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"Planet Killer" Asteroid 415029 (2011 UL21)

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Abstract

Since January 1, 1900, asteroid 415029 (2011 UL21) is considered one of the top 10 largest asteroids that have passed within 7.5 million kilometers from Earth. This asteroid belongs to the Apollo group of asteroids, and it is classified as a potentially hazardous Asteroid (PHA). This paper presents a concise overview of the gigantic asteroid 2011 UL21 that was discovered in 2011 by the Catalina Sky Survey (CSS). Additionally, we try to highlight the physical properties of that giant space rock, including its size, speed, and composition.

Keywords: Asteroid 415029 (2011 UL21); Planet Killer; Apollo-class asteroids; Catalina Sky Survey; Near-Earth Objects

Abbreviations

CSS: Catalina Sky Survey; NEOs: Near-Earth Objects; PHA: Potentially Hazardous Asteroid; NASA: National Aeronautics and Space Administration.

Introduction

Asteroid 415029 (2011 UL21) is a potentially hazardous asteroid. It is an Apollo class asteroid discovered in 2011 by the Catalina Sky Survey (CSS). This asteroid is known as planets killer due to its huge size, as it is one of the largest near-Earth objects (NEOs) [1] ever detected, and it is classified as a "potentially hazardous asteroid" (PHA) [2-11]. Although the mountain-size 'Planet Killer' asteroid is larger than 99% of all known near-Earth asteroids, it does not currently pose a threat to Earth. Since its discovery in 2011, its trajectory has been carefully monitored. On June 27, 2024, asteroid 2011 UL21 passed past Earth at a distance of 6.6 million kilometers (17 times the distance between Earth and the Moon). Its next closest approach will be in 2089 (about 2.7 million kilometers near Earth). This year's close approach gave astronomers and scientists a rare chance to examine and study such a massive NEO. NASA's planetary radar has discovered a secret moon orbiting nearby asteroid 2011 UL21 after the last close approach to Earth [12]. The rest of the paper is organized as follows: In Section 2, some features of asteroid 415029 (2011 UL21) are presented, while in Section 3, we explore its composition and origin. In Section 4, we try to answer the question, What would happen if 2011 UL21 hit Earth?.

Some Features of Asteroid 415029 (2011 UL21)

The massive asteroid 2011 UL21 is estimated to have an absolute magnitude of 15.9, a diameter of 2.3 km, and an optical albedo of pV= 0.16 [12]. It travels at a speed of roughly 93,000 km/h (about 25 km/s); it takes 3 years to complete a full revolution around the Sun. It is possible that the object's quick rotation is the reason for its almost spherical shape, as indicated by the limited recorded light curve amplitude. NASA's planetary radar has discovered a secret moon orbiting nearby asteroid 2011 UL21 after the last close approach to Earth (Figure 1).

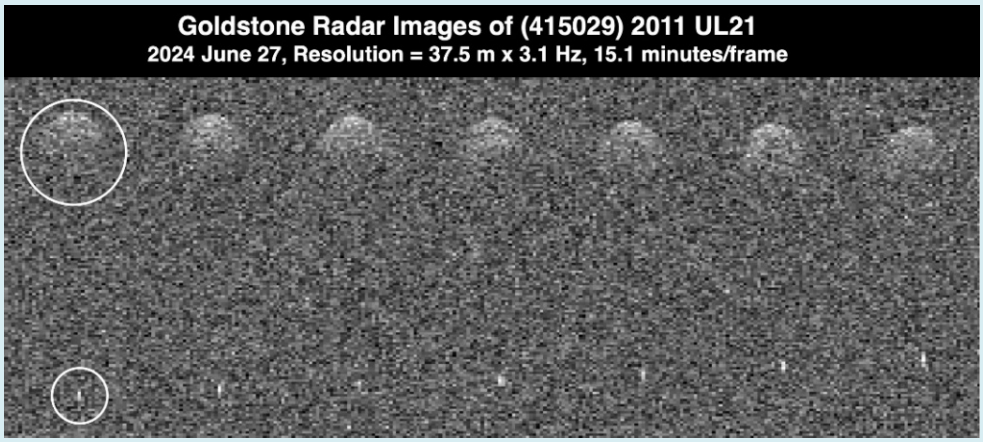

Figure 1: The asteroid and its moon: Radar observations by the Deep Space Network's Goldstone Solar System Radar [1].

The Composition and Origin of Asteroid 415029 (2011 UL21)

Asteroids like 2011 UL21 most likely originated in the early solar system, which was formed more than 4.5 billion years ago. It belongs to the Apollo group of asteroids, which is a class of asteroids whose orbits intersect the Earth orbit and are rich in metals or carbonaceous materials [12,13]. Furthermore, observation and investigation via advanced technology tools like spectroscopy or radar might provide more accurate details about its composition. Observations indicate that its high metal content includes significant quantities of nickel and iron, which are typical of Apollo-class asteroids. Further, spectroscopy and radar observations suggest a surface abundant in silicate minerals, with possible traces of olivine and pyroxene. This composition aligns with the broader characteristics of NEOs thought to originate in the asteroid belt between Mars and Jupiter, migrating inward due to gravitational interactions. Given its classification as a potentially hazardous asteroid (PHA), understanding the composition of 2011 UL21 is crucial for assessing planetary defense strategies. The metal-rich nature of this asteroid implies a dense, robust structure that could increase the severity of an impact if such an event were to occur.

What Would Happen if 2011 UL21 Hit Earth?

If an asteroid as massive as 2011 UL21 were to collide with Earth, it would release an immense amount of kinetic energy. Based on current models, the impact energy could exceed hundreds of megatons, equivalent to several nuclear detonations. The immediate impact would create a crater of significant size, leading to devastating local destruction. Moreover, the global effects could include drastic atmospheric changes, similar to historical impact events such as the Chicxulub impact that is believed to have contributed to the extinction of the dinosaurs. These effects could involve intense fires, shock waves, and a prolonged "impact winter" due to dust and debris blocking sunlight. Even though asteroid 2011 UL21 does not currently pose an imminent threat to Earth, it serves as a reminder of the potential risks associated with large NEOs. Astrophysicist Gianluca Masi, director of the Virtual Telescope project, has reassured the public, stating, "The large, potentially hazardous asteroid 2011 UL21 is safely approaching; no risk for our Earth" [14,15].

Conclusion

Asteroid 2011 UL21 is one of the largest NEOs that has caught attention recently due to its huge size and extreme speed. This giant asteroid has been considered one of the potentially hazardous asteroids, although it did not pose any threat during its last approach to the Earth in June 2024. This paper highlights the importance of studying the physical properties of the asteroid 2011 UL21. This work underscores the importance of detecting and tracking objects like asteroid 2011 UL21 to enhance planetary defense strategies by using sophisticated computational models and advanced technology.

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