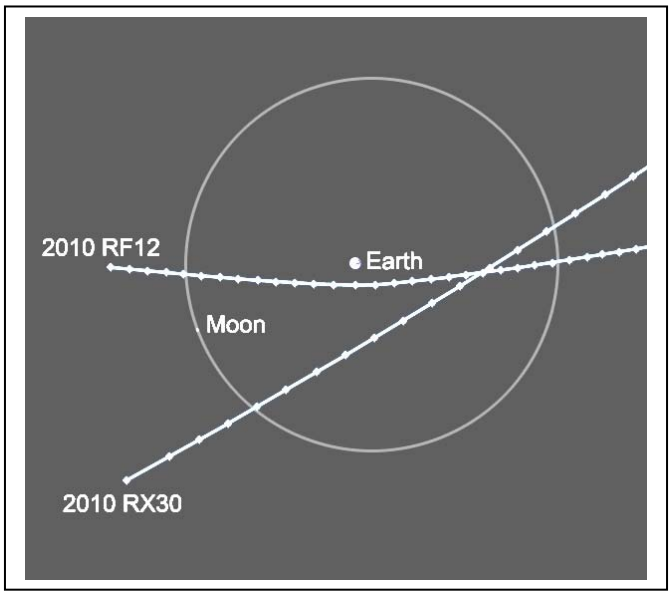

The Catalina Sky Survey near Tucson, Ariz., discovered two small asteroids on the morning of Sunday, September 5, 2010 during a routine monitoring of the skies.

Asteroid 2010RX30 is about 15 meters in diameter and will pass within 248,000 kilometers of Earth. Asteroid 2010RF12, about 10 meters in diameter, will pass within 79,000 kilometers of Earth.

Both asteroids should be observable near closest approach to Earth with moderate-sized amateur telescopes.

Neither of these asteroids has a chance of hitting Earth. A 10-meter- sized near-Earth asteroid from the undiscovered population of about 50 million would be expected to pass almost daily within a lunar distance, and one might strike Earth's atmosphere about every 10 years on average. The last asteroid that was observed to enter Earth's atmosphere in this size range was the *Great Daylight Fireball of 1972* which streaked above the Grand Tetons. It was about 5 meters in diameter but skipped out of the atmosphere and never struck ground.

Small asteroids appear very faint in the sky, not only because they are small in size, but because their surfaces are very dark and reflect very little sunlight. The formula for the brightness of a typical asteroid that is spotted within a few million kilometers of Earth is given by:

$$R = 0.011\, d\, 10^{-\frac{1}{5}(m)}$$

where: R is the asteroid radius in meters, d is the distance to the asteroid from Earth in kilometers, and m is the apparent brightness of the asteroid viewed from Earth. Note, the faintest star you can see with the naked eye is about m = +6.5. The planet Venus when it is brightest in the evening sky has a magnitude of m = -2.5. The asteroid is assumed to have a reflectivity similar to lunar rock.

Problem 1 - What does the formula estimate as the brightness of these two asteroids when they are closest to Earth on September 8, 2010?

Problem 2 - Astronomers are anxious to catalog all asteroids that can potentially impact Earth and cause damage to cities. Suppose that at the typical speed of an asteroid (10 km/sec) it will take about 24 hours for it to travel 1 million kilometers (3 times lunar orbit distance). What is the astronomical brightness range for asteroids with diameters between 1 meter and 500 meters?

Problem 1 - What does the formula estimate as the brightness of these two asteroids when they are closest to Earth on September 8, 2010?
Answer:

2010RX30, R=15 meters, d = 248,000 kilometers

$15 = 0.011\ (248{,}000)10^{\mathbf{-.2m}}$ then $0.0055 = 10^{\mathbf{-.2(m)}}$

Log(0.0055) = -0.2m so **m = +11.3 magnitudes**

2010RF12, R=10 meters, d= 79,000 kilometers

$10 = 0.011\ (79{,}000)10^{\mathbf{-.2m}}$ then $0.011 = 10^{\mathbf{-.2(m)}}$

Log(0.011) = -0.2m so **m = +9.7 magnitudes**

Problem 2 - Astronomers are anxious to catalog all asteroids that can potentially impact Earth and cause damage to cities. Suppose that at the typical speed of an asteroid (10 km/sec) it will take about 24 hours for it to travel 1 million kilometers (3 times lunar orbit distance). What is the astronomical brightness range for asteroids with diameters between 1 meter and 500 meters?

Answer: First evaluate the equation for d = 1 million km and solve for m®

$R = 0.011\ (1.0 \times 10^{\mathbf{6}})\ 10^{\mathbf{-.2m}}$
$R = 1.1 \times 10^{\mathbf{4}}\ \ 10^{\mathbf{-.2m}}$

so m(R) = - 5 log10(0.000091R)

For R = 1 to 500 meters, **m = +20.2 to +6.7**

The most common asteroids have sizes between 1 meter and 50 meters, so the detection of such small, faint, and rapidly moving asteroids with ground based telescopes is a major challenge and may be a matter of luck in most cases.

For more information, read the NASA press release at

"Two Asteroids to Pass By Earth Wednesday"

http://www.nasa.gov/topics/solarsystem/features/asteroid20100907.html