433	46.93226	296.188634	0.969779651	1.605338549	1.461001827	3.169188801	9.897	6.258	4.731174666
2006 HW50	Apollo	1.2353957	0.19072229	5.54249	323.32473	216.17475	123.9749428	0.999778203	1.471013197	1.373122008	3.68008849	8.916	6.179	4.416337411
2006 HX30	Amor	1.480857	0.30997621	1.0024	38.07601	180.38577	280.9094659	1.02182656	1.93988744	1.802061814	2.246786698	10.561	8.3	4.713758401
2006 HZ5	Apollo	1.2015397	0.20579792	4.27895	307.40468	202.84909	241.6375562	0.954265329	1.448814071	1.317064935	4.153928078	8.528	6.085	4.53468914
2006 JY26	Apollo	1.0100886	0.08306927	1.43923	273.60219	43.47088	86.3505161	0.926181277	1.093995923	1.015171004	66.91521776	8.549	6.321	4.342251141
2006 KL21	Amor	1.1990818	0.12743639	9.35552	214.19707	117.22954	99.5781898	1.046275144	1.351888456	1.31302567	4.194626178	8.556	5.83	5.36098521
2006 KQ1	Amor	1.244342	0.17534771	9.60486	18.19106	88.69992	172.1133761	1.02614948	1.46253452	1.388064477	3.576891365	9.87	7.098	5.224493536
2006 KV89	Apollo	1.1502001	0.27281639	3.55439	87.71134	71.73479	22.1813958	0.836406661	1.463993539	1.233559498	5.281564265	8.115	6.129	5.337224565
2006 MB	Amor	1.113862	0.0830369	14.42766	287.02472	257.64295	146.1989429	1.021370352	1.206353648	1.175566176	6.695857938	10.662	6.691	6.896641616
2006 MV1	Apollo	1.3160439	0.24131126	4.27215	31.56619	264.65244	207.8691175	0.998467688	1.633620112	1.50975183	2.96173891	10.461	6.843	4.44568663
2006 OT9	Apollo	1.1238081	0.18185205	14.56301	193.99665	310.26449	164.9157344	0.919441293	1.328174907	1.191346894	6.226110429	11.808	7.902	6.698734917
2006 QQ23	Aten	0.8035912	0.28464055	3.43846	124.76683	4.90217	18.2585734	0.574856559	1.032325841	0.720365256	2.576093538	10.521	7.404	7.923788741
2006 QV89	Apollo	1.1918407	0.22429729	1.07087	236.70485	166.06485	86.2692995	0.924514061	1.459167339	1.301149856	4.320605938	6.552	5.638	4.559411636
2006 RH120	Aten	0.9986249	0.01983256	1.52613	177.87923	290.52215	5.774614	0.978819612	1.018430188	0.997938059	483.9799879	3.972	3.808	3.9382444
2006 RH2	Apollo	1.0865356	0.08173199	11.78637	222.84488	172.27873	59.5871314	0.997730883	1.175340317	1.132572313	8.543053124	8.348	5.968	6.090480249
2006 RJ1	Aten	0.9506695	0.30059323	1.41464	110.28769	93.49859	86.6106424	0.664904684	1.236434316	0.926924457	12.68446896	8.783	6.402	6.85684817
2006 SF281	Apollo	1.3376251	0.26422993	3.04047	31.43702	9.85032	341.1831992	0.984184513	1.691065687	1.547040254	2.828019039	9.032	7.739	4.489683007
2006 SF6	Aten	0.9492319	0.28047791	5.86564	305.60798	228.12283	147.8386597	0.682993321	1.215470479	0.924822713	12.30188995	9.31	6.592	6.807618231
2006 SK61	Amor	1.3804311	0.26422201	0.35389	62.53441	304.58789	18.5073227	1.01569082	1.74517138	1.621892638	2.607994593	9.818	6.032	4.447899718
2006 SP19	Aten	0.8805283	0.29297992	4.58805	166.31217	358.26814	181.9496466	0.622551189	1.138505411	0.826256669	4.755616609	9.818	6.986	7.102937233
2006 SQ134	Apollo	1.2428605	0.25314534	10.18537	247.11313	186.84766	317.7436764	0.928236156	1.557484844	1.385586293	3.593453183	10.929	7.172	5.552642404

2006 SR131	Apollo	1.3515345	0.33686121	0.63079	120.98881	184.88472	108.0348726	0.896254953	1.806814047	1.571233407	2.750597896	9.894	6.652	5.090427796
2006 SU217	Aten	0.9852942	0.17399396	2.63823	38.43191	193.72505	252.7572739	0.81385896	1.15672944	0.978022598	44.50128268	10.115	7.808	5.034694823
2006 SV217	Apollo	1.3196097	0.35138224	0.8792	97.28619	179.58947	53.8520427	0.855922288	1.783297112	1.515891958	2.938390365	9.975	6.913	5.35138774
2006 SV5	Amor	1.4448597	0.29309773	4.82839	208.175	182.2608	243.8879203	1.021374602	1.868344798	1.736754836	2.357303612	11.256	9.1	4.841504459
2006 SY5	Apollo	1.0432114	0.15237298	7.56492	175.57282	335.96042	110.2778607	0.88425417	1.20216863	1.065512347	16.2642983	7.948	5.628	5.463079507
2006 UB17	Amor	1.1408537	0.10394856	1.99385	135.09813	213.95285	275.7462533	1.022263601	1.259443799	1.21855443	5.575519244	6.666	5.939	4.058791294
2006 UN	Amor	1.548884	0.330579	0.494	72.05517	323.37931	75.433903	1.036855476	2.060912524	1.9276507	2.077991964	11.486	6.282	4.920731678
2006 UQ216	Apollo	1.1035801	0.16244379	0.47331	247.51335	217.80107	305.7756482	0.924310366	1.282849834	1.159326574	7.276416886	5.557	4.826	4.401931418
2006 VB45	Amor	1.2224396	0.16460571	12.47045	171.1988	234.51006	353.6866957	1.021219062	1.423660138	1.351578003	3.844319013	11.179	7.33	5.838169953
2006 VG13	Aten	0.8175806	0.30361938	5.86032	115.22533	96.62246	175.0871864	0.569347285	1.065813915	0.739257717	2.835204584	11.237	7.674	8.008087716
2006 VP13	Amor	1.1768367	0.14213902	11.0338	234.61963	230.97184	73.9024151	1.009562285	1.344111115	1.276657219	4.614581265	10.087	6.847	5.514900898
2006 VX2	Aten	0.9339807	0.29078059	9.82565	126.55767	47.29412	246.5555042	0.662397241	1.205564159	0.90262395	9.269465674	11.756	7.47	7.46855927
2006 WB	Aten	0.8494289	0.18027079	4.88011	162.08754	65.23936	299.750495	0.696301681	1.002556119	0.782871619	3.605570201	7.262	6.433	6.81940154
2006 WV1	Aten	0.8279757	0.2890465	5.57787	149.39314	61.84596	111.207017	0.588652222	1.067299178	0.753401337	3.055172024	11.386	7.476	7.722293816
2006 WZ184	Apollo	1.3655143	0.32817081	0.84752	127.84744	249.47109	32.9578619	0.917392366	1.813636234	1.595674772	2.678768427	10.139	6.417	4.95858503
2006 XP4	Aten	0.8731056	0.21418807	0.53406	343.71742	296.40485	86.5788711	0.686096797	1.060114403	0.815830919	4.429793077	7.381	6.043	6.269455281
2006 XQ4	Amor	1.4724034	0.29577891	6.13286	182.89657	260.96864	167.5262905	1.036897527	1.907909273	1.786653019	2.271208495	11.331	6.288	5.076161816
2006 XW	Amor	1.1022675	0.03755524	8.21975	229.785	75.85633	98.0892293	1.060871579	1.143663421	1.157258832	7.358943333	6.689	5.449	5.626098798
2006 XW4	Apollo	1.0423043	0.08641799	13.3188	261.56794	79.93424	271.6355784	0.952230457	1.132378143	1.064122912	16.59504975	9.038	5.917	6.848897316
2006 XY	Apollo	1.4979104	0.33844112	3.63844	184.12022	257.93399	127.4806022	0.990955927	2.004864873	1.833279804	2.200077087	9.478	8.339	4.853435406
2006 YF	Apollo	1.1083702	0.19899133	4.67598	27.09703	274.4111	81.0131286	0.88781414	1.32892626	1.166882861	6.992227088	9.68	5.833	4.969915688
2006 YM	Aten	0.8979065	0.12367167	12.88099	171.0365	86.42295	326.0049447	0.786860904	1.008952096	0.850837599	5.704102312	9.938	6.728	7.843014702
2006 YP	Apollo	1.1448007	0.21092165	5.38492	95.20284	69.41901	130.0430846	0.903337447	1.386263953	1.224883627	5.446744361	7.203	5.627	4.958307082
2007 AA2	Apollo	1.0325259	0.1208139	10.55093	96.22368	287.85538	264.9198004	0.907782419	1.157269381	1.04918345	21.33204239	7.69	5.663	6.110202767
2007 BB	Aten	0.9324982	0.14130875	3.52541	301.77797	297.88574	166.3145725	0.800728045	1.064268355	0.900475712	9.047798563	5.963	5.132	5.257442238
2007 CM26	Aten	0.9424276	0.1800381	7.14068	152.35185	142.69159	55.5497467	0.772754726	1.112100474	0.91489656	10.75040632	8.687	5.821	5.895523109
2007 CS5	Aten	0.9803969	0.17289292	0.75106	261.42738	125.24674	114.6566875	0.810893217	1.149900583	0.97073993	33.17626807	4.814	4.571	4.952792522
2007 CX50	Apollo	1.2070298	0.22604602	7.50144	126.21343	322.42936	357.3983494	0.934185518	1.479874082	1.326102179	4.066523517	9.109	6.528	5.068537426
2007 DC	Apollo	1.351584	0.32431676	0.40764	278.07046	174.88533	30.1501419	0.913242656	1.789925344	1.571319727	2.750333398	8.691	6.907	4.957413235
2007 DD	Aten	0.9875658	0.11579704	2.62461	77.48233	329.03247	65.7142399	0.873208604	1.101922996	0.981406799	52.78310123	8.428	6.51	4.467374938
2007 DG8	Apollo	1.3603223	0.37470338	3.06927	90.08098	131.99386	295.1621463	0.850604936	1.870039664	1.586582744	2.704789326	11.261	7.543	5.528486287
2007 DH8	Amor	1.4370626	0.26331379	4.45229	356.20226	149.53146	191.4913752	1.0586642	1.815461	1.722715377	2.383670573	11.728	8.971	4.951162828
2007 EC	Aten	0.927032	0.19634086	5.81166	45.76672	307.90021	58.1037988	0.74501774	1.10904626	0.892569595	8.308351741	7.576	5.585	5.937424006
2007 EE26	Apollo	1.2448335	0.24057931	1.03176	123.21476	342.60445	244.2909813	0.945352316	1.544314684	1.388886961	3.571441318	7.042	5.977	4.495010623
2007 EK	Apollo	1.1260355	0.2722858	1.20665	83.33964	168.56038	121.5985399	0.819432023	1.432638977	1.194890543	6.131085306	8.05	6.043	5.353184752
2007 FO3	Apollo	1.2688326	0.2962397	6.31294	262.10421	356.85734	311.6318439	0.892954011	1.644711189	1.429244378	3.329675241	10.319	6.947	5.284432106
2007 FP3	Apollo	1.4133336	0.40332826	0.23642	119.71488	352.35286	244.6830613	0.843296218	1.983370982	1.680223388	2.470105287	11.287	7.756	5.612660019
2007 GS3	Apollo	1.0610961	0.1290415	15.08898	61.19055	215.45081	300.1224357	0.924170668	1.198021532	1.093029989	11.74922201	11.825	7.239	7.182445234
2007 HB15	Apollo	1.2560461	0.25628423	1.11079	226.20459	37.30532	129.4719635	0.934141292	1.577950908	1.407694355	3.452817871	8.54	6.436	4.608153914
2007 HC	Apollo	1.1550805	0.2072509	3.15642	57.91043	216.8804	8.0714106	0.915689027	1.394471973	1.241418972	5.142176528	7.365	5.725	4.667001807
2007 HL4	Amor	1.1182815	0.08952412	6.52012	138.47789	31.15552	200.2591272	1.018168333	1.218394667	1.1825696	6.477363156	6.788	5.165	4.72984543
2007 LT	Apollo	1.4979076	0.37941428	0.68496	342.78202	222.22762	58.2111947	0.929580066	2.066235134	1.833274664	2.20008449	11.597	8.035	5.136631745
2007 PS9	Apollo	1.0740877	0.07627253	8.70238	80.00944	313.26305	145.5772358	0.992164314	1.156011086	1.113165185	9.836640024	6.101	5.126	5.313342687
2007 RC20	Aten	0.9543454	0.19810228	2.88372	309.42442	165.11495	257.8025555	0.7652874	1.1434034	0.93230578	13.77230999	5.649	4.885	5.464039164
2007 RF1	Aten	0.8369056	0.2363911	2.59141	350.7646	159.86738	11.5814657	0.639068565	1.034742635	0.76562254	3.26662189	8.36	4.91	7.02548269
2007 RO17	Aten	0.9268931	0.19693905	2.46176	195.39352	355.1662	189.930521	0.744351653	1.109434547	0.892368998	8.291003319	7.055	5.469	5.61304443
2007 RT12	Apollo	1.0170635	0.15985615	4.2504	43.35727	167.6023	151.1854599	0.854479645	1.179647355	1.025704128	39.90425755	9.427	7.472	5.167319167
2007 RV12	Amor	1.6674205	0.3891288	4.01241	190.09938	163.34034	129.4766554	1.018579162	2.316261838	2.153117372	1.867214409	11.877	5.966	5.24762414
2007 RX8	Apollo	1.1383037	0.21111845	9.39088	281.98509	348.46203	44.2746945	0.897986787	1.378620613	1.214471202	5.662630641	9.357	6.347	5.594647786
2007 SG11	Aten	0.8352803	0.24830121	6.88392	345.66856	193.67998	343.3332188	0.627879191	1.042681409	0.763393325	3.226423448	10.374	7.89	7.52684317
2007 SQ6	Apollo	1.0429924	0.14550173	9.10123	283.74658	191.42257	173.6503355	0.891235201	1.194749599	1.065176842	16.34287291	6.489	5.135	5.752338522
2007 TA23	Amor	1.3825331	0.24841517	6.05158	5.71534	18.43625	143.5402477	1.039090905	1.725975295	1.625598563	2.598469145	10.182	6.007	4.905088055
2007 TE66	Apollo	1.0555133	0.20424925	10.24559	355.25555	195.75532	59.605265	0.8399255	1.2711011	1.084415122	12.84621878	11.647	8.937	6.195390488
2007 TE71	Amor	1.2436225	0.18746616	7.44734	109.97575	200.52111	105.5043051	1.010485365	1.476759635	1.386860747	3.584909449	9.393	6.337	4.749519737
2007 TF15	Amor	1.1088066	0.04482017	4.25285	28.88731	193.14095	199.7579703	1.0591097	1.1585035	1.167572086	6.967581013	6.62	5.11	4.635163934
2007 TH3	Aten	0.9682124	0.12104036	8.23237	238.06519	11.85636	300.8410218	0.851019623	1.085405177	0.952699551	20.14144842	7.191	5.895	5.641449836
2007 TH71	Apollo	1.3413777	0.31318682	7.06526	52.88899	20.01968	189.4297765	0.921275884	1.761479516	1.553554964	2.806505342	10.778	7.382	5.277193975
2007 TN74	Aten	0.8964204	0.2984783	9.68605	146.20671	14.87256	41.9663522	0.628858363	1.163982437	0.848726177	5.610529019	11.992	7.486	7.661124154
2007 TR68	Aten	0.8753732	0.25788322	11.37631	144.98925	18.1622	143.7938347	0.64962914	1.10111726	0.819011254	4.525205422	11.502	7.963	7.778943516
2007 TT24	Amor	1.4403362	0.28024163	0.81696	19.67108	6.09498	355.4120382	1.036694036	1.843978364	1.728605195	2.37248541	10.752	8.477	4.688357616
2007 TV18	Apollo	1.2375022	0.34805696	0.93417	289.21629	353.27434	128.1261482	0.806780946	1.668223454	1.376635515	3.65508684	10.428	7.209	5.622291812
2007 UD6	Apollo	1.2321332	0.24264127	1.69391	131.15871	205.95715	109.0959634	0.933166836	1.531099564	1.367686278	3.719709869	8.498	5.866	4.584547493
2007 UN12	Apollo	1.0537561	0.06050395	0.23532	134.37624	216.07494	247.1498204	0.989999694	1.117512506	1.081708276	13.2386623	4.504	3.757	3.805354717
2007 UP6	Aten	0.9678435	0.09432661	9.57789	236.26873	31.42752	289.289641	0.876550104	1.059136896	0.952155119	19.9008775	6.691	5.474	6.014226527
2007 UW1	Aten	0.9077021	0.12090205	8.21738	146.5737	25.97708	316.4813763	0.797959055	1.017445145	0.864798665	6.396376647	7.203	5.848	6.437587599
2007 UY1	Aten	0.9510404	0.17517732	1.02001	273.55127	337.83242	7.2408737	0.784439692	1.117641108	0.927466964	12.7868212	5.505	4.799	5.155229033
2007 VB188	Aten	0.8814081	0.22472725	7.21476	155.04382	43.07568	61.6785715	0.683331682	1.079484518	0.827495338	4.796944796	9.784	6.605	6.795923045
2007 VD3	Aten	0.9721264	0.15029987	13.1189	179.89911	53.79076	309.0830252	0.826015928	1.118236872	0.958482319	23.08612395	11.286	6.917	6.877514407
2007 VT83	Apollo	1.3055358	0.29564605	6.91847	290.17632	38.34641	42.723428	0.919559298	1.691512302	1.491705799	3.033736437	10.482	7.354	5.214914174

