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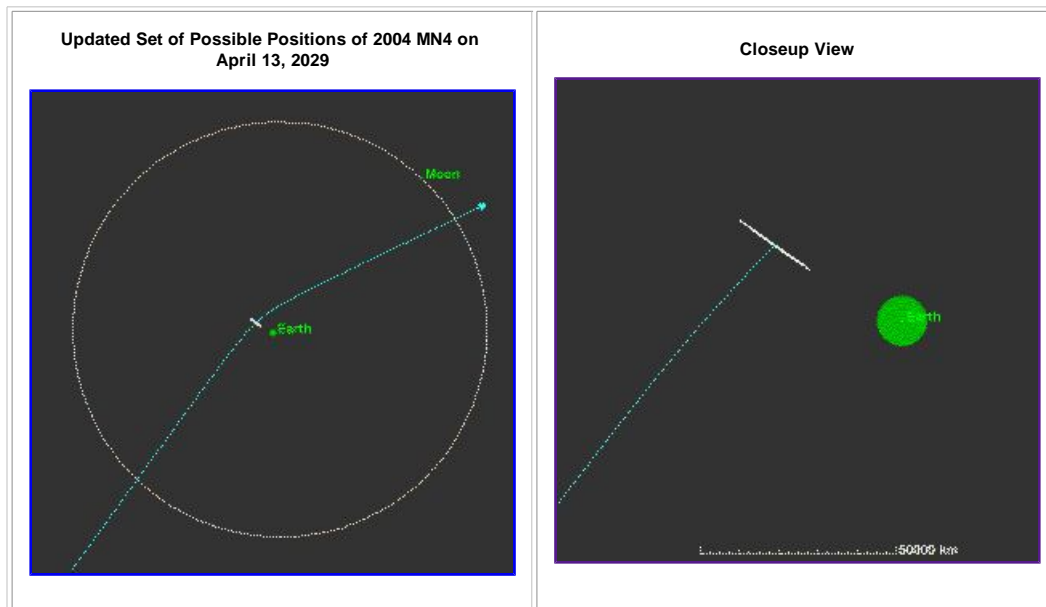
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### Radar Observations Refine the Future Motion of Asteroid 2004 MN4

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 February 3, 2005

Radar observations taken at the Arecibo Observatory in Puerto Rico on January 27, 29, and 30 have significantly improved our estimate for the orbit of asteroid 2004 MN4 and changed the circumstances of the Earth close approach in 2029. On April 13, 2029, the predicted trajectory now passes within 5.7 Earth radii (36,350 km or 22,600 miles) of the Earth's center - just below the altitude of geosynchronous Earth satellites. However, an Earth collision in 2029 is still ruled out. The asteroid's motion subsequent to the 2029 Earth close approach is very sensitive to the circumstances of the close approach itself and a number of future Earth close approaches will be monitored as additional observations are received. However, our current [risk analysis for 2004 MN4](#) indicates that no subsequent Earth encounters in the 21st century are of concern.

In the accompanying diagrams, the most likely trajectory of asteroid 2004 MN4 is shown as a blue line that passes near the Earth on 13 April 2029. The second of the two figures is an enlarged view of the Earth close approach circumstances. Since the asteroid's position in space is not perfectly known at that time, the white dots at right angles to the blue line are possible alternate positions of the asteroid. Neither the nominal position of the asteroid, nor any of its possible alternative positions, touches the Earth, effectively ruling out an Earth impact in 2029. Based on albedo constraints by Andrew Rivkin and Richard Binzel (MIT), the diameter of the object is about 320 meters. At the time of the closest approach, the asteroid will be a naked eye object (3.3 mag.) traveling rapidly (42 degrees per hour!) through the constellation of Cancer. On average, one would expect a similarly close Earth approach by an asteroid of this size only every 1300 years or so.



The passage of the asteroid by the Earth in 2029 alters its subsequent trajectory and causes its position uncertainty region to expand rapidly as it moves away from Earth (i.e., the line of white dots increases in extent). As a result, the asteroid's motion is much less predictable after the 2029 close Earth approach. Even so, the asteroid's uncertainty region is not large enough to extend to the moon as it passes by, and so a lunar impact is not possible.

Lance Benner (JPL), Mike Nolan (NAIC), Steve Ostro (JPL), and Jon Giorgini (JPL) provided the Arecibo radar data that made these updated results possible.

#### Related Articles

- [Possibility of an Earth Impact in 2029 Ruled Out for Asteroid 2004 MN4](#) (Near Earth Object Program Office - December 27, 2004)
- [Near-Earth Asteroid 2004 MN4 Reaches Highest Score To Date On Hazard Scale](#) (Near Earth Object Program Office - December 23, 2004)

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 Last Updated: 02 Sep 2008