Near Earth Object Observations Program

Close Approaches of 2011

Presentation to
UN COPUOS
Scientific & Technical Subcommittee

Lindley Johnson
Program Executive
NASA HQ
14 February 2012
Continued Survey Success

**Known Near-Earth Asteroids**
1980-Jan through 2011-Dec

- **All NEAs**
- **Large NEAs**

**NASA Program Start**

Year:
- 1980
- 1982
- 1984
- 1986
- 1988
- 1990
- 1992
- 1994
- 1996
- 1998
- 2000
- 2002
- 2004
- 2006
- 2008
- 2010
- 2012

Number:
- 0
- 1000
- 2000
- 3000
- 4000
- 5000
- 6000
- 7000
- 8000

18 January 2012
Alan B. Chamberlin (JPL)
Improved Population Estimate by NEOWISE

A Near-Earth Asteroid Census
Each image represents 100 objects

> 1000 m

500–1000 m

300–500 m

100–300 m

< 100 m
First Discovery of an Earth Trojan Asteroid

A team led by Martin Connors of Athabasca University, Canada, announced discovery of Earth’s first Trojan asteroid. The object was first detected by NASA’s Wide-field Infrared Explorer (WISE) mission, and follow-up observations by Connors and his team confirmed the asteroid's Trojan nature.

This diagram shows the motion of 2010 TK7 in 2011 relative to Earth, looking down from above the Solar System. Although Earth and asteroid both actually orbit the Sun, the relative motion appears as a large loop leading the Earth in its orbit.
## Close Approaching Asteroids in 2011

<table>
<thead>
<tr>
<th>Object</th>
<th>Closest Approach Date -Time</th>
<th>Min Dist. x Lunar</th>
<th>Relative Velocity (km/sec)</th>
<th>H Mag(v)</th>
<th>Size meters (est)</th>
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</table>
Asteroid 2011 MD passed only 12,300 kms (7,600 miles) above the Earth’s surface on Monday June 27. The NEO was discovered by NASA’s LINEAR asteroid search team observing from Socorro, New Mexico. The diagram to the right gives a view looking from the general direction of the Sun that indicates that 2011 MD reached its closest Earth approach point in extreme southern latitudes - in fact over the southern Atlantic Ocean.
Pass of Asteroid 2005 YU55 Observed with Ground-based Radars

- 2005 YU55 passed by Earth the evening of 8 Nov, 2 at just less than 200,000 miles – within the Moon’s orbit
- Earth based planetary radars at Goldstone, CA and Arecibo, PR, were used to track and image the asteroid
- Planetary radar can be used to determine the size and shape of the asteroid, study its surface properties, and help predict any future encounters with the Earth
- The radar imaging shows the asteroid to be roughly spherical, about 1300 feet across, and rotating with a period of about 18 hours
- This event demonstrates how Near Earth Asteroids could be characterized by planetary radar for studies of potential human spaceflight destinations

This image of asteroid 2005 YU55 with about 12 foot resolution was obtained by Lance Benner at NASA’s Goldstone Radar on Nov. 7, 2011, about one day before closest approach, when the object was at 3.6 lunar distances, which is about 860,000 miles from Earth. NASA/JPL-Caltech

These two radar images were obtained by Patrick Taylor at the Arecibo Planetary Radar on Nov 12. The asteroid was about 2,000,000 miles away and the images show objects of about 25 feet in size. The image on right shows a radar bright feature, possibly a boulder on the asteroid’s surface.

The Arecibo Observatory is operated by SRI International under a cooperative agreement with the National Science Foundation, in alliance with Ana G. Méndez-Universidad Metropolitana, and the Universities Space Research Association. The radar operations are funded by NASA.
Radar Rotation Study of 2005 YU55
These orbit diagrams show our prediction of where 2005 YU55 would be in March 2031 and in February 2050, first before the Nov 8 2011 radar observations (on the left) and then after those observations (on the right).

The November observations have allowed us to narrow the uncertainty in position from almost 20% of the orbit, in the 2050 case, to almost a point 40 years into the future.