2007 VU6	Aten	0.9760634	0.09040475	1.22315	34.72329	220.29095	269.8016816	0.887822632	1.064304168	0.964310825	27.01970086	4.852	4.123	4.30204687
2007 VV6	Amor	1.4158446	0.28018874	3.8061	149.85468	235.76774	84.9301794	1.019140885	1.812548315	1.684703132	2.460486967	9.728	8.076	4.691164138
2007 VV83	Aten	0.9665559	0.09776314	10.11381	318.76023	225.56887	32.5641571	0.87206236	1.06104944	0.950255658	19.10278887	7.794	6.509	6.164297161
2007 VW83	Aten	0.901443	0.21987826	7.09425	163.35457	39.08773	315.5716136	0.703235282	1.099650718	0.855869216	5.938143074	10.119	6.527	6.526014022
2007 WA	Apollo	1.0351537	0.15264691	6.15515	276.6464	229.42533	179.294225	0.877140686	1.193166714	1.053191289	19.80007099	6.012	5.064	5.265515273
2007 WC5	Aten	0.9730507	0.21038739	8.54127	66.36046	236.66206	215.921189	0.768333103	1.177768297	0.959849635	23.90637388	9.425	6.971	6.22909756
2007 WU3	Apollo	1.0101033	0.20471763	2.39992	350.77897	178.7268	247.2284676	0.803317346	1.216889254	1.015193165	66.81907262	7.134	5.077	5.439269323
2007 WZ4	Apollo	1.3626936	0.28179402	2.94562	316.21911	62.82882	176.9589684	0.978694692	1.746692508	1.590733123	2.692811797	10.669	7.049	4.576136279
2007 XB23	Apollo	1.0412256	0.05428559	8.52871	192.97547	260.28598	196.8436173	0.984702054	1.097749146	1.062471419	17.0073202	4.695	4.433	5.523115008
2007 XP	Aten	0.9862696	0.27069836	7.64884	64.67675	255.67379	83.5278113	0.719288037	1.253251163	0.979475259	47.72168685	11.401	8.599	6.923282458
2007 YF	Aten	0.9530524	0.12002229	1.6519	34.948	277.33863	298.4989748	0.838664868	1.067439932	0.930411713	13.37023442	5.426	4.348	4.740987576
2007 YJ	Apollo	1.103732	0.27993685	3.30566	199.0116	29.15879	239.318525	0.794756741	1.412707259	1.159565942	7.267001514	9.836	7.332	5.632940379
2007 YJ1	Amor	1.2642689	0.17790028	4.00943	333.54223	97.39998	339.0104392	1.039355109	1.489182691	1.421540319	3.372252319	8.908	5.441	4.500228732
2007 YM56	Apollo	1.2471946	0.31168745	6.42744	306.59329	273.59845	272.0699099	0.858459695	1.635929505	1.392840328	3.5455635	10.625	7.124	5.524413003
2007 YS56	Aten	0.942509	0.28390401	6.24662	63.65167	274.66303	299.6358231	0.674926915	1.210091085	0.915015096	10.76679561	9.989	6.964	6.899934248
2007 YT56	Apollo	1.2938565	0.28743442	5.99934	81.76955	302.51597	303.562153	0.921957607	1.665755393	1.471733474	3.119841085	9.755	6.824	5.081392277
2008 AF3	Apollo	1.2068251	0.19137097	2.07239	22.89041	109.12027	59.6552996	0.97587381	1.43777639	1.325764853	4.069698868	8.789	6.035	4.219170013
2008 AG4	Apollo	1.1400475	0.19239801	6.75301	286.57384	110.36452	299.2712561	0.92070463	1.35939037	1.217262996	5.602716614	7.299	5.636	5.016692278
2008 BT2	Amor	1.1732413	0.08076894	3.07468	201.91355	333.64921	100.7863929	1.078479844	1.268002756	1.270811141	4.692610264	7.179	4.792	4.532857461
2008 BW2	Apollo	1.3938397	0.33147071	4.10781	319.88563	117.53102	86.4102258	0.931822665	1.855856735	1.645580928	2.548992477	11.538	6.896	5.040490835
2008 BX2	Aten	0.8568704	0.34121609	3.15172	350.50523	336.80683	18.8401428	0.564492432	1.149248368	0.793181746	3.835163151	11.119	7.569	7.759404856
2008 CB175	Amor	1.3474063	0.24027379	9.12795	344.65852	148.3457	136.2027566	1.023659882	1.671152718	1.564040017	2.772923854	11.646	7.401	5.181723168
2008 CC71	Apollo	1.4544054	0.36918682	1.87606	222.29439	339.23363	333.5611524	0.917458095	1.991352705	1.753994461	2.32626969	11.544	7.344	5.159979956
2008 CD70	Apollo	1.0776335	0.08247878	12.58476	332.8529	141.04058	60.0027625	0.988751604	1.166515396	1.118681936	9.425882065	8.721	6.366	6.385026016
2008 CE119	Apollo	1.2101486	0.17716474	7.72923	49.9657	147.35426	4.8492001	0.995752938	1.424544262	1.331245198	4.018911693	8.719	5.94	4.742057672
2008 CE22	Apollo	1.2208326	0.31217237	4.80668	110.358	318.82532	63.0454542	0.839722394	1.601942806	1.348913735	3.866037937	9.845	7.348	5.492360713
2008 CK119	Amor	1.1935476	0.15575827	9.30724	129.43694	327.37532	117.0015648	1.007642691	1.379452509	1.303946028	4.2900578	8.741	6.362	5.080726107
2008 CM74	Apollo	1.0890785	0.14680566	0.85531	242.70888	321.56438	313.6854947	0.929195612	1.248961388	1.136550603	8.323292442	5.035	4.59	4.349047232
2008 CN116	Apollo	1.2195795	0.36104064	2.38776	87.75265	135.67808	340.6188509	0.779261737	1.659897263	1.346837418	3.883195261	11.473	7.369	5.870269524
2008 CO	Amor	1.1761249	0.01173121	8.07594	80.24214	319.26868	225.4194753	1.162327532	1.189922268	1.275499131	4.62977552	9.513	7.411	6.074686312
2008 CP	Amor	1.1204293	0.07771094	13.59651	17.06563	140.04256	258.0196104	1.033359686	1.207498914	1.185978145	6.376975873	10.276	7.159	6.721509202
2008 CX118	Amor	1.1442045	0.03473407	2.41433	178.74568	106.67106	65.404018	1.104461621	1.183947379	1.223926892	5.46574322	6.541	4.46	4.620851758
2008 CY21	Aten	0.9685656	0.24864296	10.72253	53.89834	322.85565	154.7119953	0.727738582	1.209392618	0.95322091	20.37707259	11.556	8.092	7.056178206
2008 DB	Apollo	1.0545651	0.23301468	4.22332	274.99443	141.55998	168.7233167	0.808835951	1.300294249	1.082954205	13.05484402	7.349	5.486	5.538406431
2008 DG5	Apollo	1.255784	0.24269457	5.70649	59.62369	244.07132	164.9087814	0.951012042	1.560555958	1.407253761	3.45547149	8.73	5.763	4.785147161
2008 DL4	Aten	0.9293563	0.12295796	3.20447	42.31583	341.29161	328.7412291	0.815084545	1.043628055	0.895928539	8.608782201	6.368	4.928	5.188824833
2008 DU22	Apollo	1.3797849	0.39836877	3.08074	70.87232	155.30374	34.7661749	0.830121687	1.929448113	1.620753924	2.610944307	11.704	7.859	5.721775792
2008 EA9	Apollo	1.0591238	0.07980585	0.42462	335.85389	129.47701	125.6893123	0.974599525	1.143648075	1.08998392	12.11309666	4.41	3.765	3.9354822
2008 ED85	Apollo	1.5016848	0.34879086	4.82938	204.48379	352.60187	348.7084769	0.977910867	2.025458733	1.840213351	2.190173899	11.506	6.136	5.017472148
2008 EJ68	Apollo	1.0904127	0.27784366	7.7476	99.89635	166.29546	290.5709824	0.787448445	1.393376955	1.138639778	8.212937122	11.558	7.539	6.111602179
2008 EJ85	Apollo	1.2076398	0.26040502	6.68339	301.73378	169.23191	62.4215831	0.893164334	1.522115266	1.32710757	4.057098315	8.639	6.331	5.244001302
2008 EK85	Apollo	1.3775545	0.27460747	6.57612	165.40434	355.00189	67.3006796	0.999267744	1.755841256	1.616825629	2.621203714	11.58	7.676	4.796788016
2008 EL68	Amor	1.1155432	0.09972593	0.22639	106.05351	39.78194	16.5769557	1.004294617	1.226791783	1.17822868	6.610769276	5.691	4.916	3.832010157
2008 EV68	Amor	1.4596462	0.28434232	3.2658	288.87476	191.31925	324.531516	1.044607013	1.874685387	1.763483504	2.309785994	11.566	6.451	4.857121946
2008 EY84	Apollo	1.0305098	0.17489973	4.3353	260.54151	174.57943	236.7425217	0.850273914	1.210745686	1.046112013	22.68632284	6.133	4.837	5.204283235
2008 FC	Apollo	1.5157921	0.34434656	5.4368	349.97274	170.69384	225.3402459	0.993834305	2.037749895	1.866205474	2.154460495	10.828	5.648	5.018747118
2008 FJ7	Apollo	1.1337006	0.29113149	0.47002	359.76813	99.85871	254.339671	0.803644655	1.463756545	1.207111993	5.828305625	7.799	5.889	5.494255716
2008 FO	Apollo	1.2404334	0.2759632	0.73878	141.25981	336.01917	346.73735	0.89811943	1.58274737	1.381529546	3.621028989	8.778	6.188	4.860195885
2008 FS6	Amor	1.2943262	0.14681961	5.16841	210.0568	21.03871	167.88656	1.104293732	1.484358668	1.472534957	3.116245549	10.31	7.265	5.006404172
2008 FX6	Aten	0.9233754	0.12648203	11.14429	324.71762	9.99902	58.9698484	0.806585005	1.040165795	0.887293807	7.872626892	8.376	6.199	6.919863829
2008 GB21	Apollo	1.4591378	0.41375309	1.50015	305.74322	192.26514	307.2511861	0.855415027	2.062860573	1.762562243	2.311368363	11.742	7.732	5.615743774
2008 GC110	Apollo	1.0911305	0.15421517	13.98364	142.63099	206.50249	170.7403279	0.922861624	1.259399376	1.139764283	8.154903782	11.093	6.836	6.680648421
2008 GD110	Apollo	1.0227114	0.25437026	5.34406	100.93742	213.13241	76.4877574	0.762564035	1.282858765	1.034259802	30.18872688	9.981	6.962	6.042009055
2008 GE	Amor	1.2717274	0.20888608	9.93037	95.31733	39.45561	275.2417354	1.006081249	1.537373551	1.434138328	3.303413302	10.566	6.922	5.163260756
2008 GL2	Apollo	1.1231082	0.12892106	5.17236	235.68944	16.53822	173.6332466	0.9783159	1.2679005	1.190234124	6.256680459	6.376	4.65	4.428166915
2008 GL20	Aten	0.8936927	0.2020474	6.88453	220.77346	198.83892	83.8487005	0.713124414	1.074260986	0.844855267	5.445594242	8.573	6.086	6.474975443
2008 GM2	Apollo	1.0519185	0.15731458	4.09791	278.26955	195.09316	132.7151111	0.886436383	1.217400617	1.078879993	13.67748587	4.807	4.56	4.899467534
2008 GY21	Apollo	1.0729841	0.37886508	1.87112	259.69192	197.69901	57.1462045	0.666467893	1.479500307	1.111449999	9.972633579	11.9	9.044	6.783061212
2008 HQ3	Amor	1.3571509	0.26304444	1.79026	334.91373	211.73031	83.8652904	1.000159902	1.714141898	1.581037637	2.721058906	8.126	7.322	4.378768526
2008 HS3	Amor	1.3510234	0.2258997	8.17649	4.65287	227.81849	65.6042772	1.045827619	1.656219181	1.570342218	2.753333294	10.018	6.01	5.153758026
2008 HU4	Amor	1.0929927	0.0732416	1.25758	341.46479	221.33024	297.2300914	1.012940166	1.173045234	1.142683331	8.008527168	4.594	3.37	3.898366962
2008 JL24	Apollo	1.03821	0.10652371	0.55032	282.00253	225.7915	149.5255535	0.927616019	1.148803981	1.057859064	18.28337676	4.628	3.927	4.299669997
2008 JM26	Apollo	1.3704136	0.31005538	5.19915	301.71554	231.6926	32.592514	0.94550949	1.79531771	1.604270102	2.654889091	10.647	7.316	4.980917219
2008 JP24	Apollo	1.2488727	0.277437	1.15265	125.24337	41.45702	294.8406135	0.902389205	1.595356195	1.395652373	3.527471258	8.67	5.924	4.848740208
2008 KT	Apollo	1.0108713	0.08483133	1.98424	102.09585	240.62771	63.2672916	0.925117743	1.096624857	1.016351189	62.1576303	8.374	5.804	4.39891654
2008 LD	Aten	0.8918787	0.15448413	6.54167	201.42192	250.88234	58.4511966	0.754097595	1.029659805	0.842284266	5.340521497	6.863	4.625	6.30494815
2008 LG2	Aten	0.853291	0.22850996	3.06865	336.52121	86.30229	288.2846946	0.658305508	1.048276492	0.788216909	3.721812292	7.642	6.34	6.748063631

2008 LH2	Aten	0.9788887	0.27581082	5.77113	249.10284	249.33637	345.2382018	0.708900605	1.248876795	0.968500775	30.74681321	9.437	7.107	6.765081032
2008 MQ1	Amor	1.3919788	0.25661849	2.32404	162.34733	108.71403	336.4850321	1.034771302	1.749186298	1.642286532	2.556937519	9.195	4.933	4.619227748
2008 NP3	Apollo	1.0055372	0.33438728	1.43239	329.01422	77.61844	52.7054313	0.669298351	1.341776049	1.008317287	121.2315111	8.625	6.349	6.722841459
2008 NX	Amor	1.3202217	0.20729674	0.59813	26.19305	258.14847	86.5471596	1.046544046	1.593899354	1.516946626	2.934435685	10.406	6.306	4.469594465
2008 ON10	Apollo	1.1625377	0.16103957	7.08623	242.78854	131.09448	338.3372468	0.975323129	1.349752271	1.253460257	4.94539173	7.654	5.827	4.744706308
2008 OT7	Apollo	1.1354459	0.31417915	1.77745	93.2543	124.67393	145.692146	0.778712472	1.492179328	1.209900538	5.764161216	9.595	6.631	5.747418837
2008 PG2	Amor	1.1386338	0.04230152	8.95493	67.27565	325.08646	3.8085529	1.09046786	1.18679974	1.214999523	5.651173115	8.088	6.398	5.8652972
2008 PW4	Apollo	1.1619344	0.27290668	2.68302	295.13606	117.15008	318.5832314	0.844834741	1.479034059	1.252484657	4.960636712	8.615	6.697	5.23260016
2008 RH1	Apollo	1.0636668	0.16179552	7.46834	147.33146	350.89278	113.402524	0.891570277	1.235763323	1.097004492	11.30880097	7.267	5.377	5.365273721
2008 SA	Apollo	1.3259524	0.33273384	2.64296	64.45303	354.04654	353.5673002	0.884763166	1.767141634	1.526834275	2.898130109	9.636	6.836	5.182215109
2008 ST	Aten	0.9640025	0.12581246	1.90743	291.21689	189.49076	93.9950739	0.842718974	1.085286026	0.946492638	17.68901703	5.027	4.153	4.680527618
2008 ST1	Apollo	1.3809819	0.30102945	8.5748	144.37113	179.05862	20.8541852	0.965265678	1.796698122	1.622863452	2.605488325	11.931	8.013	5.244117037
2008 SY150	Apollo	1.3845796	0.32874079	6.96287	120.79636	192.93344	314.0506869	0.929411808	1.839747392	1.629209346	2.589296163	11.467	7.816	5.28540682
2008 TD	Aten	0.8961255	0.33827297	5.07074	144.45705	357.7756	3.0102056	0.592990466	1.199260534	0.848307396	5.592279224	10.6	7.271	7.662718107
2008 TD2	Amor	1.5303629	0.33430567	4.01588	315.88798	16.03867	120.0060758	1.018753905	2.041971895	1.893178846	2.119596601	11.419	8.399	4.957306896
2008 TE2	Amor	1.4918604	0.32348577	3.167	3.13153	10.55021	139.9456542	1.00926479	1.97445601	1.822184211	2.216272444	11.379	6.715	4.788176471
2008 TN9	Apollo	1.1982072	0.30232326	1.61758	290.19913	7.46719	46.425306	0.835961293	1.560453107	1.311589368	4.209352128	9.508	6.583	5.323716268
2008 TS10	Amor	1.2589844	0.20286724	1.46891	345.43138	5.61018	20.6626924	1.00357771	1.51439109	1.412636825	3.42343858	7.816	6.649	4.143730979
2008 TT26	Apollo	1.3454635	0.25723589	8.47587	190.03751	210.53743	327.4256711	0.999361999	1.691565001	1.560658496	2.783616956	11.467	7.687	4.975757109
2008 TX3	Apollo	1.1796541	0.18666607	2.38026	249.82656	193.30128	244.5782658	0.959452705	1.399855495	1.281244524	4.555624786	7.054	5.468	4.312708282
2008 TY9	Amor	1.4321632	0.27931925	8.28526	158.6238	205.17956	221.5082207	1.032132449	1.832193951	1.71391297	2.400730961	11.063	8.605	5.226818615
2008 TZ	Aten	0.9530047	0.39698152	1.50534	127.48078	9.75344	148.9362666	0.574679446	1.331329954	0.930341863	13.35582473	11.571	7.973	8.727443399
2008 UA202	Apollo	1.0332587	0.06866056	0.264	300.91226	21.05702	0.8364267	0.962314579	1.104202821	1.050300582	20.88048574	4.031	3.798	4.007827659
2008 UB95	Aten	0.9895441	0.26871126	3.23752	253.39352	22.00628	163.0536387	0.723642458	1.255445742	0.984357219	62.92725147	8.488	6.614	6.472348646
2008 UC202	Apollo	1.0103293	0.06859846	7.45257	91.72231	37.35244	287.3469074	0.941022266	1.079636334	1.015533892	65.37536793	9.518	7.075	5.435056904
2008 UD	Aten	0.9976817	0.28192369	11.60975	51.05415	205.76919	100.2821498	0.716411594	1.278951806	0.996524566	286.7338669	11.215	8.513	7.768518857
2008 UD95	Apollo	1.1433543	0.13821464	4.3541	106.98126	223.31281	52.1778663	0.985325997	1.301382603	1.222562989	5.493110038	6.551	5.297	4.268293486
2008 UL3	Amor	1.2940294	0.22376819	6.57277	240.70398	205.78235	324.0973924	1.004466783	1.583592017	1.472028489	3.118516198	10.073	6.374	4.653451125
2008 UR	Apollo	1.3150181	0.27102326	4.83895	229.34073	206.04649	359.0598658	0.958617608	1.671418592	1.507986994	2.968554338	9.919	6.877	4.751420628
2008 UR2	Apollo	1.4198867	0.36896334	2.36337	124.04925	210.78628	249.3032673	0.896000561	1.943772839	1.691922776	2.445247988	11.352	7.526	5.265033502
2008 VA15	Amor	1.4518155	0.30468922	1.82202	96.47799	335.35569	159.6205404	1.009462968	1.894168032	1.749311467	2.334558516	10.396	5.694	4.625141321
2008 VA4	Amor	1.2853788	0.21929657	11.41758	197.93636	220.81449	54.8016358	1.003499638	1.567257962	1.457292397	3.186784663	11.799	7.525	5.436467375
2008 VC	Apollo	1.1211969	0.17251554	5.72439	240.5526	218.40015	5.7821091	0.927773011	1.314620789	1.187197115	6.341962676	6.158	4.678	4.819864885
2008 WH14	Amor	1.3791313	0.24990519	6.42346	351.66532	61.77206	3.1533023	1.03447923	1.72378337	1.619602441	2.613938122	11.665	7.746	4.918691533
2008 WK	Amor	1.4175359	0.28169645	6.33933	29.02582	61.76628	193.7490237	1.018221069	1.816850731	1.687722731	2.454074374	10.428	6.105	4.914606437
2008 WM	Apollo	1.0744049	0.1422519	12.35033	84.8959	57.73269	290.216964	0.921568762	1.227241038	1.113658332	9.798299128	8.041	5.632	6.32962732
2008 WM61	Apollo	1.4799041	0.33229928	2.67861	198.50027	240.37136	119.3778904	0.988133033	1.971675167	1.800322711	2.249495968	9.566	8.662	4.767852081
2008 WN2	Apollo	1.4180021	0.3119216	3.74661	283.26582	227.17895	154.5969259	0.975696616	1.860307584	1.688555388	2.452315989	10.329	7.517	4.768388213
2008 WO2	Apollo	1.0252341	0.18827017	2.00974	85.71318	238.14527	10.7181062	0.832213102	1.218255098	1.03808894	27.25434046	6.661	4.789	5.165401839
2008 WS62	Apollo	1.2691325	0.31681055	5.15203	109.80239	238.61396	42.4610974	0.867057935	1.671207065	1.42975113	3.326928144	10.572	7.052	5.374398092
2008 WY94	Apollo	1.1768663	0.18152097	6.05479	31.2958	71.40841	234.0290018	0.963240388	1.390492212	1.276705385	4.613952071	8.081	5.741	4.656201806
2008 XS	Amor	1.277016	0.21494412	3.31548	169.9442	250.96629	66.9917006	1.00252892	1.55150308	1.443093624	3.256859374	8.233	5.174	4.285999024
2008 YN2	Apollo	1.038314	0.22066804	3.48975	263.95236	88.5307	299.8628582	0.809191285	1.267436715	1.05801802	18.23602416	8.081	5.753	5.469239326
2009 BD	Apollo	1.008614	0.04081772	0.38516	110.50392	58.48799	294.2954235	0.967444676	1.049783324	1.012948786	78.22731957	4.978	4.147	3.95955358
2009 BF2	Apollo	1.0623954	0.184441	4.55403	95.79118	301.21794	196.9454596	0.86644613	1.25834467	1.095038207	11.52208403	5.655	4.868	5.102231563
2009 BF58	Apollo	1.5122848	0.37753193	0.98428	145.00152	303.33697	72.0030091	0.941349001	2.083220599	1.859732071	2.163153072	10.565	7.906	5.086931205
2009 BG	Apollo	1.1055656	0.27295426	5.55971	93.18685	300.07224	78.6405143	0.80379676	1.40733444	1.162456675	7.155487308	9.641	6.674	5.731869255
2009 BJ2	Aten	0.946433	0.27914896	6.51061	300.07957	296.15954	54.9625458	0.682237212	1.210628788	0.920735339	11.61596258	10.092	6.802	6.856864414
2009 BK2	Apollo	1.0123978	0.21273176	3.57102	121.2696	126.3803	171.2397299	0.797028634	1.227766966	1.018654221	54.60717022	8.175	5.537	5.576256106
2009 BL71	Aten	0.9369272	0.26604213	5.55299	292.37341	17.64265	348.742142	0.687665092	1.186189308	0.906898682	9.740986506	8.972	6.359	6.588483523
2009 BN58	Amor	1.3676389	0.24726197	6.70985	194.29052	313.60224	350.2491621	1.029473811	1.705803989	1.599400279	2.668334224	11.333	7.706	4.908754288
2009 BO5	Apollo	1.4220346	0.3262122	3.46045	212.41697	306.04868	150.2154307	0.958149565	1.885919635	1.695763352	2.437270298	10.702	7.678	4.874716048
2009 BW2	Apollo	1.0212089	0.13975349	1.01953	195.0267	24.71273	173.0312464	0.878491392	1.163926408	1.03198144	32.26813554	5.235	4.556	4.715703282
2009 CE	Aten	0.8931215	0.18819948	8.14213	190.39714	127.72342	139.5752283	0.725036498	1.061206502	0.844045417	5.41212322	9.321	6.691	6.641514301
2009 CR5	Apollo	1.0759366	0.26230498	5.05538	321.21932	316.81877	319.3057471	0.793713072	1.358160128	1.116040671	9.617668175	10.759	6.084	5.752920302
2009 CV	Apollo	1.1124288	0.14953513	0.95602	178.93497	24.10573	300.0161872	0.946081615	1.278775985	1.173298015	6.77040655	5.709	4.862	4.24600805
2009 DB43	Apollo	1.1024676	0.1722904	0.93456	38.53892	43.7714	54.7275758	0.912523016	1.292412184	1.15757397	7.346225824	6.268	4.939	4.50792159
2009 DC1	Aten	0.8732894	0.27622332	8.7815	34.8887	329.65789	164.9682728	0.632066503	1.114512297	0.816088547	4.437399273	11.217	7.694	7.479049502
2009 DC12	Apollo	1.3316483	0.25669957	2.90533	275.60702	345.42529	199.4411825	0.989814754	1.673481846	1.536683077	2.863297062	9.874	7.373	4.431874263
2009 DL46	Amor	1.4561269	0.30526833	7.91928	159.79303	63.50784	71.3778503	1.011617473	1.900636327	1.757109543	2.320812833	10.603	8.495	5.147008296
2009 DM40	Apollo	1.351348	0.35391476	7.03017	305.48272	153.58432	28.7972429	0.873085997	1.829610003	1.570908193	2.751595111	10.669	7.399	5.629322341
2009 DN1	Amor	1.4423546	0.28545174	7.859	314.20973	280.93608	68.7056844	1.03063197	1.85407723	1.732240012	2.365672435	11.41	8.466	5.184700003
2009 DN4	Apollo	1.2284999	0.23950333	3.08771	53.14529	151.62743	58.5473274	0.934270083	1.522729717	1.361641214	3.765171558	8.293	6.078	4.636463719
2009 DO111	Apollo	1.0496946	0.2802845	2.98308	273.09861	2.16189	52.7398344	0.755481474	1.343907726	1.075460452	14.25197473	9.869	7.374	5.933925277
2009 EH1	Apollo	1.1739303	0.350437	0.98928	94.6729	156.7617	142.7395126	0.762541687	1.585318913	1.271930754	4.677406782	10.325	7.356	5.925410157
2009 EK1	Apollo	1.2419728	0.22976411	9.11172	21.71569	358.48865	184.7711032	0.956612025	1.527333575	1.384102098	3.603474455	10.681	7.376	5.204670398
2009 ET	Amor	1.4467907	0.30501712	3.17397	28.93322	153.49731	349.5790711	1.005494767	1.888086633	1.740237659	2.350917489	10.423	8.434	4.675704251
2009 FE19	Amor	1.2454823	0.1953885	12.39467	218.28047	1.40715	14.8731839	1.002129382	1.488835218	1.389972922	3.564280601	11.492	7.656	5.652142338
2009 FK	Apollo	1.5216738	0.36935447	2.81518	210.41633	359.71354	3.9828698	0.95963678	2.08371082	1.877078108	2.140149311	11.341	8.049	5.040934003

2009 FQ32	Apollo	1.2252907	0.1886912	6.14628	203.47016	7.76654	344.9489967	0.994089127	1.456492273	1.356309194	3.806551209	8.417	5.289	4.517082719
2009 FS32	Apollo	1.0514166	0.06354797	14.3697	281.20453	7.00795	9.2691563	0.984601209	1.118231991	1.078107939	13.80279585	9.872	6.17	7.194718017
2009 FX10	Apollo	1.1992136	0.29673473	1.93072	204.86288	55.5411	311.1813113	0.843365276	1.555061924	1.313242163	4.19241826	9.555	6.658	5.271409852
2009 FX4	Apollo	1.2835975	0.32025741	0.51829	194.38969	51.01846	300.8628139	0.872515889	1.694679111	1.454264136	3.201362427	9.391	6.782	5.147409783
2009 HC	Apollo	1.0393559	0.12566207	3.77797	269.86173	203.81603	197.1119911	0.908748286	1.169963514	1.059610928	17.77544766	4.431	4.133	4.70547823
2009 HE60	Aten	0.996162	0.26498629	1.58572	219.98547	229.07222	331.9204107	0.732192727	1.260131273	0.994248527	172.8685144	6.968	5.562	6.351346518
2009 HG	Amor	1.3673495	0.22381165	3.63652	356.33567	231.11207	178.2931341	1.061320752	1.673378248	1.598892643	2.669748345	9.752	5.457	4.767348558
2009 HH21	Amor	1.4022075	0.26314594	4.22617	11.64352	213.35471	131.1379416	1.033222289	1.771192711	1.660421807	2.514183798	11.757	7.599	4.750937446
2009 HK73	Apollo	1.2455902	0.28274147	5.62702	300.3521	216.05379	49.9372328	0.893410196	1.597770204	1.390153553	3.563093409	9.866	7.119	5.178486318
2009 JE1	Apollo	1.3677551	0.29435942	8.03274	223.18739	46.15183	335.0188526	0.965143502	1.770366698	1.599604121	2.667767057	11.902	7.763	5.151744975
2009 JL1	Apollo	1.180001	0.17082927	11.50789	289.50642	69.60607	15.25926	0.978422291	1.381579709	1.281809727	4.54849355	9.971	6.557	5.610767291
2009 JR5	Apollo	1.2523578	0.35136329	3.9482	309.82629	128.27024	127.8399036	0.812325243	1.692390357	1.401498501	3.490669325	11.011	7.338	5.706214297
2009 JS	Apollo	1.3456049	0.35896861	6.38127	112.44713	43.86249	33.6416727	0.862574979	1.828634821	1.560904526	2.782834607	11.347	7.847	5.635143919
2009 KR4	Aten	0.8438889	0.23912673	10.7031	191.22842	239.97567	220.1593499	0.642092507	1.045685293	0.775225253	3.448898355	10.27	6.288	7.997827295
2009 KT4	Amor	1.2774173	0.20235325	11.0062	309.13235	230.71043	40.943855	1.018927758	1.535906842	1.443773912	3.253399698	11.386	7.647	5.446169648
2009 KW2	Amor	1.3617731	0.25394628	5.18786	2.96719	243.50061	173.726669	1.015955887	1.707590313	1.589121584	2.697442475	10.046	7.501	4.676775958
2009 KY1	Apollo	1.1474164	0.18957321	9.36776	281.44801	236.93316	245.642521	0.92989699	1.36493581	1.22908404	5.365210244	8.339	5.987	5.410037649
2009 LD	Aten	0.9888625	0.1505516	9.78639	253.84957	244.64042	316.2716196	0.839987668	1.137737332	0.983340353	59.02528207	10.539	7.118	5.932976575
2009 LQ1	Amor	1.4278601	0.21685577	1.20825	136.14582	104.22451	87.548557	1.118220399	1.737499801	1.7061943	2.416040882	11.541	6.838	5.041959953
2009 OS5	Amor	1.1441569	0.09674943	1.69528	120.83561	145.37372	173.3736992	1.033460372	1.254853428	1.223850518	5.467266856	6.076	4.117	4.110451539
2009 PD	Amor	1.2655621	0.16976451	3.90219	166.03758	113.20012	295.3770752	1.05071457	1.48040963	1.423721983	3.360038046	9.757	6.517	4.553262382
2009 QE34	Apollo	1.2892181	0.23196403	2.62673	163.47801	142.80893	237.3527751	0.990165874	1.588270326	1.463826454	3.155978798	9.997	6.789	4.31790286
2009 QH6	Apollo	1.0594985	0.18699338	14.24692	104.15299	323.81316	234.4826701	0.861379294	1.257617706	1.090562398	12.04211046	11.773	7.354	7.025973938
2009 QR	Apollo	1.3426251	0.26737474	3.41575	209.66339	150.49664	128.5793488	0.983641063	1.701609137	1.555722536	2.799459146	8.909	5.013	4.528680437
2009 RG2	Apollo	1.5543623	0.3730743	3.0504	38.07744	353.90614	234.3417232	0.974469673	2.134254927	1.937886696	2.066226873	11.812	9.824	5.029681239
2009 RH	Apollo	1.2468549	0.30634338	3.54434	264.565	165.75709	225.8614139	0.864889156	1.628820644	1.392271312	3.549256011	9.372	6.524	5.243784011
2009 RT1	Amor	1.155463	0.1062506	4.14969	136.46706	159.67209	119.2550423	1.032694363	1.278231637	1.242035659	5.131622603	8.112	5.76	4.368336121
2009 RU1	Apollo	1.3484263	0.37799734	0.85358	329.57386	301.02241	40.8313269	0.838724745	1.858127855	1.565816343	2.767357927	11.587	7.837	5.540028284
2009 SA100	Apollo	1.1428977	0.28525892	3.81235	109.80977	160.62641	152.3202336	0.816875936	1.468919464	1.221830714	5.507942034	9.641	6.416	5.512022458
2009 SC15	Amor	1.2656863	0.17929684	6.8436	333.8175	178.66205	91.5402834	1.038752746	1.492619854	1.42393157	3.358871268	10.185	7.011	4.836115106
2009 SH1	Apollo	1.1983245	0.24599137	3.32567	294.87464	354.92542	41.6319771	0.903547015	1.493101985	1.311781972	4.207369542	9.032	6.471	4.840544247
2009 SH2	Aten	0.9915588	0.09422173	6.81115	101.64342	6.69814	356.2105202	0.898132414	1.084985186	0.987364958	78.14496784	10.878	7.752	5.060752052
2009 SJ	Apollo	1.2343175	0.26371131	10.12517	245.16548	176.99011	318.8617895	0.908814015	1.559820985	1.371324798	3.693060105	10.114	6.666	5.655314573
2009 SJ18	Aten	0.9451033	0.11153574	12.56886	172.77111	0.44189	73.2384313	0.839690504	1.050516096	0.918795627	11.3146077	9.31	6.184	7.079859533
2009 SN103	Apollo	1.2989535	0.265427	3.59463	39.45253	5.6542	159.9731749	0.954176169	1.643730831	1.480438622	3.081431328	10.789	7.311	4.654506218
2009 SQ104	Apollo	1.2850422	0.279788	4.01844	95.58507	56.56844	75.8711725	0.925502813	1.644581587	1.456720006	3.18952528	9.588	6.48	4.869268512
2009 SS	Aten	0.9079059	0.19921136	9.43724	162.49804	350.5533	210.4141473	0.727040731	1.088771069	0.865089932	6.412345221	10.245	6.508	6.749598161
2009 SW171	Amor	1.3313828	0.23335644	3.05752	150.11751	188.0644	154.8695774	1.02069605	1.64206955	1.536223531	2.864893915	10.313	6.632	4.462902374
2009 TD17	Apollo	1.1273454	0.22027485	0.07784	82.30871	218.97135	165.3658713	0.879019561	1.375671239	1.196976146	6.076756858	6.758	5.141	4.818493723
2009 TD8	Aten	0.8832787	0.24508524	5.08655	147.12674	20.46552	301.0470867	0.666800128	1.099757272	0.830131008	4.886889593	9.311	6.39	6.65216549
2009 TJ4	Apollo	1.0901003	0.12497054	9.22786	249.00346	201.42061	133.4875969	0.953869877	1.226330723	1.138150487	8.238483324	6.889	5.504	5.410216565
2009 TM8	Apollo	1.5555392	0.40719319	2.38651	220.50862	205.52389	206.2353135	0.922134231	2.188944169	1.940088047	2.063730151	10.334	5.945	5.341490243
2009 TP	Apollo	1.0293061	0.22409354	0.78888	103.45991	15.13485	261.5117537	0.798645252	1.259966948	1.044279662	23.58373168	6.131	4.931	5.434404542
2009 UB	Apollo	1.3379409	0.29127317	3.54194	300.15242	21.70425	34.5972943	0.948234613	1.727647187	1.547588148	2.82619	11.217	7.646	4.773296595
2009 UD	Apollo	1.0393164	0.12153257	4.41219	261.73315	203.72777	240.3986445	0.913005607	1.165627193	1.059550524	17.79246356	5.275	4.589	4.76565256
2009 UD2	Apollo	1.3928945	0.32295355	3.83818	106.99721	2.61421	351.597025	0.943054276	1.842734724	1.643907343	2.553018476	10.341	7.424	4.941716583
2009 UK20	Apollo	1.0536709	0.20731781	2.84698	277.38014	216.01619	185.5217398	0.835226157	1.272115643	1.081577089	13.25834379	6.278	5.369	5.205001256
2009 UX17	Amor	1.1892079	0.08336469	10.8038	278.46238	216.15012	251.0971063	1.090069952	1.288345848	1.296840839	4.3688087	10.501	6.757	6.071392904
2009 UX87	Apollo	1.0959351	0.11371635	12.91555	57.28104	35.28623	117.0576501	0.971309361	1.220560839	1.14730069	7.788834462	9.329	6.364	6.324571731
2009 UY19	Apollo	1.023622	0.03078233	9.05334	99.86377	33.04279	244.9233143	0.99211253	1.05513147	1.035641433	29.05723329	5.152	4.618	5.904101936
2009 UZ87	Aten	0.9238124	0.18802269	3.77778	45.30604	218.52245	27.0552296	0.750114707	1.097510093	0.887923767	7.922498333	7.938	5.898	5.668136969
2009 VA	Apollo	1.4279505	0.35734794	7.54106	223.99105	224.54202	338.9461324	0.91767533	1.93822567	1.706356335	2.415716048	10.463	6.837	5.501577393
2009 VM24	Apollo	1.114347	0.23219086	11.64832	88.59993	46.46136	52.8924161	0.855605812	1.373088188	1.176334061	6.671054099	11.663	7.693	6.292470093
2009 VS25	Aten	0.970714	0.28081018	5.32193	315.56859	226.52605	1.7953308	0.698127627	1.243300373	0.956394214	21.93273625	9.991	6.814	6.783149293
2009 WC106	Apollo	1.0829061	0.17824549	5.34722	257.78592	243.00708	300.2872383	0.889882972	1.275929228	1.126902131	8.880088319	6.144	4.964	5.026236724
2009 WD54	Aten	0.8182512	0.29472651	3.00928	211.09511	61.40972	129.2174399	0.57709088	1.05941152	0.74016744	2.84863236	10.345	7.428	7.714582512
2009 WF54	Apollo	1.439248	0.30952065	3.28336	128.07371	240.63497	28.1707152	0.993771024	1.884724976	1.726646577	2.376184836	11.256	5.933	4.681914002
2009 WG106	Apollo	1.4150054	0.31303125	2.40008	149.45763	252.89161	8.0717603	0.972064491	1.857946309	1.683205517	2.463688415	11.477	9.434	4.708761528
2009 WG7	Apollo	1.241517	0.25408732	3.34967	292.19124	61.61763	39.6682348	0.926063273	1.556970727	1.383340226	3.608648744	9.423	6.669	4.739881354
2009 WM105	Aten	0.9003702	0.15628349	9.2466	198.33935	45.70086	143.4192979	0.759657203	1.041083197	0.854341826	5.865388836	8.737	6.43	6.725847708
2009 WR52	Apollo	1.0337107	0.15530521	4.24185	269.88208	61.02793	359.4450605	0.873170043	1.194251357	1.05098984	20.61175023	5.401	4.633	5.018878978
2009 WV7	Amor	1.4641347	0.31572081	3.65534	34.28868	47.76818	293.9644762	1.001876907	1.926392493	1.771623981	2.295968017	11.894	7.757	4.740766949
2009 WW7	Apollo	1.090638	0.26169919	2.52392	273.72746	57.16786	213.8263196	0.805218919	1.376057081	1.138992693	8.194622814	9.347	5.961	5.484766923
2009 WZ104	Aten	0.8554379	0.19271964	9.83427	10.53797	263.2929	266.1751471	0.690578216	1.020297584	0.791193538	3.789123814	9.727	6.052	7.576145426
2009 XP2	Apollo	1.2142394	0.19810827	9.25008	325.72659	79.91157	287.5878616	0.973688533	1.454790267	1.338001133	3.958569961	10.736	7.924	5.127844921
2009 XZ6	Apollo	1.2220074	0.20165641	6.47042	326.84096	85.10482	268.6929534	0.975581775	1.468433025	1.35086128	3.850129255	8.747	6.228	4.672013901
2009 YF	Aten	0.9357732	0.121362	1.52661	193.24992	87.58325	340.029636	0.822205893	1.049340507	0.905223677	9.551158394	5.63	4.28	4.947889859

2009 YR	Aten	0.942389	0.11042914	0.70056	127.82587	87.06265	39.4247393	0.838321793	1.046456207	0.914840352	10.74265069	4.953	3.969	4.775751557
2009 YS	Apollo	1.1921707	0.17921139	6.75064	338.74342	81.47777	313.7834377	0.978520132	1.405821268	1.301690292	4.314657535	8.452	6.182	4.673421412
2010 AF30	Apollo	1.3244467	0.37141809	3.0591	162.76681	62.44246	4.135324	0.832523236	1.816370164	1.524234293	2.907544038	11.816	8.054	5.609898151
2010 AG3	Apollo	1.3696844	0.28003399	2.48771	30.60171	110.36864	5.7998962	0.986126212	1.753242588	1.602989819	2.658402793	9.227	7.792	4.517779547
2010 AL30	Apollo	1.0466144	0.30784345	3.83001	97.71502	112.37669	148.1946077	0.724421012	1.368807788	1.070730216	15.13822913	11.205	7.747	6.277972167
2010 AN61	Amor	1.1585287	0.13368406	3.61212	8.45603	116.58178	325.8128431	1.00365188	1.31340552	1.246982031	5.048877544	7.206	4.561	4.117150144
2010 AR1	Apollo	1.5255616	0.37101739	0.55687	227.10976	202.55675	236.5887868	0.959551717	2.091571483	1.884276461	2.130868053	11.398	6.577	4.982341022
2010 BB	Aten	0.8205298	0.27719806	10.03514	28.97589	279.85609	345.4172442	0.593080531	1.047979069	0.743261329	2.895011204	11.71	7.391	8.380875943
2010 CB19	Apollo	1.0263875	0.31029556	6.00643	76.56089	320.52637	298.1356612	0.707904016	1.344870984	1.039841225	26.09962958	10.914	7.864	6.606168863
2010 CD55	Apollo	1.0238732	0.20123299	5.93146	279.30886	326.84061	152.9224796	0.817836135	1.229910265	1.036022681	28.7602882	8.261	5.804	5.652787109
2010 CE55	Amor	1.2898777	0.22053263	2.52841	58.62283	191.98387	18.9698492	1.005417578	1.574337822	1.464949999	3.150768904	9.063	6.732	4.273318032
2010 CF19	Apollo	1.1930802	0.26988245	7.17668	265.23162	154.75807	299.9383871	0.871088793	1.515071607	1.303180154	4.29836893	9.449	6.417	5.450447778
2010 CJ18	Apollo	1.1975635	0.25999358	7.78583	63.42488	148.70113	201.0296228	0.886204678	1.508922322	1.310532593	4.220273887	11.563	6.912	5.424815593
2010 CO44	Apollo	1.0704378	0.23056312	6.18179	73.77519	327.52091	201.3905453	0.823634321	1.317241279	1.107495972	10.30267419	8.004	5.634	5.625800591
2010 CP19	Amor	1.1864569	0.14743579	13.95109	27.42056	145.26959	241.104958	1.01153069	1.36138311	1.292343461	4.420634066	11.741	7.586	6.240252516
2010 DE2	Apollo	1.546889	0.35823047	4.71031	187.60961	336.8949	172.0196654	0.992746226	2.101031774	1.923927608	2.082335879	11.508	8.73	5.033364689
2010 DJ	Amor	1.2079908	0.13645842	0.23506	106.82321	3.19088	28.37322	1.043150284	1.372831316	1.327686197	4.051700103	8.224	6.044	4.220050205
2010 DL	Apollo	1.3526155	0.31374482	2.56743	113.68238	333.64787	33.1221247	0.928239393	1.776991607	1.573118867	2.744838737	9.932	7.226	4.899136566
2010 EG21	Aten	0.8446692	0.2260226	9.71624	186.31304	168.67198	215.4959007	0.653754871	1.035583529	0.776300717	3.470287024	11.131	7.617	7.764286244
2010 EN44	Apollo	1.1447252	0.16537251	10.1849	210.48074	13.84034	325.1750948	0.95541912	1.33403128	1.224762457	5.449141617	9.31	6.234	5.467407634
2010 EX11	Aten	0.9559497	0.10954852	9.74807	42.71202	4.02465	141.3864638	0.851226825	1.060672575	0.934657643	14.30400879	7.013	5.327	6.15985714
2010 FC	Amor	1.3296101	0.24003277	7.03957	62.3597	155.77912	5.6017407	1.010460105	1.648760095	1.533156393	2.875622264	10.172	6.459	4.798278703
2010 FK	Aten	0.9396492	0.09723651	12.67319	166.07797	173.52033	267.2017027	0.848280991	1.031017409	0.910853691	10.21751434	9.042	6.235	7.278346203
2010 FM	Aten	0.8175352	0.27029727	7.74315	202.37893	175.33153	287.0751162	0.596557667	1.038512733	0.739196141	2.8342991	10.419	5.964	8.042983132
2010 FN	Aten	0.989696	0.21107266	0.12329	126.08375	161.51867	199.6681197	0.780798233	1.198593767	0.984583883	63.86717889	10.023	6.773	5.424680049
2010 FT	Apollo	1.089945	0.19473859	5.6065	246.04713	13.84441	354.9446259	0.877690648	1.302199352	1.137907278	8.251248914	7.514	5.522	5.147303693
2010 FV9	Apollo	1.1475519	0.28734417	0.6397	64.80477	30.49043	358.7890409	0.817809552	1.477294248	1.229301763	5.361065462	8.1	5.949	5.387699632
2010 FX9	Apollo	1.1297163	0.36666266	3.75967	74.69516	10.26157	28.9041203	0.715491516	1.543941084	1.200754139	5.981217339	11.427	8.371	6.411535155
2010 FY9	Aten	0.8946663	0.14767446	4.34333	335.09252	357.13795	63.4822071	0.762546937	1.026785663	0.846236236	5.503482854	6.433	5.625	5.904744449
2010 GC35	Amor	1.2093503	0.12514222	8.47316	1.73428	195.47245	1.5141992	1.058009519	1.360691081	1.329928139	4.030963055	8.833	6.02	5.244746302
2010 GH7	Apollo	1.4042368	0.30163999	3.46561	335.29178	192.49326	306.2949167	0.980662826	1.827810774	1.6640276	2.5059615	9.765	5.165	4.688037748
2010 GP67	Apollo	1.1135681	0.10701638	13.27212	44.70479	211.50139	311.4568642	0.994398073	1.232738127	1.175100936	6.710991758	9.939	6.697	6.319768422
2010 GV23	Aten	0.9295157	0.20305702	3.62391	233.83737	198.64684	180.5331446	0.740771012	1.118260388	0.896159049	8.63011211	6.902	5.392	5.732777641
2010 HA	Aten	0.9597615	0.19585559	2.1825	185.71422	251.31922	89.1693442	0.771786845	1.147736155	0.940253561	15.7373992	6.302	5.133	5.368081018
2010 HX107	Aten	0.800485	0.30063941	3.36483	352.99746	51.63692	317.2292096	0.559827662	1.041142338	0.716192547	2.523515645	10.163	8.106	8.071057798
2010 JA	Apollo	1.2154584	0.29315287	2.51948	74.9318	222.391	111.8448974	0.859143282	1.571773518	1.340016509	3.941033662	8.88	6.462	5.187259025
2010 JK1	Apollo	1.0294984	0.15030397	0.16594	137.43015	202.14987	47.3173115	0.874760703	1.184236097	1.044572322	23.43544793	4.86	4.61	4.737607452
2010 JR34	Aten	0.9592994	0.14471829	0.72169	316.2896	36.86901	205.6550026	0.820471231	1.098127569	0.939574582	15.54932687	4.983	4.273	4.810084226
2010 JT39	Apollo	1.2021815	0.20800907	5.04566	283.6202	35.8885	101.62357	0.952116844	1.452246156	1.318120337	4.143464545	9.757	6.075	4.629283529
2010 JW34	Aten	0.9811624	0.05468057	2.25935	43.65361	49.80159	25.8049884	0.927511881	1.034812919	0.971877091	34.55819977	10.969	7.15	4.24591674
2010 KE	Apollo	1.2970721	0.24515868	5.24185	224.94807	56.40042	4.2006683	0.979083616	1.615060584	1.477223394	3.095454693	10.109	7.045	4.617033616
2010 KJ37	Amor	1.1024944	0.05789849	11.28231	99.278	236.43494	270.9786251	1.038661639	1.166327161	1.15761618	7.344526304	9.59	6.995	6.243484429
2010 KV7	Apollo	1.2142444	0.21867145	0.3146	36.85771	255.92559	321.7045698	0.948723816	1.479764984	1.338009398	3.958497623	6.811	5.875	4.39578933
2010 MB	Aten	0.9478507	0.15610532	11.66783	19.14868	87.81318	95.0702823	0.799886163	1.095815237	0.922804923	11.95419395	10.554	8.385	6.72022446
2010 MS1	Aten	0.9300632	0.26856923	9.03313	349.95974	98.92198	185.1276706	0.680276843	1.179849557	0.896950944	8.70411608	10.952	6.858	7.081366554
2010 MY1	Apollo	1.2139664	0.21098643	9.70127	218.80061	102.54394	87.7539874	0.957835963	1.470096837	1.33754992	3.962524769	9.766	6.894	5.293962585
2010 NG	Amor	1.5332246	0.344411	8.29543	207.42416	106.59894	104.7824525	1.005165182	2.061284018	1.898491548	2.112976524	11.494	6.312	5.330520664
2010 PH9	Amor	1.263697	0.18457612	12.11879	182.75506	132.06597	19.4044854	1.030448711	1.496945289	1.420575864	3.377692314	11.194	7.748	5.759658979
2010 PR10	Apollo	1.1982453	0.17598498	9.16329	65.26303	334.4981	44.3911638	0.987372125	1.409118475	1.311651926	4.20870791	8.339	5.768	5.049641063
2010 PS66	Amor	1.3450854	0.24132731	1.11605	131.4804	171.33936	288.4068232	1.020479559	1.669691241	1.560000682	2.785712112	10.39	6.519	4.404192079
2010 PW58	Aten	0.8885928	0.2118641	14.23695	130.98397	324.49215	290.0322968	0.700331886	1.076853714	0.837633783	5.15891668	11.62	7.425	8.108600905
2010 RA91	Apollo	1.1669257	0.34926664	5.61833	272.66099	183.66761	63.9194508	0.759357482	1.574493918	1.26056373	4.837832688	10.795	7.263	6.170107519
2010 RE	Apollo	1.0344727	0.18557639	8.00745	73.585	159.33293	105.5312372	0.842498991	1.226446409	1.05215216	20.1746613	8.301	5.426	5.795125358
2010 RF12	Apollo	1.0604849	0.18817314	0.88236	267.57726	163.84117	256.9176765	0.860930126	1.260039674	1.092085733	11.85944548	5.967	5.534	4.898333231
2010 RF31	Apollo	1.3714417	0.27743626	5.94746	57.34823	332.4621	207.9085658	0.990954044	1.751929356	1.606075753	2.649958762	10.869	7.369	4.763229035
2010 RG31	Apollo	1.0991468	0.19137941	13.07513	187.673	343.95614	53.5335993	0.888792734	1.309500866	1.152347728	7.563931178	11.229	7.822	6.497026529
2010 RK53	Apollo	1.3467599	0.31365173	6.09322	310.97699	346.09677	284.4327156	0.924346327	1.769173473	1.562914661	2.77646821	10.948	7.578	5.16473371
2010 RM122	Amor	1.3051678	0.21808201	7.21638	318.15041	344.1088	32.3660714	1.020534183	1.589801417	1.491075128	3.036348295	10.911	7.453	4.833261758
2010 RM80	Apollo	1.1765457	0.19960342	2.36483	304.29625	345.04152	157.7522246	0.941703154	1.411388246	1.276183724	4.620778178	7.735	5.668	4.444744134
2010 SD	Apollo	1.3770687	0.40509481	3.56354	93.03281	336.44297	186.524041	0.819225317	1.934912083	1.615970434	2.623454543	11.556	7.731	5.824065031
2010 SF	Aten	0.8380974	0.21918138	9.36542	184.11758	351.06738	3.0517239	0.654402055	1.021792745	0.767258556	3.296613367	10.708	7.429	7.803755272
2010 SH13	Amor	1.2059587	0.1369638	13.86153	10.9687	190.61198	214.8805022	1.040786014	1.371131386	1.324337426	4.083208783	11.977	7.797	6.385798537
2010 SH15	Amor	1.2713052	0.03309093	4.05144	96.65248	0.94086	241.2282414	1.229236529	1.313373871	1.433424209	3.307208454	11.655	9.723	5.535199589
2010 SJ	Aten	0.9210242	0.16601366	11.30177	335.60822	183.45782	124.632038	0.768121602	1.073926798	0.883906978	7.613782109	9.275	6.483	6.93187106
2010 SO16	Apollo	1.0020446	0.07532931	14.5243	108.73222	40.43708	271.5364474	0.926561272	1.077527928	1.003068467	326.8956226	11.226	6.703	7.584194224
2010 SW3	Apollo	1.6236081	0.40317644	1.50238	331.42718	344.32342	16.7137478	0.969007566	2.278208634	2.06881575	1.935614955	11.387	8.629	5.139543053
2010 SX11	Apollo	1.1596452	0.24952888	5.1728	266.87236	182.52381	73.1778439	0.870280232	1.449010168	1.248785082	5.019533613	7.638	5.716	5.201182548
2010 SZ3	Amor	1.1848515	0.14140459	2.21355	163.40189	179.89735	108.0177152	1.017308059	1.352394941	1.289721335	4.451592549	8	5.949	4.106090931
2010 TB54	Apollo	1.1524314	0.27911989	6.61926	82.56648	14.23276	81.2309521	0.830764874	1.474097926	1.237150754	5.216727045	9.041	6.311	5.65718761

2010 TE	Aten	0.9093592	0.19758164	5.49885	36.38779	182.10275	74.6803354	0.729686518	1.089031882	0.867167908	6.528301239	7.613	5.393	6.074229336
2010 TE55	Aten	0.9493551	0.12730218	1.1543	304.99938	198.11464	66.7673507	0.828500126	1.070210074	0.925002767	12.3338252	5.043	4.529	4.797777211
2010 TK	Apollo	1.2899053	0.38043508	0.55714	141.68082	315.76686	262.7121743	0.799180074	1.780630526	1.464997018	3.150551424	10.335	7.183	5.764660032
2010 TK19	Aten	0.9409414	0.12840156	12.95594	208.16862	15.50676	347.4112732	0.820123056	1.061759744	0.912733238	10.45911654	9.72	6.849	7.176476574
2010 TW54	Apollo	1.0431225	0.23386098	3.84213	85.90429	196.31838	34.5402409	0.79917685	1.28706815	1.065376149	16.29609832	9.064	5.71	5.586484254
2010 UC	Aten	0.9388343	0.06855399	4.82933	176.50917	21.71214	26.1482834	0.874473463	1.003195137	0.909669057	10.07040361	5.573	4.483	5.346256079
2010 UD8	Amor	1.4203395	0.26051817	4.72711	137.60473	229.72486	170.5957857	1.050315253	1.790363747	1.692732169	2.443559352	10.824	8.255	4.902733366
2010 UE51	Apollo	1.055214	0.05966574	0.6244	47.21552	32.28552	246.8096968	0.992253876	1.118174124	1.083953911	12.91129732	4.426	4.007	3.801782789
2010 UE8	Amor	1.4543045	0.26827566	2.63609	54.57322	9.29766	346.4831947	1.06415	1.844459	1.753811938	2.326590824	10.823	5.839	4.899931712
2010 UH	Apollo	1.3620021	0.3075887	0.63053	40.28381	295.21423	244.5126492	0.943065645	1.780938555	1.589522449	2.696288245	9.973	6.136	4.753907621
2010 UJ	Aten	0.9442317	0.09487861	0.37043	72.9299	134.21814	178.142327	0.854644309	1.033819091	0.917524912	11.12487344	4.489	3.81	4.68107362
2010 UK	Aten	0.8662055	0.21840085	4.92178	36.4839	203.48651	178.0067309	0.677025483	1.055385517	0.80617886	4.159395914	8.836	5.815	6.665112284
2010 UP	Apollo	1.0650788	0.09955054	9.3148	244.77	211.36342	216.0542761	0.95904963	1.17110797	1.099189599	11.08170217	7.102	5.414	5.541429721
2010 UY7	Aten	0.8972398	0.15013045	0.45767	210.35553	40.06543	76.1659916	0.762536785	1.031942815	0.849890148	5.661787923	6.03	4.164	5.57606495
2010 VA140	Amor	1.5350566	0.3255791	1.56157	16.53574	15.02035	10.6462395	1.035274254	2.034838946	1.901895233	2.108776234	11.833	8.79	4.905024186
2010 VB	Aten	0.9233878	0.33142923	5.08306	128.48964	40.01282	130.1010023	0.617350092	1.229425508	0.88731168	7.87403416	10.547	7.072	7.533186807
2010 VB1	Apollo	1.1347358	0.27074946	2.61365	74.20978	106.36486	23.3137202	0.827506695	1.441964905	1.20876572	5.790058448	7.789	5.853	5.341946093
2010 VC140	Apollo	1.4815899	0.3309616	1.45874	175.70524	233.6567	93.0524594	0.991240536	1.971939264	1.803399783	2.244710318	10.377	8.265	4.696407449
2010 VC72	Amor	1.1595549	0.13717877	5.93505	39.14204	199.73546	260.7116628	1.000488585	1.318621215	1.248639223	5.021891587	10.12	6.409	4.423284778
2010 VD139	Aten	0.8454052	0.2378988	3.81909	155.45407	57.33608	294.1431538	0.644284317	1.046526083	0.777315579	3.49065991	8.026	6.631	6.978584395
2010 VL65	Apollo	1.0654057	0.1440668	4.39891	253.98508	223.11249	200.655911	0.91191611	1.21889529	1.099695693	11.03052363	5.475	4.514	4.752218633
2010 VO	Amor	1.3321878	0.18882406	9.90699	319.24595	30.83563	272.6385664	1.080638691	1.583736909	1.537617022	2.860060152	11.78	7.471	5.600632213
2010 VO21	Apollo	1.3272439	0.26026382	1.97189	206.14086	221.02407	229.7161465	0.981810333	1.672677467	1.529065562	2.890124916	8.761	4.945	4.425877238
2010 VP139	Apollo	1.2057531	0.30784862	2.70373	290.03895	48.90174	41.5009072	0.834563672	1.576942528	1.323998767	4.086431496	9.453	6.555	5.385955781
2010 VQ	Aten	0.8610089	0.19835235	0.38712	200.24467	27.54275	212.1095361	0.690225761	1.031792039	0.798935025	3.97351665	6.027	4.199	6.360259753
2010 VQ98	Apollo	1.0231959	0.02709829	1.47573	341.66021	46.16385	358.5183005	0.995469041	1.050922759	1.034994845	29.57563708	3.984	3.624	3.894151179
2010 VR139	Amor	1.4351038	0.30246229	0.36859	232.37113	155.45149	12.2855887	1.001039018	1.869168582	1.719194336	2.390444766	10.238	6.201	4.508609455
2010 VT21	Apollo	1.066377	0.08462044	7.28359	114.21643	221.55066	59.0021605	0.976139709	1.156614291	1.101199877	10.88143493	5.519	4.676	5.006147409
2010 VU	Apollo	1.4773514	0.35961734	2.82949	96.30837	234.69006	134.8038791	0.946070219	2.008632581	1.795666631	2.256807765	11.713	7.379	5.040176201
2010 VZ11	Apollo	1.1042778	0.15373828	4.6441	300.55073	42.68559	234.7302755	0.93450803	1.27404757	1.160426163	7.233397211	6.678	5.308	4.627342957
2010 WA9	Apollo	1.2262307	0.3158949	1.11238	58.02378	89.85726	300.2808468	0.838870676	1.613590724	1.357870263	3.794308731	8.634	6.262	5.333043956
2010 WB	Apollo	1.3586947	0.288236	5.49857	150.25521	231.0555	220.6109044	0.967069974	1.750319426	1.583736121	2.713102829	9.969	7.666	4.84017064
2010 WC1	Apollo	1.1445443	0.16063962	2.09066	303.7957	66.63053	40.9146861	0.960685139	1.328403461	1.224472146	5.454895712	7.039	5.185	4.229353917
2010 WD1	Aten	0.8765044	0.25827826	1.82598	222.21536	63.57268	114.205212	0.650122369	1.102886431	0.820599316	4.574114769	8.371	6.29	6.615491945
2010 WD9	Apollo	1.3777348	0.30607416	2.12882	333.6165	63.83693	192.4624045	0.956045778	1.799423822	1.617143064	2.620369826	10.392	7.251	4.728879479
2010 WH1	Apollo	1.0769194	0.15661694	12.23845	97.71418	243.83644	65.7582726	0.908255579	1.245583221	1.117570169	9.505558906	9.859	6.485	6.315214495
2010 WR7	Apollo	1.0462901	0.23531373	1.56286	159.13464	20.45478	187.3400912	0.800083674	1.292496526	1.070232596	15.23840295	7.576	5.91	5.453096486
2010 WS	Aten	0.9295699	0.31399069	4.56764	232.61498	60.96063	278.0056891	0.637693606	1.221446194	0.896237433	8.637386823	10.463	7.351	7.215918619
2010 WT8	Apollo	1.1523087	0.28254318	4.51798	161.75802	58.50159	301.1829153	0.826731736	1.477885664	1.23695318	5.220243011	10.425	6.378	5.489652725
2010 WU8	Aten	0.9599991	0.18558246	2.79365	339.83999	260.88337	287.5141309	0.781840105	1.138158095	0.940602739	15.83579301	6.631	5.219	5.292104916
2010 XC	Apollo	1.4336109	0.32471463	1.21728	212.14337	248.17452	344.2555596	0.968096467	1.899125333	1.716512386	2.395649286	11.09	7.643	4.735960922
2010 XD	Amor	1.3335744	0.23740877	8.11368	196.90287	250.01613	348.8633516	1.016972142	1.650176658	1.540018276	2.851789178	10.974	7.168	4.979999266
2010 XF11	Apollo	1.0867943	0.15788747	11.88685	274.99513	69.86949	262.9143587	0.915203098	1.258385502	1.132976829	8.520107139	9.754	6.326	6.168455282
2010 XF3	Aten	0.951812	0.11202373	6.03263	140.85232	77.30874	336.6686336	0.84518647	1.058437531	0.928595904	13.00479889	6.755	6.038	5.335107465
2010 XF64	Apollo	1.4819917	0.32660602	3.63885	185.01172	261.08671	357.545351	0.997964289	1.966019111	1.804133443	2.243574694	10.542	5.784	4.786649814
2010 XG64	Amor	1.5507674	0.34901294	2.16024	190.22886	256.98067	357.4032497	1.00952951	2.09200529	1.931167723	2.073920385	10.657	8.843	4.865101169
2010 XN	Apollo	1.1276187	0.34727314	1.0889	101.46728	78.94765	57.4874222	0.736027013	1.519210387	1.197411443	6.065562486	10.34	6.976	6.121077498
2010 XO	Apollo	1.3108401	0.24034326	7.11385	169.22428	248.72248	6.1447126	0.995788517	1.625891683	1.50080607	2.996780908	10.838	7.405	4.75421277
2010 XO69	Apollo	1.1878194	0.27473729	2.74256	247.06998	267.58832	316.232973	0.861481117	1.514157683	1.294570246	4.394775994	7.921	6.003	5.133693683
2010 XT10	Apollo	1.3878808	0.29004371	3.24158	155.73604	257.43195	173.0704455	0.985334704	1.790426896	1.63503951	2.574705171	9.556	5.256	4.607968097
2010 XU	Apollo	1.3293871	0.29333568	0.70699	49.00631	324.67806	254.2936514	0.939430431	1.719343769	1.532770701	2.876980093	8.606	6.804	4.712922416
2010 XU10	Aten	0.9453703	0.05958295	4.53856	169.37721	66.6243	328.6052988	0.889042349	1.001698251	0.919185006	11.3739414	5.618	4.609	5.217752524
2010 XX72	Aten	0.9031128	0.28337047	4.48092	334.41652	279.10576	57.4422067	0.647197301	1.159028299	0.858248388	6.054593506	10.02	6.945	6.84297201
2011 AA23	Amor	1.2954959	0.21745979	7.01385	346.66405	111.14454	244.1710608	1.013777634	1.577214166	1.474531533	3.107341518	9.52	7.704	4.758599538
2011 AA37	Amor	1.0959829	0.01685826	3.81339	128.55961	275.85628	213.989338	1.077506535	1.114459265	1.147375751	7.785376776	5.861	4.3	4.750475564
2011 AB3	Aten	0.9672343	0.18244424	7.25632	138.19583	105.70713	280.2716046	0.790767973	1.143700627	0.951256273	19.51546025	8.639	5.892	5.767154388
2011 AB37	Apollo	1.1153818	0.20872281	7.70373	76.24739	113.14883	306.9689352	0.882576176	1.348187424	1.177972985	6.618830307	9.541	5.82	5.411935425
2011 AE3	Aten	0.956568	0.1054975	5.18174	68.2689	283.03411	100.0509249	0.855652467	1.057483533	0.935564583	14.51941528	5.816	4.358	5.104513785
2011 AH5	Apollo	1.0780708	0.29011017	6.84479	267.23287	294.68097	118.8929209	0.765311497	1.390830103	1.119362942	9.377809622	10.661	7.209	6.182068265
2011 AK5	Apollo	1.1881575	0.23034012	5.51633	325.67513	316.91101	196.8348841	0.914477159	1.461837841	1.295123014	4.388417554	8.834	6.326	4.933636145
2011 AM24	Amor	1.1782824	0.14972705	9.13492	214.81491	127.25799	143.863271	1.001861652	1.354703148	1.27901043	4.584095406	8.612	6.074	5.023967678
2011 AM37	Apollo	1.100254	0.14704386	2.62561	129.19854	291.27231	177.2804069	0.938468405	1.262039595	1.154089352	7.489741086	5.826	4.961	4.383468132
2011 AN1	Apollo	1.2465652	0.27913097	3.91602	65.02302	99.85018	259.8433193	0.898610247	1.594520153	1.39178611	3.5524131	9.483	6.434	4.999226851
2011 AN37	Apollo	1.1521431	0.23433426	4.2026	278.02704	116.08531	54.6139137	0.882156499	1.422129701	1.236686543	5.224997286	7.996	5.909	5.010576197
2011 AU4	Apollo	1.0694073	0.11072471	4.51797	285.39792	105.01388	260.8410927	0.950997487	1.187817113	1.105897093	10.44312983	5.256	4.461	4.522181565
2011 AX22	Aten	0.9673972	0.3367825	0.68643	291.14287	57.81529	123.6036939	0.641594752	1.293199648	0.951496596	19.61710981	9.47	6.718	7.560789991
2011 BF10	Apollo	1.353086	0.27756362	6.91401	34.7132	123.64281	340.4964621	0.977518552	1.728653448	1.57393974	2.742343195	10.639	6.675	4.913098548

2011 BF24	Apollo	1.3846195	0.36091731	7.8771	244.39136	307.22437	102.6877749	0.884886355	1.884352645	1.629279771	2.5891183	11.939	7.983	5.687534519
2011 BG24	Apollo	1.4036526	0.31971583	1.50912	218.44874	305.56801	98.1379329	0.954882644	1.852422556	1.662989288	2.508319996	10.832	5.991	4.772888111
2011 BG40	Amor	1.3768603	0.22108846	3.10539	163.6433	310.25913	150.7736023	1.072452377	1.681268223	1.615603617	2.624421906	10.376	6.079	4.805026354
2011 BJ39	Amor	1.5158169	0.33106047	5.14848	350.78135	132.7973	3.5415872	1.013989845	2.017643955	1.866251274	2.154399457	11.159	6.317	4.9988134
2011 BL45	Amor	1.0378605	0.02101177	3.04968	155.2271	134.78323	74.9241386	1.016053214	1.059667786	1.057324937	18.44441518	4.43	3.844	4.309171232
2011 BP40	Apollo	1.1207804	0.15136863	0.91251	236.31911	164.69777	163.8978213	0.951129406	1.290431394	1.18653565	6.360905551	5.848	4.323	4.216439272
2011 BQ50	Aten	0.9505046	0.09795684	0.35873	1.3258	280.9421	272.3166055	0.857396173	1.043613027	0.926683296	12.63945649	4.882	4.164	4.608334373
2011 BR15	Aten	0.8736173	0.27710631	10.22594	72.08901	216.88015	104.3086948	0.631532434	1.115702166	0.816548224	4.451023812	11.916	7.35	7.715295577
2011 BT15	Apollo	1.2946449	0.30290183	1.66504	308.26807	105.75653	254.8385167	0.902494591	1.686795209	1.473078861	3.11381248	8.835	6.695	4.94914712
2011 CA4	Apollo	1.3008642	0.28296868	2.28407	322.33646	127.56325	237.5994911	0.932760374	1.668968026	1.483706308	3.067370188	9.778	6.651	4.74741084
2011 CA7	Apollo	1.0807303	0.28822752	0.11785	278.88255	310.69169	89.9227715	0.769234086	1.392226514	1.123507541	9.096671618	8.594	6.188	5.749908263
2011 CE22	Amor	1.1067657	0.09143823	4.57664	60.8042	317.75997	111.0631588	1.005565003	1.207966397	1.164349972	7.084576639	6.804	5.087	4.273414114
2011 CE66	Amor	1.2934297	0.1793316	9.61287	204.59637	327.95492	340.3019606	1.061476882	1.525382518	1.471005321	3.123118266	10.85	7.352	5.433067664
2011 CF66	Aten	0.9970513	0.27098486	0.61534	265.58676	351.19039	277.9712387	0.726865493	1.267237107	0.995580212	225.2552045	7.677	5.868	6.434540687
2011 CG2	Apollo	1.1775088	0.15844718	2.75745	283.81638	293.26962	298.6208778	0.990935851	1.364081749	1.277751037	4.600346589	7.714	4.943	4.101112569
2011 CG66	Aten	0.9792743	0.37173672	2.9595	246.26957	131.5018	86.0248136	0.615242084	1.343306516	0.969073094	31.33430441	10.605	7.413	8.427670113
2011 CG71	Amor	1.3205845	0.16243508	4.53261	178.82431	329.33302	181.2470279	1.106075251	1.535093749	1.517571959	2.932098488	10.936	6.606	4.981054108
2011 CH22	Aten	0.8465604	0.2409916	0.34871	26.77308	324.91803	129.45127	0.642546455	1.050574345	0.778909362	3.523031872	7.596	6.344	6.825256753
2011 CK50	Aten	0.8750866	0.32524393	4.18399	176.71724	134.05392	205.3858171	0.590469995	1.159703205	0.818609067	4.512954709	11.337	7.463	7.500301056
2011 CL33	Amor	1.3666376	0.26659356	4.08141	168.68553	336.66715	357.5113359	1.002300817	1.730974383	1.597644129	2.673236549	11.035	7.291	4.54359597
2011 CL50	Aten	0.8869545	0.14412608	0.18784	289.5354	17.45114	48.5688564	0.759121225	1.014787775	0.835318331	5.072321271	5.721	3.977	5.717359868
2011 CO14	Apollo	1.1294925	0.17789187	7.68434	273.77919	143.63028	131.1380602	0.928564967	1.330420033	1.200397348	5.990086	7.129	5.67	5.122180842
2011 CQ1	Aten	0.8366014	0.20569023	5.24466	335.39543	315.23478	223.4007627	0.664520666	1.008682134	0.765205143	3.259037078	8.974	7.459	7.154088672
2011 CR1	Amor	1.5271358	0.34304556	3.64719	338.8195	137.21614	21.8966892	1.003258644	2.051012956	1.88719374	2.127149522	11.773	6.691	4.888032593
2011 CY7	Amor	1.2875849	0.21416993	3.94718	164.8149	327.14386	229.3792116	1.011822932	1.563346868	1.46104574	3.168982192	9.006	5.729	4.3973133
2011 DR	Amor	1.1825586	0.13238581	10.57428	7.44349	152.06599	337.1243014	1.026004622	1.339112578	1.285979384	4.496755561	9.06	6.635	5.520104838
2011 DS	Apollo	1.0353319	0.22940514	0.27847	71.22118	346.51846	285.7086474	0.797821441	1.272842359	1.053463258	19.70443439	6.068	5.079	5.440711893
2011 DT9	Amor	1.1043932	0.08331483	11.59703	171.21642	338.4564	99.4311532	1.012380868	1.196405532	1.16060807	7.226337206	8.341	6.227	6.035527815
2011 DU	Apollo	1.1726175	0.31805103	2.95353	120.16517	177.0322	246.6720736	0.799665296	1.545569704	1.269797761	4.706479984	10.412	7.147	5.650790413
2011 DV	Aten	0.9567423	0.04974874	10.59448	350.71605	35.15135	150.0868662	0.909145576	1.004339024	0.935820304	14.58125166	6.458	5.183	6.815409498
2011 EB74	Aten	0.9327962	0.17610617	10.57243	300.85591	355.99569	255.1962244	0.768525034	1.097067366	0.900907396	9.091570513	9.211	6.143	6.648433142
2011 EC	Apollo	1.5057042	0.36402777	1.08071	33.42313	167.61698	357.2324767	0.957586058	2.053822342	1.847606548	2.179792679	10.712	5.992	4.962047679
2011 ED12	Apollo	1.0981494	0.13407849	2.81762	117.61636	349.99898	141.8508568	0.950911187	1.245387613	1.150779569	7.632198277	5.799	4.864	4.304669426
2011 ED41	Apollo	1.259819	0.27724994	4.29693	191.86486	52.89662	318.8026323	0.910534258	1.609103742	1.414041745	3.415215402	10.704	7.194	4.957611095
2011 EE41	Aten	0.9251078	0.18385836	10.40787	350.94214	4.98344	169.0203997	0.755018997	1.095196603	0.889792035	8.073754372	10.195	7.454	6.713475655
2011 EK	Aten	0.8966779	0.16481549	8.71157	178.195	155.43645	356.5218224	0.748891493	1.044464307	0.849091902	5.626549635	9.036	6.264	6.663730382
2011 EK47	Aten	0.912345	0.27625745	10.67862	43.88325	334.90368	129.6068618	0.660302897	1.164387103	0.871442315	6.77860928	11.774	8.356	7.50617692
2011 EL17	Apollo	1.5207849	0.41103643	3.84069	302.74289	170.6567	23.1082911	0.895686904	2.145882896	1.875433579	2.142291116	11.727	8.226	5.522185068
2011 EM40	Apollo	1.1503348	0.37135249	0.55592	262.86346	174.16976	64.4068298	0.723155108	1.577514492	1.233776198	5.277595454	10.441	7.122	6.26000136
2011 EM51	Apollo	1.3209948	0.3351517	1.8658	142.24788	134.22542	108.3920978	0.878261147	1.763728453	1.518279269	2.929461701	10.948	7.201	5.196622567
2011 EP51	Aten	0.8282743	0.30756403	3.40784	169.65234	160.115	205.7402856	0.573526918	1.083021682	0.753808932	3.061885787	11.065	7.063	7.695638289
2011 ES4	Apollo	1.0912506	0.24333257	3.3848	273.51743	339.91763	45.7237444	0.825713787	1.356787413	1.139952468	8.145283057	7.751	5.86	5.353117988
2011 ET74	Apollo	1.1541271	0.21502352	2.973	304.64207	157.31142	54.2974407	0.905962628	1.402291572	1.239882294	5.168711174	7.563	5.768	4.730668513
2011 EX4	Aten	0.8559755	0.2736818	3.02421	218.91285	153.29386	44.7435464	0.621710584	1.090240416	0.791939494	3.806294174	9.082	5.932	7.034344551
2011 FQ21	Apollo	1.3110901	0.31926235	3.36543	300.63045	185.7422	33.2377764	0.892508394	1.729671806	1.501235436	2.995070438	11.856	6.881	5.12873407
2011 FQ29	Amor	1.3298909	0.22274615	3.52647	240.06099	5.09599	111.4784087	1.033662822	1.626118978	1.533642099	2.873915125	10.245	7.046	4.552629615
2011 FQ6	Aten	0.9799088	0.35155267	5.14887	246.31701	183.20827	10.6480691	0.635419245	1.324398355	0.970015082	32.35009937	11.587	8.512	8.139446337
2011 FR29	Apollo	1.0575261	0.34649051	3.61953	175.82608	215.38042	273.5757037	0.691103342	1.423948858	1.087518471	12.42615939	11.11	8.311	6.596607702
2011 FS2	Apollo	1.0792197	0.11539298	13.92579	76.48363	180.30938	50.1426208	0.954685323	1.203754077	1.121152776	9.254041181	11.044	6.618	6.724260828
2011 FS9	Apollo	1.0376553	0.05230513	8.24494	336.14681	156.32916	232.6121203	0.983380605	1.091929995	1.05701138	18.54035778	5.845	5.183	5.473512128
2011 FT9	Apollo	1.5227254	0.35095958	2.51373	185.41622	28.41589	336.8120206	0.988310333	2.057140467	1.879024264	2.137625025	10.952	8.3	4.8541497
2011 FU9	Amor	1.6757077	0.38028246	0.4073	110.11447	81.91511	252.5046438	1.038465454	2.312949946	2.169189022	1.855293696	11.81	9.464	5.186892659
2011 FV9	Apollo	1.1283664	0.34097189	3.17199	23.38539	50.48589	109.0731082	0.743625176	1.513107624	1.198602608	6.035180617	10.654	7.351	6.116843577
2011 GB3	Apollo	1.3608384	0.29716852	5.72028	314.05745	192.90018	141.2797074	0.956440067	1.765236733	1.587485742	2.702168968	11.068	7.389	4.935562448
2011 GD60	Apollo	1.083358	0.16249972	6.06217	211.0422	115.03837	336.0180055	0.907312628	1.259403372	1.127607594	8.836524207	7.85	5.813	5.011741973
2011 GE	Apollo	1.3891503	0.36806286	0.95189	212.69419	48.51064	56.6982081	0.877855668	1.900444932	1.637283388	2.569160625	11.26	7.575	5.308809288
2011 GE3	Aten	0.813566	0.29363461	6.20858	20.81236	13.4451	151.6662095	0.574674865	1.052457135	0.733819395	2.756847718	10.459	5.872	8.041328243
2011 GJ3	Apollo	1.1412659	0.20446365	0.84402	308.53536	331.06383	304.0886116	0.907918508	1.374613292	1.2192149	5.561733705	6.534	5.36	4.603306245
2011 GP59	Aten	0.8689367	0.25779721	8.51109	319.25143	24.42863	66.2302471	0.644927243	1.092946157	0.809994762	4.2630128	10.379	7.304	7.345658907
2011 GR59	Apollo	1.2632429	0.25424154	1.63241	116.25407	141.1592	172.4106374	0.94207408	1.58441172	1.419810223	3.382028699	8.15	6.366	4.574595374
2011 GW65	Amor	1.2622357	0.17387033	11.10125	111.78065	61.48894	24.7998658	1.042770362	1.481701038	1.418112512	3.391700729	11.067	6.978	5.622435819
2011 HF	Apollo	1.2837315	0.23485589	10.62059	149.56317	204.93054	47.3520294	0.982239596	1.585223404	1.454491866	3.200259397	11.59	8.085	5.350722513
2011 HH	Amor	1.304214	0.2124817	3.47904	151.14218	45.7795	166.3685048	1.027092392	1.581335608	1.489440939	3.043147438	10.483	7.219	4.465964495
2011 HN24	Apollo	1.3729195	0.31135876	1.09363	323.38001	205.45101	27.0074231	0.945448987	1.800390013	1.608672398	2.642919907	10.677	6.792	4.766522635
2011 HN5	Aten	0.9182449	0.24279553	3.96282	201.44802	223.28379	177.1214164	0.695299143	1.141190657	0.879909056	7.327022548	8.547	6.208	6.242488624
2011 HO24	Amor	1.1810944	0.08082287	3.75695	321.1964	220.9551	322.6246782	1.085634961	1.276553839	1.283591745	4.526195724	8.111	5.555	4.659813023
2011 HO5	Apollo	1.0553825	0.1365891	11.2934	289.43218	48.51411	17.9081376	0.911228754	1.199536246	1.084213556	12.87457283	9.074	6.39	6.169709422
2011 HP24	Amor	1.1873936	0.10961284	3.06204	42.69017	168.22952	291.6477711	1.057240015	1.317547185	1.293874208	4.40281649	7.284	4.345	4.412552098
2011 HR4	Aten	0.9137298	0.22316007	7.89649	350.85208	47.57538	175.2152128	0.709821794	1.117637806	0.873427142	6.900587968	10.208	6.409	6.560349161

2011 JM5	Aten	0.8739298	0.28233789	1.55261	32.27997	52.16837	259.522595	0.627186304	1.120673296	0.816986392	4.464074561	8.557	6.392	6.87418401
2011 JV10	Apollo	1.1399149	0.20224954	1.40498	297.51065	221.3822	29.4803668	0.909367636	1.370462164	1.21705063	5.607219976	6.677	4.947	4.603830488
2011 KR12	Apollo	1.00719	0.37986675	7.40581	1.61558	20.33748	87.7087553	0.624592008	1.389787992	1.010804363	93.55520313	11.804	8.736	7.571068027
2011 LV10	Amor	1.3274885	0.22916533	9.5941	131.41745	77.07755	29.7623551	1.02327416	1.63170284	1.529488272	2.888615957	11.178	7.523	5.23369959
2011 LZ2	Apollo	1.380958	0.30496009	4.84482	318.33259	253.9276	81.9592476	0.959820924	1.802095076	1.622821323	2.605596924	11.158	7.308	4.875313673
2011 MD	Amor	1.0602173	0.04163756	2.5837	4.67997	274.09205	9.1059323	1.016072439	1.104362161	1.091672398	11.90840885	5.126	4.163	4.103087874
2011 MJ	Apollo	1.2209073	0.20808367	10.39003	99.94538	93.85386	255.2286664	0.966856428	1.474958172	1.349037542	3.865021322	10.224	6.979	5.377215836
2011 MQ3	Apollo	1.1225069	0.11010812	5.67436	301.09063	274.07703	13.4528713	0.998909776	1.246104024	1.189278394	6.283223193	6.703	5.06	4.410509029
2011 MW1	Apollo	1.0555365	0.2750316	3.26107	124.47294	277.14891	336.7429347	0.765230608	1.345842392	1.084450875	12.84120357	9.026	5.861	5.861461433
2011 OB57	Aten	0.9514588	0.24262447	4.91106	223.66485	296.25052	351.9608223	0.720611613	1.182305987	0.928079075	12.9041593	8.249	6.381	6.1807085
2011 OJ45	Apollo	1.0169687	0.20374679	0.75218	135.17489	289.40699	6.1152712	0.809764592	1.224172808	1.025560723	40.12252427	6.074	4.686	5.321876967
2011 OK45	Amor	1.290831	0.21407044	2.87016	327.7403	300.00381	130.6755342	1.01450224	1.56715976	1.466574333	3.143281208	7.882	6.972	4.335900175
2011 OR5	Amor	1.3963048	0.28014875	4.77372	314.26333	308.02126	38.6557478	1.005131756	1.787477844	1.649948339	2.538583822	11.624	7.462	4.674994573
2011 PN1	Amor	1.2129657	0.12877996	1.94862	142.21911	155.88003	192.794162	1.056760026	1.369171374	1.335896402	3.977108398	8.098	5.228	4.358771317
2011 PT	Amor	1.3123249	0.21463409	2.21303	298.75996	71.09317	43.7318949	1.030655239	1.593994561	1.503356757	2.986662515	8.996	7.22	4.422582702
2011 PU1	Apollo	1.3060535	0.24696295	4.34758	326.33209	302.2913	111.4178186	0.983506675	1.628600325	1.492593174	3.030072794	10.083	6.405	4.522575086
2011 QE23	Amor	1.4407586	0.30132946	2.09737	314.588	353.23431	337.214078	1.006615589	1.874901611	1.72936566	2.371054404	10.872	7.943	4.603904979
2011 QS49	Apollo	1.5052294	0.33727289	2.22405	33.12136	349.10091	256.4932519	0.99755633	2.01290247	1.846732697	2.181010257	10.545	5.448	4.757891593
2011 SC16	Amor	1.3454621	0.22268715	6.68803	192.6678	178.99805	350.5146849	1.04584498	1.64507922	1.56065606	2.783624705	11.12	7.484	4.948092769
2011 SH189	Amor	1.2233297	0.10517254	5.86629	217.47008	182.77236	104.7104856	1.094669008	1.351990392	1.353054467	3.832424152	8.675	5.789	5.010618164
2011 SK16	Amor	1.4248578	0.27613751	6.29722	198.29159	167.91928	315.1932721	1.031401115	1.818314485	1.700815818	2.426908432	11.793	8.6	4.977101281
2011 SK68	Apollo	1.3626849	0.29813106	7.7956	135.04381	181.0076	30.1095954	0.956426206	1.768943594	1.590717889	2.692855452	11.398	7.726	5.167250474
2011 ST12	Apollo	1.117385	0.21639953	6.14962	89.16332	353.86111	199.6708797	0.875583411	1.359186589	1.181147828	6.520353258	6.951	5.453	5.238340271
2011 TO	Aten	0.9260186	0.27981677	2.232	57.26171	185.43296	303.4476623	0.666903066	1.185134134	0.891106404	8.183276531	8.585	6.364	6.575272237
2011 TP6	Amor	1.320304	0.22436151	2.58691	227.74145	192.35967	3.192225	1.024078601	1.616529399	1.517088473	2.933905032	10.555	6.355	4.42687892
2011 UB64	Amor	1.4390546	0.27363521	5.73907	165.40244	206.88532	302.1761782	1.045278592	1.832830608	1.726298559	2.376844257	11.014	8.834	5.007144078
2011 UC292	Apollo	1.0779619	0.25883523	1.68481	52.45314	187.12088	63.9233035	0.798947384	1.356976416	1.119193339	9.389730557	7.733	5.906	5.495798146
2011 UD21	Aten	0.9785891	0.03042797	1.06248	209.86379	22.35106	237.7170896	0.94881262	1.00836558	0.968056178	30.30495823	4.699	4.248	4.114608198
2011 UF10	Apollo	1.2889767	0.29486304	9.95771	79.43971	19.43117	5.2837405	0.908905112	1.669048288	1.463415331	3.157891492	11.678	7.547	5.669426801
2011 UG169	Amor	1.3822142	0.21811869	1.57128	295.41758	108.97704	323.7077491	1.080727449	1.683700951	1.625036146	2.599907472	10.198	5.862	4.787007938
2011 UH10	Amor	1.4638584	0.31595874	3.35507	27.804	23.36268	347.515768	1.001339544	1.926377256	1.771122514	2.296810794	11.895	7.676	4.719808494
2011 UJ169	Amor	1.3281455	0.21800798	10.52125	350.89267	36.11159	17.4070367	1.038599182	1.617691818	1.530623873	2.884574085	11.746	7.838	5.476684265
2011 UK10	Apollo	1.2296631	0.25935161	6.07581	125.22039	196.85142	148.7334596	0.910747995	1.548578205	1.363575568	3.750459841	9.252	6.701	5.073698444
2011 UP63	Apollo	1.076349	0.1211425	11.33797	93.85032	29.58774	209.008595	0.945957391	1.206740609	1.11668239	9.570273525	8.188	5.839	6.019347755
2011 UV63	Amor	1.1930727	0.13402428	9.78614	189.74121	13.7295	329.8729634	1.03317199	1.35297341	1.303167866	4.298502621	8.72	5.868	5.370075678
2011 UW158	Amor	1.616558	0.37478779	4.6483	8.61759	286.29513	253.7298727	1.0106918	2.2224242	2.05535544	1.947548061	11.964	5.851	5.170218133
2011 UX275	Apollo	1.0349039	0.07609638	4.54122	50.35671	221.19699	100.6835219	0.95615146	1.11365634	1.052810082	19.93577808	5.639	4.254	4.581475409
2011 UY114	Amor	1.1839829	0.09547624	9.10987	78.65306	25.16091	90.4324431	1.070940664	1.297025136	1.288303376	4.468568465	11.407	7.718	5.530284938
2011 UY255	Apollo	1.3499254	0.31911517	8.04176	276.00824	192.34795	312.8351503	0.919143726	1.780707074	1.568428241	2.759237012	11.176	7.509	5.418628992
2011 UZ275	Amor	1.28678	0.18733113	8.50576	352.37158	51.99039	40.8748724	1.045726049	1.527833951	1.459675953	3.175445538	10.621	6.998	5.147506824
2011 WC	Amor	1.2034487	0.09880907	9.39785	244.91296	226.15362	64.4915684	1.084537053	1.322360347	1.320205	4.12299933	9.495	7.353	5.644492533
2011 WD	Amor	1.3600518	0.22845224	5.66664	208.17252	234.05901	317.2538431	1.04934492	1.67075868	1.586109529	2.706165742	10.61	6.279	4.872887382
2011 WP4	Apollo	1.3594795	0.41420636	0.94594	263.60755	228.01378	299.752235	0.796374445	1.922584555	1.585108499	2.709084727	11.801	7.657	5.900659125
2011 WU2	Amor	1.1842111	0.04554681	3.03762	200.94848	236.7729	338.1715113	1.130274062	1.238148138	1.288675854	4.464092978	7.942	5.456	4.848973499
2011 YA63	Amor	1.4379188	0.24961253	1.30401	222.24588	215.46888	267.3606175	1.07899625	1.79684135	1.724255194	2.380728793	11.881	7.271	4.887172836
2011 YD29	Aten	0.7640894	0.31112389	6.88844	5.07254	281.92778	310.5188668	0.526362934	1.001815866	0.667907411	2.011208419	11.728	6.375	9.173590353
2011 YL28	Apollo	1.4188622	0.35787515	4.42116	46.95979	98.87835	243.784308	0.911086677	1.926637723	1.690091931	2.449082297	11.125	7.565	5.257492345
2011 YP10	Amor	1.2106739	0.1717042	9.32033	55.4063	87.72154	41.0266111	1.002796107	1.418551693	1.33211209	4.011031609	8.988	6.675	5.033984304
2011 YT62	Apollo	1.1990011	0.19389095	6.1446	344.33654	34.83931	144.4754703	0.966525638	1.431476562	1.312893119	4.195979515	7.517	6.483	4.663577533
2011 YU74	Apollo	1.2797518	0.2592627	1.9555	275.67395	275.4284	311.94642	0.947959893	1.611543707	1.447733499	3.233471479	8.012	6.516	4.574420002
2011 YX15	Apollo	1.1269033	0.16288906	12.8174	125.14663	277.68517	206.9229827	0.943343081	1.310463519	1.196272105	6.094967509	9.924	6.622	6.179335446
2012 AF3	Apollo	1.0581794	0.13978613	12.89007	250.51216	105.14277	342.0557596	0.910260597	1.206098203	1.088526369	12.29606932	9.859	6.374	6.578082349
2012 AO10	Apollo	1.327698	0.29235096	5.99708	112.26454	303.4459	354.616457	0.939544215	1.715851785	1.529850355	2.887325338	11.009	7.578	5.015717727
2012 AP10	Aten	0.8892583	0.13901583	2.73086	212.10821	101.56902	317.2794899	0.765637319	1.012879281	0.838574962	5.194825856	6.735	5.463	5.792614884
2012 AQ	Apollo	1.0709716	0.10376615	2.85574	316.06296	97.31966	272.4337958	0.959841	1.1821022	1.108324495	10.2315224	5.247	4.29	4.235058995
2012 BA102	Apollo	1.5480795	0.39618328	2.3685	142.7056	306.88022	18.6062581	0.934756286	2.161402714	1.926149044	2.079739818	11.908	9.09	5.240963532
2012 BA35	Apollo	1.0717779	0.11774397	5.71452	234.48931	145.45732	304.8821887	0.945582515	1.197973285	1.109576363	10.12605577	6.304	4.661	4.751896822
2012 BA62	Apollo	1.0600136	0.11583287	14.095	262.94636	305.59423	156.2278181	0.937229182	1.182798018	1.091357798	11.9459731	10.804	6.835	6.904702708
2012 BB14	Apollo	1.0644848	0.09935114	2.64545	255.0075	316.93637	143.9550282	0.958727022	1.170242578	1.098270192	11.1760257	5.063	4.388	4.218945697
2012 BD14	Apollo	1.0181795	0.24026436	1.53904	293.80124	292.30129	211.8306065	0.773547254	1.262811746	1.027392812	37.5059267	7.704	5.739	5.683100513
2012 BK14	Aten	0.9783473	0.18377876	1.46493	253.33786	118.74765	87.6367312	0.798547846	1.158146754	0.967697404	29.95726469	5.521	4.796	5.112039342
2012 BL11	Amor	1.2453285	0.1532257	10.85647	163.67761	299.56697	13.7064687	1.054512169	1.436144831	1.389715466	3.56597463	10.595	7.033	5.666982842
2012 BN1	Aten	0.9029325	0.18543176	4.15456	24.15603	296.76099	279.0089919	0.735500137	1.070364863	0.857991386	6.041826367	8.14	5.59	5.914227363
2012 BO1	Amor	1.3560517	0.18303832	4.54739	30.0309	117.41035	339.0313419	1.107842275	1.604261125	1.579117226	2.726766109	10.704	6.53	5.043363881
2012 BO11	Apollo	1.3914188	0.36237079	0.47076	320.25469	103.30647	299.9352027	0.88720927	1.89562833	1.641295582	2.559343348	10.925	7.232	5.236443768
2012 BP123	Apollo	1.1225384	0.15602626	2.59732	272.80274	148.55734	53.7346374	0.947392932	1.297683868	1.189328455	6.281826238	6.462	4.852	4.336455408
2012 BS1	Apollo	1.4306077	0.37835109	1.04596	56.58024	117.16434	222.3562231	0.889335717	1.971879683	1.711121457	2.40622954	10.688	7.457	5.302057282

2012 BT1	Aten	0.7833304	0.30646474	4.34292	193.67236	117.59312	216.2896266	0.543267253	1.023393547	0.693294048	2.260451889	11.182	6.129	8.495620408
2012 BV1	Apollo	1.236159	0.31605192	0.76469	248.57007	296.60021	359.702314	0.845468575	1.626849425	1.374394798	3.670977282	8.849	6.469	5.288772478
2012 BV13	Aten	0.9430707	0.10123027	12.21736	306.02231	295.53743	296.0313021	0.847603398	1.038538002	0.915833189	10.8811678	9.235	6.3	7.062987329
2012 BV61	Apollo	1.5293129	0.3531549	0.63682	60.00849	48.939	193.9903183	0.989228556	2.069397244	1.891230782	2.12204383	11.213	8.428	4.790051346
2012 BY76	Apollo	1.432291	0.37141927	4.54242	272.08199	141.46149	36.1574894	0.900310522	1.964271478	1.714142388	2.400280976	11.412	7.416	5.36761651
2012 CA53	Amor	1.265776	0.1926332	10.80994	136.97916	321.88704	24.066431	1.021945519	1.509606481	1.424082945	3.358029276	11.377	8.155	5.428163309
2012 CM2	Aten	0.9866329	0.21239082	5.87456	28.95967	337.50777	106.1318033	0.777081129	1.196184671	0.980016505	49.04129606	9.038	6.633	5.835512469
2012 CN2	Amor	1.3368163	0.21075703	10.00345	167.76553	320.46219	4.8876688	1.055072867	1.618559733	1.545637331	2.832719177	11.893	8.305	5.478981136
2012 CO46	Amor	1.3199401	0.19655329	3.63337	64.13942	349.75314	18.1548512	1.060501531	1.579378669	1.51646131	2.936253463	10.276	7.427	4.673846838
2012 CP46	Amor	1.1523608	0.06944716	7.34982	347.88375	141.90104	111.0309483	1.072332615	1.232388985	1.237037071	5.218749394	8.003	5.877	5.248650197
2012 CR46	Amor	1.3388943	0.24143432	2.66734	196.37871	318.74988	288.4228105	1.015639265	1.662149335	1.549242631	2.820688971	10.345	6.795	4.433088559
2012 CS46	Apollo	1.2876356	0.29610732	0.44083	343.99558	223.67117	324.4745601	0.906357273	1.668913927	1.461132036	3.168576289	9.824	6.722	4.88267232
2012 DH54	Aten	0.9361992	0.14634069	3.30817	131.04376	162.28258	263.3980238	0.799195163	1.073203237	0.905841886	9.620433623	5.97	5.193	5.217062243
2012 DJ54	Apollo	1.1761461	0.22992546	1.99107	120.02617	336.89403	104.9408028	0.905720167	1.446572033	1.275533618	4.629321201	7.433	5.375	4.714957451
2012 DK4	Aten	0.8909556	0.18118879	4.08339	148.54837	168.29071	314.7445469	0.729524433	1.052386767	0.840976951	5.288396577	7.742	6.336	6.040688641
2012 DK61	Amor	1.2434192	0.16564586	6.26737	301.3663	336.17475	264.8864626	1.037451957	1.449386443	1.386520687	3.587183644	9.224	6.3	4.729091882
2012 DL31	Aten	0.9585859	0.22419028	9.49875	200.02143	159.80022	135.3584868	0.743680259	1.173491541	0.938526533	15.26718068	11.086	8.109	6.581846219
2012 DL4	Apollo	1.2504558	0.30477815	7.7183	280.31942	154.67569	44.8106058	0.869344195	1.631567405	1.398306955	3.510626506	10.671	7.541	5.590133691
2012 DM32	Apollo	1.0520641	0.1719229	12.88429	274.65677	155.44239	275.3611432	0.871190189	1.232938011	1.079103999	13.64158596	10.985	7.026	6.682774537
2012 DN14	Amor	1.3018001	0.18395962	7.50114	9.37029	166.36204	302.201208	1.062321448	1.541278752	1.485307763	3.060548124	11.166	7.754	5.09232296
2012 DO8	Aten	0.9460812	0.24570876	8.77752	356.92872	347.44593	187.0384699	0.713620761	1.178541639	0.920222015	11.53478633	11.121	8.325	6.729427908
2012 DS30	Apollo	1.0931936	0.09190281	9.56599	228.86376	332.46027	119.1021642	0.992726036	1.193661164	1.142998395	7.993085459	6.788	5.513	5.420800529
2012 DS32	Apollo	1.2478172	0.30430408	7.54142	243.09565	340.2646	321.450262	0.868101335	1.627533065	1.393883418	3.538822289	10.44	7.14	5.574930807
2012 DT60	Amor	1.1916556	0.11255445	7.48109	73.78856	353.89473	120.1879326	1.057529459	1.325781741	1.300846753	4.323951444	8.285	5.573	5.071019731
2012 DV43	Amor	1.4446138	0.27572814	3.04332	357.27084	149.53704	223.1422894	1.046293124	1.842934476	1.736311489	2.358120871	11.961	7.619	4.820290253
2012 DW60	Apollo	1.1113861	0.16780577	4.82202	237.89161	353.67919	78.8491263	0.9248891	1.2978831	1.171648771	6.825850053	6.696	5.186	4.717538922
2012 DY32	Apollo	1.0840186	0.1658685	9.53635	259.90037	158.37311	243.5637361	0.904214061	1.263823139	1.128639124	8.77368475	8.506	6.443	5.671791784
2012 EB	Apollo	1.0760547	0.07827853	15.82159	115.04574	344.49403	227.3510546	0.99182272	1.16028668	1.116224429	9.604043104	11.032	7.043	7.420842479
2012 EC	Apollo	1.1543092	0.13884539	0.90966	332.78429	306.856	341.3629734	0.994038689	1.314579711	1.240175752	5.163617657	5.871	3.977	3.932830891
2012 EJ5	Amor	1.4727872	0.31630425	0.18743	141.02215	36.46228	189.7263857	1.006938349	1.938636051	1.787351634	2.270080555	9.532	8.003	4.615829584
2012 EL8	Amor	1.1884908	0.1492597	4.25776	166.12404	358.36112	47.4102892	1.01109702	1.36588458	1.295668011	4.382171775	7.994	5.725	4.265167247
2012 EM8	Amor	1.3689123	0.24317436	3.91885	15.68991	183.40488	240.6655868	1.036027928	1.701796672	1.601634587	2.662138485	9.84	5.483	4.671569274
2012 EN5	Apollo	1.0271836	0.30418416	3.94036	102.78219	174.52886	158.2088709	0.714730619	1.339636581	1.041051263	25.35978662	10.789	7.343	6.373064163
2012 EP10	Apollo	1.0503692	0.11595981	1.03319	105.75174	348.02743	262.4183078	0.928568587	1.172169813	1.076497356	14.07234716	4.702	3.764	4.317792203
2012 EY11	Apollo	1.1483959	0.15076752	9.0218	238.86536	167.62145	181.599517	0.975255098	1.321536702	1.2306582	5.335419239	8.174	6.022	5.132358851
2012 FC71	Aten	0.9884819	0.08800601	4.94336	348.04099	38.18431	67.5621438	0.901489552	1.075474248	0.982772696	57.04738771	7.733	4.574	4.680071746
2012 FH58	Apollo	1.1910909	0.30120147	7.58149	258.50168	10.585	338.5666471	0.83233257	1.54984923	1.299922198	4.334198027	10.896	7.09	5.789080995
2012 FM35	Apollo	1.0113186	0.11835091	2.12173	77.22478	11.18874	322.2132224	0.891628123	1.131009077	1.017025851	59.73421447	7.258	6.376	4.665530173
2012 FN	Apollo	1.2214449	0.1870983	3.23294	147.89259	356.90891	21.7419581	0.992914636	1.449975164	1.349928669	3.857725269	7.11	4.531	4.201476082
2012 FN35	Apollo	1.1671444	0.27088432	9.29043	71.59655	6.9527	74.5182263	0.850983283	1.483305517	1.26091812	4.832619975	10.393	6.706	5.872760648
2012 FS35	Apollo	1.0989353	0.11840693	2.33658	42.26475	186.55699	90.773748	0.968813745	1.229056855	1.152015138	7.578292214	5.977	4.659	4.130541604
2012 FT35	Aten	0.833779	0.20413752	5.12153	169.52585	185.1055	34.6559697	0.663573423	1.003984577	0.76133611	3.189992883	8.613	7.121	7.190856315
2012 FV23	Apollo	1.5500975	0.36683205	1.07427	136.67151	74.61212	133.0423316	0.981472056	2.118722944	1.92991652	2.075365345	9.964	8.126	4.895413928
2012 FV35	Apollo	1.2950357	0.35912748	5.81054	263.60278	194.12184	48.1179431	0.829952793	1.760118607	1.473745904	3.110836192	11.335	7.299	5.757279378
2012 FX35	Amor	1.0731316	0.06560101	10.8294	343.09276	183.24801	172.6367536	1.002733083	1.143530117	1.111679188	9.954219817	7.228	5.724	5.960709805
2012 GA5	Amor	1.141779	0.06601169	7.29924	108.73004	192.50994	331.0074619	1.066408239	1.217149761	1.22003721	5.544685867	7.327	5.833	5.226914335
2012 GV11	Apollo	1.0450314	0.21563657	5.40349	217.48868	164.67315	6.3823862	0.819684413	1.270378387	1.068301922	15.6408764	8.907	7.063	5.565048662
2012 HB2	Amor	1.3891837	0.26005577	1.63757	142.52296	67.24762	220.0967487	1.027918463	1.750448937	1.637342438	2.569015243	9.224	7.966	4.554079728
2012 HC25	Apollo	1.2102341	0.18846304	6.41305	317.26633	198.99264	43.1149941	0.982149702	1.438318498	1.331386284	4.017626405	8.479	6.073	4.612731849
2012 HD20	Apollo	1.1809185	0.27148379	4.6935	32.08538	87.13149	85.7825955	0.86031827	1.50151873	1.283305009	4.529764632	9.688	6.22	5.262489078
2012 HE31	Apollo	1.3815073	0.39232414	0.53182	274.81569	10.80028	188.2828228	0.839508637	1.923505963	1.623789677	2.603104438	11.694	7.661	5.588274657
2012 HG2	Apollo	1.1890676	0.18171921	0.11122	26.39078	143.35896	40.2549098	0.972991175	1.405144025	1.296611348	4.371415175	7.548	5.585	4.150978583
2012 HH31	Amor	1.1976588	0.13733916	3.29167	75.33352	84.70681	44.6610462	1.033173346	1.362144254	1.310689031	4.218652417	8.223	6.713	4.303403521
2012 HK31	Apollo	1.0738166	0.12084191	2.20532	96.66443	222.69294	38.164634	0.944054551	1.203578649	1.112743766	9.86966997	5.746	4.65	4.285815815
2012 HM	Apollo	1.175097	0.19753912	7.14872	230.20581	39.03508	343.5891162	0.942969373	1.407224627	1.273827371	4.651935882	8.913	6.158	4.943032333
2012 HN1	Apollo	1.0253342	0.15298807	2.40323	108.64886	194.80114	117.9838197	0.8684703	1.1821981	1.038240976	27.14995991	5.514	4.764	4.877430182
2012 HN13	Apollo	1.4088168	0.30818598	4.07115	96.81193	184.03554	169.8587749	0.974639214	1.842994386	1.672175218	2.487707331	10.343	7.496	4.777672135
2012 KA42	Apollo	1.3055065	0.25092483	6.15183	315.9887	245.99675	26.3331491	0.977922503	1.633090497	1.491655582	3.03394416	10.387	7.149	4.73706243
2012 KB4	Amor	1.092989	0.0607749	6.32782	277.65934	60.50104	351.327838	1.026562703	1.159415297	1.142677528	8.008812186	6.24	5.237	4.861933387
2012 KB6	Apollo	1.353749	0.30681088	7.9865	106.14601	63.35335	37.5925929	0.938404078	1.769093922	1.575096706	2.73883799	11.501	7.888	5.291190938
2012 KC45	Apollo	1.177734	0.18132085	8.65391	310.043	247.8098	27.9458437	0.96418627	1.39128173	1.278117612	4.59560113	8.503	6.364	5.077217578
2012 KC6	Apollo	1.2408277	0.24646891	11.3188	337.93685	195.41214	347.4763422	0.935002249	1.546653151	1.382188324	3.616511119	11.393	7.653	5.718711129
2012 KT12	Amor	1.2510175	0.1977144	1.71459	25.02692	235.77377	282.6255927	1.003673326	1.498361674	1.399249233	3.50470112	6.742	4.105	4.137305316
2012 LA	Amor	1.0404291	0.02158961	3.15828	79.37221	234.13452	75.274349	1.017966642	1.062891559	1.061252523	17.32585804	4.519	3.926	4.337436555
2012 LA11	Aten	0.9884832	0.09663884	5.11877	241.1846	260.69449	302.274979	0.89295733	1.08400907	0.982774635	57.05392102	6.18	5.093	4.733543972
2012 LF4	Apollo	1.2705271	0.26100627	5.82535	73.20113	252.32747	226.5724239	0.938911561	1.602142639	1.432108424	3.314233986	9.358	6.707	4.905444075
2012 LU	Amor	1.5283722	0.33436681	3.1206	201.00722	88.61192	100.5122635	1.017335263	2.039409137	1.88948607	2.124244701	10.443	8.756	4.890667136
2012 LW7	Amor	1.3311213	0.21826399	8.63681	122.9674	91.22591	257.6055864	1.040585454	1.621657146	1.535770953	2.866469233	11.935	7.817	5.173524302
2012 MD7	Aten	0.9768803	0.10874417	3.75388	135.34947	266.19733	75.610833	0.870650263	1.083110337	0.965521674	28.0037286	5.046	4.286	4.656779297

2012 MY2	Amor	1.2603194	0.2038332	0.18313	96.96646	202.30339	247.7329336	1.003424464	1.517214336	1.414884315	3.410310452	8.602	5.353	4.110618503
2012 PB20	Apollo	1.0542132	0.09486773	5.83873	49.99307	142.92119	172.9443161	0.954202387	1.154224013	1.08241219	13.13412721	5.1	4.302	4.785618848
2012 PY19	Aten	0.8732598	0.20013667	1.36546	171.91706	318.23915	139.6365856	0.698488492	1.048031108	0.816047056	4.436172842	6.873	4.523	6.200903069
2012 PZ17	Aten	0.8941644	0.14240402	5.42109	7.3473	139.87471	79.9627387	0.766831795	1.021497005	0.84552424	5.47350754	7.436	5.91	6.066701071
2012 QM14	Apollo	1.2222267	0.3869758	0.91952	225.42439	4.00693	52.9469504	0.749254545	1.695198855	1.351224933	3.84717828	11.791	7.711	6.10596442
2012 RM15	Apollo	1.0938775	0.24951366	8.00301	89.47609	171.28095	45.5542761	0.820940121	1.366814879	1.14407115	7.941014913	10.15	6.422	5.88966298
2012 RR16	Apollo	1.3802803	0.29605132	3.84491	145.76199	170.02556	155.9278307	0.971646495	1.788914105	1.621626879	2.608682046	10.545	6.761	4.71917179
2012 SB3	Apollo	1.4749641	0.36455289	2.68889	133.84967	173.44436	109.0426601	0.937261675	2.012666525	1.791315876	2.263717854	11.77	7.304	5.089846623
2012 SJ32	Apollo	1.4701937	0.366115	2.08787	237.14902	175.58413	62.3035342	0.931933734	2.008453666	1.782632566	2.277738806	10.587	6.341	5.094705835
2012 SK50	Amor	1.2984905	0.18826666	8.80045	163.1292	187.4867	184.0221878	1.054028031	1.542952969	1.47964716	3.084865884	11.404	8.149	5.24909206
2012 SR56	Apollo	1.2965086	0.35994773	2.309	284.92631	359.94877	218.080193	0.829833273	1.763183928	1.476260851	3.099689693	11.693	7.996	5.556433928
2012 SU9	Aten	0.9298128	0.36015475	0.49607	264.21478	323.5616	261.9200277	0.594936303	1.264689297	0.896588741	8.670126896	11.57	7.476	7.861159308
2012 SX49	Aten	0.9484082	0.11709897	3.90892	210.31285	353.57275	291.5582031	0.837350577	1.059465823	0.923619196	12.09229473	6.15	4.782	5.018445422
2012 TC4	Apollo	1.4056712	0.33562942	0.85578	222.56324	198.26052	85.4043647	0.93388659	1.87745581	1.666577907	2.500199735	9.848	5.424	4.917908867
2012 TE146	Amor	1.5100657	0.31094121	3.69608	298.52534	28.92775	27.8455666	1.040524044	1.979607356	1.855640166	2.168715588	11.947	8.856	4.97224293
2012 TF79	Amor	1.0498986	0.03815923	1.0047	265.65792	199.90673	279.6993944	1.009835278	1.089961922	1.075773978	14.19714268	4.434	3.914	3.840728424
2012 TP20	Apollo	1.3869866	0.32617661	0.65057	117.39691	208.03341	143.2864212	0.934584013	1.839389187	1.633459601	2.578632636	10.96	6.065	4.870889855
2012 TP231	Apollo	1.1178924	0.25376769	6.74461	75.39582	30.27662	238.1484534	0.834207428	1.401577372	1.181952451	6.495941368	7.922	5.884	5.623874011
2012 UE34	Apollo	1.1053453	0.09921749	9.6579	18.41086	198.48785	114.0111714	0.995675714	1.215014886	1.162109238	7.168679928	7.007	6.087	5.375076667
2012 UK171	Aten	0.859695	0.2221134	1.32664	357.66765	251.20401	4.8718656	0.668745221	1.050644779	0.79710696	3.928705297	7.472	6.111	6.528086366
2012 UL171	Apollo	1.0615041	0.14324365	3.16561	92.06403	22.2875	294.2141974	0.909450378	1.213557822	1.093660467	11.67686323	4.946	4.409	4.62855376
2012 US18	Apollo	1.1941625	0.35544485	3.54365	265.90314	205.56121	183.1330531	0.769703589	1.618621411	1.304953821	4.27918501	10.197	7.042	5.970844631
2012 US9	Apollo	1.0928274	0.24671431	8.28064	182.86924	334.73237	204.3144166	0.823211242	1.362443558	1.142424118	8.021282729	11.773	6.759	5.91445997
2012 UU68	Aten	0.9397691	0.22822772	5.44341	292.94694	221.06699	24.8474665	0.725287741	1.154250459	0.911028035	10.2394955	7.672	5.664	6.104732267
2012 UU9	Apollo	1.5524145	0.38822523	2.64636	175.74642	165.03202	57.4401946	0.949728024	2.155100976	1.934245236	2.070382767	11.465	8.343	5.161089054
2012 UV136	Apollo	1.0075469	0.13896036	2.20907	289.49139	210.52856	305.0857428	0.86753782	1.14755598	1.011341682	89.17034682	4.659	4.048	4.867471177
2012 UW68	Apollo	1.1359318	0.15521593	2.47255	102.41851	15.39563	202.0148877	0.959617089	1.312246511	1.210677264	5.746596682	6.69	4.61	4.250580829
2012 UX136	Apollo	1.0890112	0.18294467	4.53771	64.79815	47.2347	252.0941508	0.889782405	1.288239995	1.136445254	8.32894672	6.063	4.823	4.930066669
2012 UX68	Apollo	1.090891	0.28057462	4.21919	93.26554	50.47001	230.9902773	0.784814672	1.396967328	1.139389042	8.17416512	8.556	6.178	5.770891825
2012 UY68	Apollo	1.174893	0.22827473	2.9015	35.74595	70.31948	189.1364486	0.906694618	1.443091382	1.273495675	4.656364947	8.434	5.694	4.751510406
2012 VB37	Apollo	1.4517224	0.31347899	1.79405	151.81072	242.43595	75.0709485	0.996637928	1.906806872	1.749143204	2.334858268	9.524	8.218	4.615651773
2012 VC26	Aten	0.9516514	0.19509598	1.48854	119.43979	43.11144	352.3084595	0.765988037	1.137314763	0.92836089	12.95885574	5.516	4.8	5.371452195
2012 VD6	Amor	1.3439412	0.25513202	10.23956	224.74739	227.23296	92.4330954	1.001058767	1.686823633	1.558010578	2.792080724	11.767	8.175	5.248280045
2012 VJ38	Apollo	1.3586784	0.28613226	0.38686	24.45396	52.44127	96.3590656	0.969916679	1.747440121	1.583707621	2.713186471	8.339	4.462	4.542846636
2012 VK5	Aten	0.9375691	0.22834232	4.80143	152.32155	42.25289	332.1353521	0.723482397	1.151655803	0.907830832	9.849615169	8.208	5.87	6.049030724
2012 VL5	Amor	1.818599	0.4471108	0.73344	351.935	46.22371	308.7762295	1.005483746	2.631714254	2.452479704	1.688477779	11.781	5.541	5.33826209
2012 VM6	Apollo	1.1279192	0.16595777	5.07552	98.77505	227.09766	327.5617119	0.940732245	1.315106155	1.197890124	6.05330929	6.748	5.187	4.647210507
2012 VP6	Amor	1.2771788	0.14153972	8.42924	147.31073	224.33538	182.6376818	1.09640727	1.45795033	1.443369592	3.255454633	10.568	7.95	5.431747366
2012 VR76	Apollo	1.0834223	0.12912878	5.01473	295.34673	50.93372	352.4776679	0.9435213	1.2233233	1.127707985	8.830363932	5.927	4.765	4.629119208
2012 VU76	Apollo	1.0186224	0.12826872	6.75904	88.53057	52.52574	290.4833454	0.887965009	1.149279791	1.028063247	36.63379555	5.741	4.664	5.354495508
2012 VZ19	Aten	0.982606	0.25373087	1.25158	221.4928	57.87163	146.8018855	0.733288525	1.231923475	0.974022788	37.49527778	7.409	5.638	6.107835119
2012 WF	Apollo	1.1215061	0.1990594	14.05036	293.13663	52.9152	312.4359492	0.898259769	1.344752431	1.187688251	6.327984021	11.887	7.206	6.635690549
2012 WH	Aten	0.9071173	0.14528786	4.09908	8.65652	235.23257	306.1519644	0.775324169	1.038910431	0.863963061	6.35094458	7.255	4.849	5.677582514
2012 WH1	Aten	0.8176988	0.33638774	4.61287	147.00455	64.07816	149.2024335	0.542634949	1.092762651	0.739418037	2.83756416	11.458	7.783	8.172338594
2012 WK4	Apollo	1.2051952	0.3076316	4.29155	161.92192	151.06075	262.5531256	0.834439072	1.575951328	1.323079955	4.095209044	10.885	7.301	5.476220576
2012 WM28	Amor	1.2145907	0.16548415	9.93835	15.47594	66.67324	174.2475146	1.01359519	1.41558621	1.338581835	3.953495719	9.751	6.777	5.229571769
2012 WR10	Apollo	1.0853648	0.11168932	0.30736	146.77521	224.29417	330.7510321	0.964141144	1.206588456	1.130742196	8.648640091	4.911	3.799	4.047549423
2012 WS3	Apollo	1.1114272	0.2795356	3.87326	86.10108	241.5212	328.9126321	0.800743731	1.422110669	1.171713764	6.823644976	10.469	7.204	5.623065692
2012 XA	Amor	1.3683365	0.26507549	5.99584	209.17797	249.13824	77.3043105	1.005624032	1.731048968	1.600624159	2.664934693	10.757	6.422	4.730937022
2012 XB	Amor	1.1985694	0.13999979	11.31074	164.27679	250.14432	205.1284096	1.030769936	1.366368864	1.312184123	4.203237852	9.785	6.796	5.688948379
2012 XB112	Apollo	1.0251109	0.14463754	1.32665	87.54093	76.98981	262.262101	0.876841381	1.173380419	1.037901829	27.38395132	4.394	4.118	4.74410632
2012 XD112	Apollo	1.3229997	0.36574196	3.71919	76.70646	97.90746	63.1453827	0.839123197	1.806876203	1.521737064	2.916674258	11.555	7.264	5.586689561
2012 XF55	Apollo	1.2759804	0.25023979	1.54006	267.27413	251.796	76.9484266	0.956679333	1.595281467	1.441338559	3.2658342	8.691	4.919	4.485005525
2012 XJ112	Apollo	1.2221873	0.3697233	2.43528	102.3872	256.91358	211.7734871	0.770316178	1.674058422	1.351159596	3.847708029	11.89	7.5	5.95397609
2012 XK134	Apollo	1.1934404	0.21526826	0.62415	265.41872	116.6932	228.0022591	0.936530562	1.450350238	1.303770359	4.29196043	7.737	5.466	4.456512084
2012 XL16	Aten	0.9852995	0.17864614	3.12581	58.37567	259.60237	114.716263	0.809279548	1.161319452	0.978030489	44.51762651	6.422	5.361	5.126893835
2012 XM55	Apollo	1.0964206	0.13013525	1.08056	68.68887	66.56668	220.4391321	0.953737631	1.239103569	1.148063157	7.753874639	5.644	4.664	4.166031089
2012 XO134	Aten	0.9751433	0.37834108	1.41824	199.00566	124.83935	96.5208444	0.606206531	1.344080069	0.962947615	25.98881579	10.539	7.56	8.48625651
2012 XP134	Apollo	1.207776	0.30810334	5.63496	250.67189	262.44324	138.0452379	0.83565618	1.57989582	1.327332087	4.055001451	11.658	8.264	5.576570494
2012 XZ132	Apollo	1.2960558	0.3397879	2.38138	314.32796	209.03803	78.5307119	0.855671721	1.736439879	1.475487552	3.103104479	9.887	6.88	5.348313188
2012 YD7	Aten	0.8807925	0.21888466	2.54022	201.60143	72.81239	312.831481	0.688000533	1.073584467	0.826628571	4.767963074	8.176	6.149	6.272784983
2012 YL7	Amor	1.4714733	0.27576104	2.38604	325.12173	152.53675	17.9889186	1.065698292	1.877248308	1.784960374	2.273949658	11.496	8.565	4.931714517
2013 AB4	Apollo	1.094964	0.2853715	5.48726	95.48268	102.41612	298.4657176	0.782492481	1.407435519	1.145776106	7.859834777	11.294	6.807	5.900204463
2013 AC53	Apollo	1.5489345	0.38286095	1.90904	342.93949	95.72816	10.0269594	0.955907966	2.141961034	1.927744974	2.077882422	10.986	8.659	5.085059249
2013 AF4	Amor	1.3441839	0.18859507	7.88446	86.4397	96.34934	27.0837141	1.090677443	1.597690357	1.558432634	2.790726291	11.751	8.199	5.335078394
2013 AG53	Amor	1.2405375	0.17539706	5.77456	345.3816	103.02745	153.436433	1.02295087	1.45812413	1.381703461	3.619834771	8.399	7.048	4.57592658
2013 AT27	Apollo	1.0348468	0.20839677	5.69977	76.678	292.54792	9.9443455	0.819188069	1.250505531	1.052722952	19.96707163	6.674	5.302	5.606858511

2013 BN18	Apollo	1.0437139	0.05606366	16.25279	238.23434	300.28731	223.7062694	0.985199479	1.102228321	1.066282302	16.08698347	11.366	7.075	7.916467778
2013 BS15	Apollo	1.1136588	0.22135481	10.03849	102.93835	114.14791	145.696063	0.867145068	1.360172532	1.175244506	6.706312975	9.869	6.471	5.912855835
2013 BS45	Aten	0.9936781	0.08387483	0.77337	149.70624	83.55082	219.4807478	0.910333518	1.077022682	0.990532153	104.6206363	4.658	4.134	4.061314683
2013 BW15	Apollo	1.4478123	0.3249353	4.24661	304.17099	117.98141	29.2119401	0.977366976	1.918257624	1.742081195	2.347561434	11.668	7.505	4.858797222
2013 BZ45	Apollo	1.0132575	0.14399024	11.8747	99.02666	131.2718	222.4650353	0.867358309	1.159156691	1.019952016	51.12024957	9.568	6.476	6.632500839
2013 CE129	Apollo	1.3436262	0.30404348	4.72356	230.43963	22.69185	346.8164164	0.935105414	1.752146986	1.557462848	2.793841516	10.453	7.314	4.962728863
2013 CG129	Amor	1.3894096	0.20486919	7.04387	166.68282	348.32243	357.5128204	1.104762381	1.674056819	1.637741835	2.56803262	11.99	7.534	5.341480461
2013 CL129	Apollo	1.1061792	0.21373856	2.72209	290.84171	140.80049	252.9570085	0.869746051	1.342612349	1.163424572	7.119030872	6.295	5.058	4.950487633
2013 CN118	Aten	0.9306093	0.32576683	3.22073	232.71375	143.63292	100.3495074	0.627447658	1.233770942	0.897741047	8.779094803	9.821	7.102	7.327611931
2013 CQ35	Apollo	1.2785753	0.31551409	9.05408	38.57509	341.05041	193.7548807	0.875166778	1.681983822	1.445737565	3.24347257	11.56	7.976	5.752482793
2013 CU83	Amor	1.2836649	0.1819059	10.34404	18.4749	303.44158	258.0942713	1.050158681	1.517171119	1.454378679	3.200807489	10.619	6.899	5.504067922
2013 CW87	Amor	1.2115926	0.12228204	6.12642	171.4291	315.71014	144.0951336	1.063436585	1.359748615	1.333628654	3.997344462	8.703	5.668	4.856981215
2013 CY	Apollo	1.1138968	0.13402003	0.78081	149.50594	302.65689	237.589625	0.964612317	1.263181283	1.175621269	6.694071156	5.269	3.838	4.093732569
2013 DA1	Amor	1.1678038	0.13621394	1.88839	348.40162	142.4742	168.5565855	1.008732643	1.326874957	1.26198684	4.816985615	6.78	4.671	4.008280467
2013 DB	Apollo	1.1264344	0.11999013	10.74848	336.78641	147.47127	202.7574347	0.99127339	1.26159541	1.195525537	6.114421449	8.331	6.372	5.559328015
2013 DG	Apollo	1.4239833	0.31433117	6.48174	64.27492	148.01399	348.3061762	0.976380963	1.871585637	1.699250256	2.430103158	11.297	7.126	5.01162359
2013 EC20	Apollo	1.111168	0.12000748	1.30421	33.08603	165.83614	154.5698643	0.977819528	1.244516472	1.171303899	6.83757876	5.949	4.846	4.00539135
2013 ED68	Apollo	1.4798331	0.34906265	1.09803	213.94277	351.21573	332.8901255	0.963278637	1.996387563	1.800193154	2.24969827	10	5.534	4.867793755
2013 EM20	Apollo	1.3717534	0.31817384	8.35858	350.04539	73.9726	108.4037966	0.935297353	1.808209447	1.606623326	2.648469417	11.971	8.193	5.386904443
2013 EM89	Amor	1.1779619	0.11660476	2.41147	189.98618	355.57522	119.6573684	1.040605935	1.315317865	1.278488617	4.590811033	7.571	5.9	4.246625539
2013 EN20	Apollo	1.5736351	0.39067659	2.07065	32.87229	166.66423	346.5162523	0.958852705	2.188417495	1.974040466	2.026651392	11.419	8.166	5.121799418
2013 EN89	Amor	1.3981669	0.26695408	0.40842	73.89279	126.95917	3.0497249	1.024920542	1.771413258	1.653249975	2.53080756	11.296	6.844	4.533437156
2013 EQ41	Apollo	1.6345215	0.42601945	0.67037	44.26976	82.46375	317.9996498	0.93818355	2.33085945	2.089709689	1.917675607	11.852	8.311	5.344611003
2013 ER4	Apollo	1.1715181	0.29798961	7.42873	92.02795	336.53853	200.7960585	0.822417878	1.520618322	1.268012411	4.731170497	10.306	6.831	5.83127979
2013 ES11	Apollo	1.2029366	0.33960989	0.37507	192.41107	69.41584	64.6622329	0.794407434	1.611465766	1.319362415	4.131238846	10.045	7.108	5.672646911
2013 EU9	Amor	1.3606934	0.19311776	3.87176	340.58622	233.33988	8.1309269	1.097919339	1.623467461	1.587232025	2.702904403	11.025	6.559	4.947747626
2013 FB8	Apollo	1.3402703	0.3181939	2.14486	213.3014	26.30345	7.0001076	0.913804466	1.766736134	1.551631511	2.812804345	10.046	7.173	4.96678195
2013 FU13	Apollo	1.7285232	0.42575613	0.75987	349.10121	177.36988	277.4588598	0.992593852	2.464452548	2.272546715	1.785825768	10.308	8.956	5.187758283
2013 FX7	Apollo	1.2655135	0.30967091	5.21829	28.82217	211.5809	40.9675606	0.873620783	1.657406217	1.423639973	3.360494911	11.162	7.582	5.323352164
2013 GH66	Amor	1.0511696	0.04459699	3.44575	35.99321	198.63208	164.2152899	1.0042906	1.0980486	1.077728056	13.86536743	4.826	4.065	4.201316933
2013 GM3	Aten	0.8362004	0.28760145	0.02605	321.33149	28.24033	291.0955543	0.595707952	1.076692848	0.764655042	3.249081892	8.928	6.815	7.317662607
2013 GN3	Amor	1.2266885	0.18473142	3.7859	288.21554	198.89975	135.2167836	1.000080592	1.453296409	1.358630753	3.788383292	8.284	6.455	4.212821661
2013 GW79	Amor	1.4227553	0.26820524	1.45302	351.43261	136.87566	41.2244162	1.041164873	1.804345727	1.697052657	2.434611846	11.352	7.902	4.684336716
2013 HO	Apollo	1.02411	0.03126171	9.80856	270.90757	202.50275	301.6676573	0.99209457	1.05612543	1.036382116	28.48603155	5.552	4.859	6.129251415
2013 HO11	Apollo	1.1945812	0.23426386	3.71881	245.88883	59.06549	22.2553307	0.914733997	1.474428403	1.3056402	4.271820914	7.959	6.032	4.774104366
2013 HP11	Amor	1.1845842	0.12537211	4.15508	9.5055	208.67263	90.1829538	1.036070379	1.333098021	1.289284922	4.456799595	8.036	5.803	4.401211405
2013 JC	Amor	1.4805039	0.31295296	5.72283	334.68963	219.14104	334.8929624	1.017175822	1.943831978	1.801417318	2.247789356	10.68	8.344	4.982193562
2013 JO7	Amor	1.1261476	0.10279392	10.15911	21.31857	220.43223	106.9258267	1.010386474	1.241908726	1.195068979	6.126391721	8.957	6.206	5.493164812
2013 JR7	Apollo	1.2598846	0.23050762	9.20066	230.74596	43.2644	327.4246153	0.969471599	1.550297601	1.414152192	3.414571306	10.219	7.077	5.156967124
2013 JV17	Apollo	1.1870767	0.25935597	10.47974	288.02038	228.00569	126.9964991	0.879201271	1.494952129	1.293356265	4.408824423	10.9	7.151	5.886724098
2013 KA	Amor	1.4492806	0.30027439	4.99748	354.86993	234.68126	325.8365599	1.014098752	1.884462448	1.744731967	2.342764974	11.725	7.163	4.84002295
2013 KB2	Amor	1.3339087	0.21055896	3.40205	355.56341	229.74876	10.522735	1.053042271	1.614775129	1.54059739	2.849805454	10.623	7.072	4.646398035
2013 KH6	Aten	0.9225611	0.16064243	15.55327	195.43734	246.31924	62.9580465	0.774358643	1.070763557	0.886120345	7.781199749	11.837	7.886	8.070696933
2013 KS1	Apollo	1.4794319	0.38768223	1.76385	63.32115	231.1131	286.5239757	0.905882442	2.052981358	1.799461123	2.250842562	11.443	7.171	5.289452639
2013 KT1	Aten	0.9230024	0.16364737	8.108	317.28818	58.87385	147.893344	0.771955485	1.074049315	0.886756224	7.830507387	7.412	5.711	6.19012541
2013 LB	Apollo	1.1164383	0.34258262	2.1684	109.24658	17.26039	188.948694	0.733965942	1.498910658	1.179647061	6.566470125	10.521	6.987	6.1561523
2013 LC1	Aten	0.9680611	0.32600833	5.31602	47.21763	80.13266	309.7304039	0.652465117	1.283657083	0.952476246	20.04210879	10.453	8.097	7.571789129
2013 LD7	Apollo	1.1817587	0.22849434	13.01973	285.84523	246.59012	56.8246221	0.911733526	1.451783874	1.284674821	4.512779935	11.856	7.407	6.215882238
2013 LE7	Amor	1.1610746	0.10350617	1.68642	37.45668	203.28256	85.8082948	1.040896215	1.281252985	1.251094707	4.982561055	6.856	5.732	4.176090493
2013 NJ	Apollo	1.2863437	0.2836928	3.93907	140.23411	238.64821	280.4520811	0.921417254	1.651270146	1.458933631	3.178964302	9.934	6.897	4.896852864
2013 NJ4	Apollo	1.1332445	0.20249001	1.31945	238.49	115.6058	15.6332962	0.90377381	1.36271519	1.206383615	5.845345891	6.432	5.303	4.637287548
2013 NX	Apollo	1.0325232	0.16986934	6.32228	312.6247	112.71622	5.2549477	0.857129165	1.207917235	1.049179335	21.33374378	6.648	4.915	5.422265861
2013 OY3	Aten	0.8344261	0.34415216	2.30573	45.6741	107.26168	53.1308254	0.547256555	1.121595645	0.762222597	3.205614108	10.078	6.652	7.943541565
2013 PA39	Amor	1.1374065	0.11033513	7.73414	232.49372	143.72819	347.2607285	1.011910606	1.262902394	1.213035634	5.694050394	7.753	6.037	4.885615429
2013 PA7	Amor	1.1539029	0.0874008	3.47424	92.34374	341.62983	279.5488905	1.053050863	1.254754937	1.239521024	5.174998859	7.014	4.868	4.4133217
2013 PG10	Apollo	1.0782816	0.2266557	0.10731	210.74743	3.82589	143.6443499	0.833882929	1.322680271	1.119691269	9.354828314	6.504	5.267	5.150055893
2013 PH10	Amor	1.4190177	0.17715081	1.2164	108.68216	200.54774	287.6623243	1.167637565	1.670397835	1.690369776	2.448499101	11.717	6.954	5.244636697
2013 PJ10	Apollo	1.2848754	0.24171314	8.26555	321.23911	312.35598	356.1066939	0.974304133	1.595446667	1.45643639	3.19088579	11.013	7.568	5.005021845
2013 PY38	Apollo	1.0425055	0.20265944	4.21392	296.99351	146.30207	346.9367723	0.831231919	1.253779081	1.064431044	16.52046861	7.513	5.433	5.344597312
2013 PZ38	Amor	1.226608	0.09647557	10.21863	359.97435	320.49293	351.2618196	1.108270294	1.344945706	1.358497017	3.789423485	10.642	7.569	5.944199474
2013 PZ6	Amor	1.1690239	0.11346071	2.0495	219.86451	120.93005	0.0706928	1.036385618	1.301662182	1.263965108	4.78837949	7.368	5.742	4.183361818
2013 QE11	Apollo	1.293505	0.23972838	5.85906	309.53572	335.12613	344.8660317	0.983415142	1.603594858	1.47113378	3.122539379	10.203	7.438	4.648138198
2013 QE16	Amor	1.4634154	0.3015333	2.96037	17.49817	338.13002	249.4162764	1.022146925	1.904683875	1.770318596	2.298164169	11.046	8.282	4.754669408
2013 QM10	Apollo	1.1890124	0.16502159	5.56978	75.70781	333.50743	298.1633804	0.992799683	1.385225117	1.29652106	4.372441737	8.477	6.18	4.412952185
2013 QM48	Apollo	1.1494628	0.22154327	7.42802	290.49582	330.78882	64.5947397	0.894807053	1.404118547	1.232373586	5.303415113	8.718	6.417	5.28889753
2013 QP48	Apollo	1.1567262	0.28495209	1.50607	101.99562	150.69799	61.6680452	0.827114652	1.486337748	1.244072983	5.09713516	9.057	6.445	5.334743095
2013 RE6	Apollo	1.0603982	0.20011611	10.43169	344.8641	192.37862	222.2751325	0.848195437	1.272600963	1.091951811	11.87526165	11.026	6.863	6.179312294
2013 RS43	Apollo	1.4568063	0.33348448	0.94158	24.14631	359.3578	237.33122	0.970984009	1.942628591	1.758339435	2.318670708	10.239	7.952	4.760662249
2013 RT9	Amor	1.1398436	0.08504497	9.0188	182.92601	161.27687	11.2558892	1.042905635	1.236781565	1.216936445	5.609645003	7.965	6.02	5.437646149

2013 RV9	Apollo	1.1651478	0.19903479	3.50086	108.28616	332.8406	285.2863331	0.933242852	1.397052748	1.257683981	4.880722418	6.677	5.525	4.570734399
2013 RX73	Amor	1.3657243	0.22860042	3.66153	216.51333	170.5925	255.6804721	1.053519151	1.677929449	1.59604288	2.677731642	10.421	6.183	4.728725505
2013 RZ53	Apollo	1.0130562	0.03168902	2.09522	68.4206	345.60077	23.177526	0.980953442	1.045158958	1.019648086	51.89554345	4.041	3.771	4.10160266
2013 SB20	Apollo	1.0859055	0.0861895	7.11238	319.93443	181.64734	250.1866891	0.992311848	1.179499152	1.13158726	8.59951991	6.262	5.07	4.843543529
2013 SB21	Amor	1.336853	0.23104805	0.80884	205.29526	186.05813	262.1564027	1.027975721	1.645730279	1.545700981	2.832505411	8.558	4.858	4.416122142
2013 SM20	Aten	0.8468481	0.27125975	3.97406	182.63636	341.72919	48.6698149	0.617132296	1.076563904	0.77930646	3.531170234	10.176	7.457	7.190070905
2013 SN24	Aten	0.8331136	0.25854773	10.08608	353.62877	189.49929	28.3108965	0.61771397	1.04851323	0.760424912	3.174056693	11.987	7.742	8.11205627
2013 SP19	Apollo	1.2846502	0.23892681	2.32549	325.92472	0.797	319.3934453	0.977712826	1.591587574	1.456053502	3.192725185	9.398	6.767	4.377956596
2013 ST	Aten	0.8727466	0.22349927	10.83843	24.565	182.6909	313.7568846	0.677688372	1.067804828	0.815327796	4.415000079	10.892	7.731	7.552445246
2013 SU24	Apollo	1.4677913	0.32821261	5.38756	28.73473	9.4663	225.6174917	0.986043686	1.949538914	1.778264931	2.284909496	11.321	9.076	4.946043163
2013 TF4	Amor	1.3449483	0.18594353	7.69631	354.74999	4.35504	280.3044475	1.094863865	1.595032735	1.559762179	2.786472965	11.427	7.404	5.330501201
2013 TG6	Aten	0.9383908	0.12589424	3.21249	220.97255	13.97237	231.8524053	0.820252803	1.056528797	0.909024549	9.991976302	5.577	4.293	5.082888777
2013 TK4	Aten	0.9352538	0.24758558	7.03738	23.56816	204.25606	237.8158001	0.703698445	1.166809155	0.904470116	9.467928541	10.169	7.441	6.53632846
2013 TN127	Aten	0.9349034	0.09688372	13.43728	2.19205	198.80886	277.6282878	0.844326481	1.025480319	0.903961864	9.412530241	9.324	6.446	7.590101028
2013 TT5	Apollo	1.0581355	0.09222883	7.34206	77.24432	11.92286	322.9405335	0.960544901	1.155726099	1.088458631	12.30471936	5.549	4.676	5.087759342
2013 UB	Aten	0.8468978	0.31482794	3.22473	314.24846	209.64678	56.5057396	0.58027071	1.11352489	0.779375065	3.532579239	10.419	7.194	7.539831186
2013 UB3	Aten	0.8842902	0.19736688	4.8359	351.41052	213.80649	314.9190301	0.709760602	1.058819798	0.831557372	4.936739482	8.243	6.553	6.294448546
2013 UD1	Apollo	1.3134694	0.32664305	5.76906	111.18982	213.08086	304.0665987	0.884433749	1.742505051	1.505323838	2.978929004	11.907	7.322	5.365922865
2013 UE3	Apollo	1.025358	0.22559279	3.37307	117.10262	50.00796	276.5192761	0.794044628	1.256671372	1.038277126	27.12526342	7.438	5.136	5.59049303
2013 UM9	Apollo	1.2133284	0.24625505	2.93262	283.26332	38.93077	348.2457073	0.914540154	1.512116646	1.336495635	3.971806752	7.813	6.139	4.754472588
2013 US1	Aten	0.8902121	0.23848979	2.11917	16.88238	207.69813	280.1711772	0.677905603	1.102518597	0.839924481	5.247051421	8.007	5.658	6.306838971
2013 US3	Apollo	1.2002015	0.18452911	12.31366	133.61304	39.64569	183.4577583	0.978729385	1.421673615	1.31486525	4.175961778	10.605	7.383	5.758411024
2013 US4	Apollo	1.0744542	0.0818102	10.043	279.55903	29.67683	76.0116471	0.986552887	1.162355513	1.113734984	9.792369441	8.087	6.052	5.672948936
2013 US8	Amor	1.4020547	0.2664573	4.73146	4.74916	22.8107	245.1852061	1.02846699	1.77564241	1.660150408	2.514806305	10.825	6.632	4.770946608
2013 UT4	Apollo	1.0708165	0.12214071	5.58689	105.61191	206.55425	69.8336709	0.940026212	1.201606788	1.108083739	10.25208553	5.591	4.671	4.758691654
2013 UX2	Apollo	1.1187508	0.14924251	4.10456	228.01553	211.44928	305.3145995	0.951785623	1.285715977	1.183314097	6.455117839	6.541	5.025	4.447336136
2013 VL	Apollo	1.1818184	0.28916795	7.51502	106.19824	218.08044	353.7766884	0.840074396	1.523562404	1.284772171	4.511579084	10.872	7.137	5.714046145
2013 VM13	Amor	1.2028824	0.03651819	3.22955	69.89423	42.97406	303.9165389	1.158955312	1.246809488	1.319273248	4.132113347	8.827	5.397	5.042987258
2013 VO11	Apollo	1.1983668	0.34338243	2.21875	274.38259	52.27185	340.3429023	0.786868696	1.609864904	1.31185143	4.20665517	10.365	7.189	5.768664293
2013 WA44	Amor	1.1004674	0.06048414	2.30239	176.73853	56.51703	158.0812169	1.033906576	1.167028224	1.154425131	7.475629929	5.442	3.655	4.143803165
2013 WR45	Apollo	1.0148507	0.22052723	4.35758	302.85984	242.4744	267.8531425	0.791048486	1.238652914	1.02235855	45.72561918	8.816	5.772	5.697090711
2013 WS44	Amor	1.40913	0.25295003	6.37113	141.34506	238.67395	249.0839159	1.052690524	1.765569476	1.672732872	2.486474115	11.791	8.145	5.048378012
2013 WY	Amor	1.52002	0.33873168	1.23391	1.97455	63.08037	198.2447639	1.005141072	2.034898928	1.874018844	2.144140092	9.927	5.044	4.743414385
2013 XA22	Apollo	1.1003136	0.23736798	1.96006	258.10981	82.63636	26.8694261	0.839134383	1.361492817	1.154183128	7.485793965	6.946	5.528	5.16901732
2013 XK22	Apollo	1.0456366	0.2033544	6.99347	265.7031	268.42801	264.7850479	0.833001797	1.258271403	1.069230071	15.44459009	7.478	5.388	5.676013023
2013 XS23	Amor	1.0611529	0.05633173	9.73086	54.09742	76.76953	279.9744268	1.001376321	1.120929479	1.093117754	11.73909066	6.801	5.239	5.734744295
2013 XV8	Amor	1.3460825	0.1925146	4.04139	15.29566	107.21686	202.9189769	1.086941966	1.605223034	1.561735625	2.780196867	10.87	6.687	4.882448437
2013 XX8	Amor	1.3897612	0.25792171	1.06742	172.0833	287.91854	205.3168793	1.031311615	1.748210785	1.638363538	2.566505512	10.364	7.932	4.555478874
2013 XY20	Amor	1.1305928	0.10646714	2.86267	18.18281	78.63944	284.5709842	1.010221818	1.250963782	1.202151833	5.946776803	6.507	5.479	4.05361661
2013 YA14	Apollo	1.1800441	0.34743766	4.59988	256.85282	277.31977	222.8524524	0.770052339	1.590035861	1.281879956	4.547609466	10.299	7.081	6.013968304
2013 YB	Apollo	1.5546189	0.42892109	0.19349	230.1575	269.04143	341.3143351	0.887810067	2.221427733	1.938366587	2.065681594	9.581	6.811	5.536463905
2013 YG	Aten	0.9771326	0.07826164	7.12062	50.09985	272.69237	120.0820943	0.9006606	1.0536046	0.965895748	28.32185707	6.637	5.911	5.30913976
2013 YM2	Aten	0.8845809	0.15414044	3.30071	160.67041	92.20403	259.5957935	0.748231211	1.020930589	0.831967453	4.951228	6.679	5.832	5.960223215
2013 YR2	Apollo	1.2485592	0.23431731	4.15176	66.0611	97.51302	196.6677223	0.956000167	1.541118233	1.395126887	3.530832581	8.857	5.783	4.587499529
2013 YS2	Amor	1.4513996	0.2961831	2.93325	216.14305	261.87492	182.0406988	1.021519567	1.881279633	1.748559836	2.33589855	10.346	5.594	4.723980449
2014 AD16	Apollo	1.4046892	0.36886333	0.34281	27.33375	130.62529	174.9499101	0.886550864	1.922827536	1.664831809	2.504139824	10.478	6.774	5.266197549
2014 AE29	Aten	0.907115	0.15832415	4.85673	137.89068	103.13351	262.8745186	0.763496789	1.050733211	0.863959775	6.350767027	7.388	5.483	5.819463469
2014 AG5	Amor	1.134495	0.03385291	9.33411	267.80491	101.9141	2.7940996	1.096089043	1.172900957	1.208380976	5.798902572	8.4	5.5	6.048880784
2014 AY28	Amor	1.425379	0.28252203	5.70835	22.62517	169.61264	146.5804806	1.022678031	1.828079969	1.701749118	2.425010698	11.801	7.735	4.884122264
2014 BA3	Aten	0.9394073	0.0745871	2.25975	332.6361	299.94915	200.6312693	0.869339634	1.009474966	0.910501983	10.17343194	5.571	4.386	4.850745942
2014 BG25	Aten	0.8974347	0.24521574	9.89473	218.55987	124.6623	131.197531	0.677369586	1.117499814	0.850167085	5.674100942	11.054	7.289	7.201606097
2014 BP43	Apollo	1.1187918	0.24032956	3.26573	87.05308	127.02612	203.543812	0.849913059	1.387670541	1.183379147	6.453182754	7.437	5.643	5.166252732
2014 BS	Amor	1.2577199	0.17606471	10.83286	188.57045	299.31379	220.032526	1.036279811	1.479159989	1.410509121	3.435999469	10.393	7.338	5.528054946
2014 BT32	Apollo	1.1186607	0.14227632	8.44068	267.17199	117.7418	82.1942976	0.959501772	1.277819628	1.18317115	6.459375009	7.309	5.721	5.131330323
2014 BT8	Aten	0.9856604	0.09354044	12.52967	264.51127	121.77202	47.3583386	0.893461292	1.077859508	0.978567894	45.65897115	7.974	5.522	6.657226237
2014 BW32	Aten	0.8202079	0.28890835	0.93351	156.48334	123.57042	285.8970764	0.583242989	1.057172811	0.742823991	2.888387589	10.122	6.394	7.567969688
2014 CA3	Amor	1.3828479	0.27038559	9.48424	53.16646	123.02672	162.1902882	1.008945755	1.756750045	1.626153813	2.597051682	11.799	8.101	5.216812568
2014 CH13	Apollo	1.1429464	0.15507791	3.62198	115.82213	110.63268	292.7631209	0.965700661	1.320192139	1.22190881	5.506355562	7.557	5.851	4.314690497
2014 CS13	Apollo	1.2554279	0.32683579	0.61341	14.39875	58.54942	249.7055413	0.845109131	1.665746669	1.406655226	3.459085576	8.754	6.219	5.323215742
2014 DD112	Amor	1.2643608	0.16632885	5.83742	302.79918	157.63257	243.2840387	1.054061122	1.474660478	1.42169532	3.371380359	9.468	7.052	4.78320276
2014 DE23	Apollo	1.3535504	0.35979039	6.12633	299.41629	155.31465	210.0529723	0.866555974	1.840544826	1.57475011	2.739886575	11.655	8.026	5.595749123
2014 DF23	Aten	0.9139641	0.20742615	7.32805	314.36503	335.15157	207.3267662	0.724384045	1.103544155	0.873763112	6.92161478	8.69	6.496	6.35609654
2014 DG23	Aten	0.9143199	0.21569946	11.85435	215.24327	157.1998	89.2832362	0.717101591	1.111538209	0.874273386	6.953765487	11.947	7.13	7.266618778
2014 DH	Aten	0.9867209	0.36124301	1.23897	284.20116	109.24426	10.4749136	0.630274872	1.343166928	0.980147623	49.3718006	9.581	6.859	8.201346418
2014 DJ80	Aten	0.9780107	0.06681661	3.03076	20.35132	338.14974	88.3389934	0.91266334	1.04335806	0.967198044	29.48598647	5.527	5.095	4.418339659
2014 DM23	Amor	1.3664144	0.22177013	5.90253	190.53584	348.41859	164.2432767	1.063384501	1.669444299	1.597252753	2.674333011	11.315	7.516	4.975949621
2014 DQ	Apollo	1.2001044	0.23735604	3.90002	296.62189	145.18952	262.9510296	0.915252372	1.484956428	1.314705688	4.177572051	7.966	5.753	4.792492454

2014 DV110	Aten	0.8287304	0.29691709	1.97741	221.74655	139.56943	154.5129844	0.582666181	1.074794619	0.75443166	3.072186174	9.688	6.115	7.53229726
2014 DW17	Apollo	1.1365384	0.33275097	3.68953	279.34698	141.99786	290.4619642	0.758354145	1.514722655	1.211647165	5.72484476	11.016	6.924	6.016165306
2014 EK24	Apollo	1.0043218	0.07232791	4.72208	62.44939	341.91529	28.1348422	0.931681303	1.076962297	1.006489699	155.0903468	4.825	4.278	4.825489195
2014 EO12	Apollo	1.6448679	0.39709011	1.25808	83.77651	122.57642	345.2092838	0.991707125	2.298028675	2.109582616	1.901239787	11.964	9.832	5.041756911
2014 EU	Apollo	1.2932874	0.2807546	0.33012	288.78212	186.63493	214.6762146	0.930191013	1.656383787	1.470762573	3.124213049	8.86	7.538	4.705165359
2014 FA44	Amor	1.2928807	0.18904409	0.97669	190.66823	45.2715	137.6174343	1.048469245	1.537292155	1.470068861	3.127347889	8.574	5.131	4.428277619
2014 FA7	Apollo	1.1196364	0.20543929	5.98705	289.70486	180.51769	267.830947	0.889619093	1.349653707	1.184719437	6.413615458	7.232	5.844	5.116860528
2014 FK38	Aten	0.884606	0.21162088	4.40966	319.02014	7.89967	181.970161	0.6974049	1.0718071	0.832002864	4.952482416	8.102	6.195	6.324675524
2014 FN38	Aten	0.8234221	0.31178958	6.62484	27.45429	9.51047	106.2846586	0.566687669	1.080156531	0.747194693	2.955613157	11.923	8.01	8.064465766
2014 FP47	Apollo	1.1666008	0.25989823	5.03564	271.59044	28.86337	117.3734734	0.863403317	1.469798283	1.26003731	4.845602002	8.652	6.21	5.250230634
2014 FR37	Apollo	1.1853304	0.27055785	6.07184	81.33825	10.38581	263.3748519	0.864629955	1.506030845	1.290503344	4.442301166	8.243	6.038	5.364357125
2014 FW32	Aten	0.930858	0.16059691	1.31001	260.32764	138.96273	57.4185656	0.781365082	1.080350918	0.898100945	8.813633684	5.304	4.699	5.223541795
2014 FZ	Amor	1.3696642	0.26517468	2.41554	176.17671	18.29083	153.7694527	1.006463934	1.732864466	1.602954358	2.658500327	8.55	7.403	4.453794349
2014 FZ43	Apollo	1.1525142	0.21342739	8.30046	52.50704	17.00806	290.9552654	0.906536102	1.398492298	1.237284087	5.214357615	8.365	6.11	5.349021208
2014 FZ6	Aten	0.9824801	0.09012352	14.39977	170.02853	183.61489	92.9226387	0.893935535	1.071024665	0.973835593	37.21986166	11.562	6.064	7.285690059
2014 GA	Apollo	1.0288441	0.05887149	9.64965	263.93779	10.17265	160.5164203	0.968274515	1.089413685	1.043576659	23.9480647	5.907	4.833	5.925860983
2014 GD34	Amor	1.1509812	0.08738102	8.55571	143.68364	22.73807	222.5637339	1.050407289	1.251555111	1.234816275	5.258648593	8.496	6.22	5.346273225
2014 GJ1	Aten	0.9421613	0.2726884	4.95365	40.41387	24.0782	7.3908757	0.685244843	1.199077757	0.914508806	10.69711122	9.052	6.795	6.613936883
2014 GQ17	Aten	0.8542708	0.24673921	0.09135	331.80867	78.04745	75.8095131	0.643488698	1.065052902	0.789574916	3.752285144	7.719	4.857	6.750936624
2014 GR1	Apollo	1.2938156	0.28308052	5.80115	89.92156	168.606	323.3553281	0.927561607	1.660069593	1.471663691	3.120154721	9.736	6.951	5.021592641
2014 HB177	Apollo	1.1146983	0.19484028	3.4662	251.573	45.34489	130.3157361	0.897510171	1.331886429	1.176890367	6.653219085	6.752	5.034	4.785490514
2014 HC192	Apollo	1.1604081	0.21693779	9.93035	280.19013	34.37018	285.5864758	0.908671731	1.412144469	1.250017599	4.999718436	10.545	7.363	5.620423879
2014 HH123	Apollo	1.1208932	0.23695108	8.3857	293.48638	198.95319	245.3246487	0.855296346	1.386490054	1.186714781	6.355762379	8.671	6.122	5.699635465
2014 HL129	Apollo	1.2782214	0.24633053	5.36085	220.38626	41.47878	126.0698618	0.963356445	1.593086355	1.445137352	3.246497614	9.89	5.886	4.700496097
2014 HN2	Aten	0.9264938	0.11818294	1.23368	207.30963	198.92314	56.1828439	0.816998039	1.035989561	0.891792419	8.241496668	5.298	4.703	5.044573147
2014 HO2	Apollo	1.1926452	0.28006642	0.58141	334.61487	156.11979	225.2064685	0.858625329	1.526665071	1.302467505	4.306140276	7.659	5.609	5.101593077
2014 HP2	Apollo	1.5053562	0.34259283	2.5042	202.45004	35.85538	110.8079693	0.989631959	2.021080441	1.846966054	2.180684864	10.487	8.383	4.807933863
2014 HS124	Apollo	1.3497063	0.293821	9.41455	224.39846	32.72997	115.8458548	0.953134245	1.746278355	1.56804641	2.76041954	11.208	7.222	5.385894681
2014 HT46	Apollo	1.281993	0.23333698	1.56827	58.62874	200.19141	127.0754533	0.982856625	1.581129375	1.451538237	3.214651867	9.358	6.606	4.30129458
2014 HU46	Apollo	1.5050769	0.41931286	1.89501	305.22958	200.52456	29.7384178	0.873978801	2.136174999	1.846452055	2.181401821	11.932	7.58	5.570174957
2014 HW	Apollo	1.0789208	0.11512346	4.49026	243.69053	34.34483	148.4706845	0.954711704	1.203129896	1.120687037	9.285894012	5.69	4.652	4.4865373
2014 JF15	Apollo	1.1447421	0.17912315	11.37917	280.17819	218.02058	240.1692258	0.939692289	1.349791911	1.224789579	5.448604795	9.734	6.6	5.793881571
2014 JG15	Apollo	1.2113555	0.24017343	9.87862	284.63562	221.47066	213.8748726	0.920420095	1.502290905	1.333237201	4.000865438	9.969	6.846	5.535314114
2014 JJ55	Apollo	1.0898919	0.10163981	7.39267	296.4992	227.3035	238.9228071	0.979115494	1.200668306	1.137824124	8.255623836	6.38	5.142	4.920654851
2014 JN25	Amor	1.3108971	0.223232	5.70184	46.84439	221.0689	332.3127889	1.018262919	1.603531281	1.500903962	2.996390677	9.347	5.681	4.642996165
2014 JR24	Apollo	1.0662909	0.11838552	0.93019	246.43396	48.89534	136.4610767	0.940057497	1.192524303	1.101066512	10.89447421	5.488	4.23	4.235380876
2014 JV54	Apollo	1.0432621	0.06027441	7.74956	277.30901	65.42767	90.8067305	0.980380092	1.106144108	1.065590023	16.24622116	5.55	4.711	5.280106787
2014 JX54	Amor	1.1722275	0.05493273	5.85278	122.33411	67.97621	198.3683092	1.107833843	1.236621157	1.269164332	4.715202506	8.011	5.561	5.156329193
2014 JY54	Amor	1.2807075	0.16104309	3.78069	168.92521	37.79608	161.236464	1.074458407	1.486956593	1.449355521	3.225409399	9.755	6.503	4.691858382
2014 KA91	Apollo	1.2569454	0.27801175	9.22374	67.53709	249.06709	93.2448676	0.90749981	1.60639099	1.409206441	3.443754303	11.846	7.438	5.536759184
2014 KD45	Amor	1.1530087	0.09248965	0.76873	358.32244	237.3543	163.5544564	1.046367329	1.259650071	1.23808048	5.20026035	6.212	4.082	4.155247434
2014 KF39	Apollo	1.0414555	0.07924851	3.64388	95.39212	235.75043	101.1855202	0.958921703	1.123989297	1.062823325	16.91765491	4.921	4.281	4.383043383
2014 KG39	Aten	0.9021792	0.35856218	3.47705	150.66	236.91529	113.4073029	0.578691859	1.225666541	0.856917901	5.988994461	11.065	7.47	7.877833927
2014 KL22	Amor	1.2912409	0.19677391	12.05538	199.52778	76.81379	110.1340343	1.037158379	1.545323421	1.467272949	3.140076807	11.74	7.798	5.768037626
2014 KO2	Amor	1.3912225	0.26459974	3.31075	167.942	64.77213	125.1913315	1.023105388	1.759339612	1.640948266	2.560188323	10.435	6.464	4.619696316
2014 KO62	Apollo	1.1265906	0.11970397	6.5063	318.48242	242.59835	196.9683763	0.991733233	1.261447967	1.195774217	6.107924921	7.071	5.402	4.592884717
2014 KP2	Apollo	1.2781212	0.25016923	6.63727	121.19956	61.29454	173.2118745	0.958374604	1.597867796	1.444967429	3.247355503	9.449	6.886	4.876415324
2014 KQ84	Amor	1.402831	0.26112157	0.93555	357.37337	253.61641	112.6158839	1.036521567	1.769140433	1.661529405	2.511648602	9.734	5.557	4.606635055
2014 KS76	Aten	0.9289396	0.26981021	1.08075	48.9196	64.68801	319.7154706	0.678302211	1.179576989	0.895326039	8.553474337	7.418	5.803	6.391985315
2014 KX76	Amor	1.305419	0.21711203	9.91834	155.20997	63.35555	147.6802541	1.021996831	1.588841169	1.49150562	3.034564731	11.067	7.759	5.265950595
2014 LJ	Apollo	1.0785697	0.13892382	1.05292	91.84914	78.15347	232.6202932	0.928730677	1.228408723	1.120140045	9.323619349	4.768	4.503	4.345981532
2014 LK21	Aten	0.9633097	0.09908302	5.79678	139.41627	251.54861	65.6772293	0.867862066	1.058757334	0.945472497	17.33936905	6.377	5.519	5.140636438
2014 LL26	Amor	1.1429779	0.10194953	9.19203	13.48103	258.21612	136.3143967	1.02645184	1.25950396	1.221959325	5.505329981	7.095	5.039	5.323206207
2014 MA18	Aten	0.8775423	0.2990953	6.15381	44.39605	86.9757	314.6882649	0.615073523	1.140011077	0.822057299	4.619786563	10.742	7.249	7.33399235
2014 MA6	Apollo	1.2654185	0.21258143	3.17788	86.16932	242.62593	77.2089071	0.996414026	1.534422974	1.42347967	3.361388444	9.047	6.722	4.262891298
2014 MA68	Apollo	1.5268656	0.34913899	1.44265	180.08995	58.0062	18.5979665	0.993777287	2.059953913	1.886692904	2.127786177	11.158	6.222	4.784522356
2014 MD42	Aten	0.8586882	0.27646911	6.94626	187.30998	264.33439	189.9883937	0.621287438	1.096088962	0.795707117	3.894933118	11.026	7.828	7.381754865
2014 MF18	Aten	0.8859491	0.16222928	2.61387	350.25306	102.32015	17.1716746	0.742222215	1.029675985	0.833898431	5.020412744	6.234	4.248	5.900889182
2014 MK55	Apollo	1.3703023	0.36998259	2.93362	207.74224	162.97931	39.9262958	0.863314306	1.877290294	1.604074667	2.655424495	11.264	7.622	5.441856891
2014 MP	Amor	1.0503714	0.02921274	9.56349	118.70043	91.17686	212.4221444	1.019687173	1.081055627	1.076500739	14.07176923	5.74	4.957	6.030030982
2014 MW26	Amor	1.203041	0.13098438	11.23352	328.71121	275.36772	151.9905144	1.045461421	1.36062058	1.319534175	4.129555701	10.815	7.485	5.771704776
2014 MZ17	Aten	0.9548632	0.21267688	2.44949	191.80136	304.95379	295.8424373	0.751785874	1.157940526	0.933064646	13.93978802	7.007	5.625	5.602709183
2014 NG65	Apollo	1.2796133	0.29628139	9.52388	315.61431	98.18945	262.8373471	0.900487693	1.658738907	1.447498486	3.234644433	11.319	7.876	5.649136146
2014 NJ65	Amor	1.3475628	0.2539565	9.66945	179.28754	281.48196	210.0351985	1.005340468	1.689785132	1.564312517	2.772067728	11.535	7.665	5.179591471
2014 NL52	Apollo	1.223921	0.1947332	7.75703	329.66894	282.70205	136.346536	0.985582947	1.462259053	1.35403559	3.824574783	9.38	6.601	4.806873149
2014 NZ64	Apollo	1.0757952	0.21448396	4.13578	263.722	175.52168	224.1197087	0.845054385	1.306536015	1.115820673	9.634037223	6.888	5.627	5.236080617
2014 OA339	Apollo	1.3077954	0.36873839	1.8705	315.15948	78.77224	39.0632487	0.82556103	1.79002977	1.495580204	3.017836853	10.606	7.242	5.596975133
2014 OC4	Apollo	1.0984385	0.1623194	7.48341	93.3357	121.30723	187.1344126	0.920140622	1.276736378	1.151234032	7.612268308	8.112	6.75	5.162193276
2014 OS338	Apollo	1.1591841	0.19152913	6.85099	103.3063	126.63809	160.1747782	0.937166578	1.381201622	1.24804034	5.031602274	7.833	5.894	4.929733586

2014 OV3	Apollo	1.1338885	0.14230905	6.6675	267.95261	126.84487	37.7578237	0.972525905	1.295251095	1.207412106	5.821319347	7.028	5.596	4.703645814
2014 PQ58	Amor	1.1937896	0.10320854	13.20641	172.40352	139.03783	97.7721164	1.070580318	1.316998882	1.304342624	4.285770447	11.477	7.238	6.511218777
2014 PZ58	Amor	1.3437803	0.17930895	6.83258	42.3375	322.81103	45.4294799	1.102828465	1.584732135	1.557730793	2.792979719	11.557	7.821	5.252750378
2014 QD364	Aten	0.9890749	0.04122384	3.97051	28.35946	158.24462	248.9989346	0.948301435	1.029848365	0.983657191	60.18899149	4.271	3.798	4.526837314
2014 QH33	Apollo	1.0853253	0.1849299	2.83253	264.41268	336.00893	162.7285756	0.884616201	1.286034399	1.130680469	8.652252906	6.312	5.226	4.812582063
2014 QJ33	Apollo	1.1290056	0.32090789	2.4912	98.21874	344.85505	13.0772428	0.766698795	1.491312405	1.199621233	6.009487138	9.956	6.635	5.874509322
2014 QN266	Apollo	1.05258	0.0923131	0.48774	61.56132	171.11328	186.1761577	0.955413077	1.149746923	1.079897835	13.51598364	4.866	4.186	4.083927921
2014 QN362	Apollo	1.1927502	0.31673875	2.81911	101.18544	139.90006	133.8772352	0.814959993	1.570540407	1.302639512	4.304261213	11.165	8.056	5.539259934
2014 QR296	Apollo	1.2600568	0.21196854	10.03407	137.75916	155.12903	100.2861324	0.9929644	1.5271492	1.41444213	3.412882107	10.332	7.223	5.178834861
2014 QU362	Amor	1.187612	0.04422657	12.08305	12.67754	345.34814	57.1355468	1.135087995	1.240136005	1.294231202	4.398687812	11.471	8.132	6.813529152
2014 QX266	Amor	1.4107502	0.22295472	2.82496	262.80066	355.96127	108.9744168	1.096216784	1.725283616	1.675618632	2.48012496	11.349	8.473	4.966850563
2014 QZ295	Aten	0.9554957	0.33718742	1.32289	326.01736	143.5065	8.5924056	0.63331457	1.27767683	0.93399189	14.14965369	9.422	7.191	7.526311127
2014 RA12	Apollo	1.3663684	0.27535561	8.00919	130.24698	149.96749	94.5434631	0.990131196	1.742605604	1.597172097	2.674559152	11.432	7.596	4.998860461
2014 RB12	Amor	1.4215245	0.27301879	6.50943	91.97618	172.72968	108.8106396	1.033421601	1.809627399	1.694850999	2.439157461	11.538	7.998	5.001625518
2014 RC	Apollo	1.3123072	0.37464551	4.57419	71.19116	345.00652	25.6439624	0.8206572	1.8039572	1.503326342	2.986782564	11.09	7.381	5.766599225
2014 RF11	Amor	1.2552249	0.13162004	7.07662	213.06212	159.78889	44.4988283	1.090012148	1.420437652	1.40631406	3.461150373	10.626	6.712	5.168369468
2014 RJ11	Apollo	1.3296966	0.31882295	2.01776	64.87697	336.28415	29.5379747	0.905758807	1.753634393	1.533306008	2.87509607	9.517	6.804	5.003266182
2014 RW22	Amor	1.5795155	0.33738054	2.94702	4.60541	339.00556	45.440693	1.046617708	2.112413292	1.985115764	2.015109124	11.419	6.002	5.09967873
2014 SB145	Apollo	1.3143959	0.2981726	4.3569	51.36572	11.72686	14.4559971	0.922479057	1.706312743	1.506916866	2.972710059	9.865	6.86	4.971029813
2014 SD145	Amor	1.2608181	0.19740224	7.2401	351.52073	359.64591	59.3160407	1.011929783	1.509706417	1.415724188	3.405440983	9.781	6.475	4.740002638
2014 SD224	Aten	0.9781529	0.33121275	4.55285	277.21007	286.48619	195.9470804	0.654176188	1.302129612	0.967408993	29.68331092	10.839	7.224	7.670623417
2014 SD304	Amor	1.1676915	0.10840321	2.29392	19.1386	7.69075	40.9485273	1.041109993	1.294273007	1.261804809	4.819639538	7.459	5.529	4.22799055
2014 SF304	Apollo	1.3059552	0.30287871	1.15797	58.2476	6.19297	14.1949448	0.910409174	1.701501226	1.492424667	3.03076748	9.788	6.543	4.897060687
2014 SJ262	Apollo	1.1323232	0.1195643	6.0944	96.58752	199.12665	115.2013499	0.996937769	1.267708631	1.204912773	5.880125253	7.741	5.676	4.483599223
2014 SL1	Amor	1.132601	0.06737774	10.15252	46.43147	354.93053	26.033933	1.056288904	1.208913096	1.205356214	5.869587246	8.84	6.53	5.890565811
2014 SM1	Aten	0.9179813	0.25793911	7.33713	220.38558	354.40186	207.9461504	0.68119802	1.15476458	0.879530191	7.300834913	9.916	7.378	6.770995657
2014 SR143	Amor	1.3017991	0.15938474	3.58019	109.21935	290.0635	329.3465425	1.094312189	1.509286011	1.485306051	3.06055539	9.857	5.782	4.810523715
2014 SS261	Aten	0.9572166	0.12046571	10.89467	128.53838	3.22085	320.0081289	0.841904823	1.072528377	0.936516282	14.75207047	7.681	5.604	6.426581087
2014 ST143	Apollo	1.1950246	0.27227482	7.02164	321.02277	162.36124	266.6808316	0.869649492	1.520399708	1.306367202	4.264056971	9.597	7.001	5.443992843
2014 ST223	Apollo	1.0532083	0.17047366	5.87601	273.54517	359.94118	137.3450569	0.873664026	1.232752574	1.080864889	13.36630643	7.634	5.156	5.223605632
2014 SU1	Apollo	1.2075372	0.17438011	2.17858	338.00935	68.85927	23.7489256	0.99696673	1.41810767	1.326938448	4.058679714	8.203	5.821	4.073904293
2014 TB	Amor	1.2009659	0.1558359	5.79289	190.78294	188.08299	43.5386294	1.013812298	1.388119502	1.316121593	4.163339747	7.274	6.329	4.493143326
2014 TL17	Apollo	1.1675755	0.31745612	9.4208	263.03434	213.27357	342.8785507	0.796921512	1.538229488	1.26161679	4.822384646	11.566	7.208	6.284611624
2014 TM	Apollo	1.2512124	0.23216543	9.73301	42.86236	9.49288	19.9183719	0.960724135	1.541700665	1.399576235	3.502651337	9.093	5.956	5.291883571
2014 TR	Amor	1.3878259	0.27853908	2.02379	218.93543	182.05038	23.0099185	1.001262151	1.774389649	1.634942496	2.574945773	10.503	6.206	4.464298328
2014 TU	Apollo	1.0628786	0.2350703	2.52737	278.64475	342.50243	143.1119654	0.813027409	1.312729791	1.095785362	11.44000858	7.478	5.763	5.389316265
2014 TW	Amor	1.0281595	0.00856504	9.00431	190.80557	10.84385	230.7693197	1.019353273	1.036965727	1.042535228	24.50992453	5.324	4.649	6.149436679

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