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Physics in the news

Apophis update

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The Apophis asteroid has received widespread attention from the media after observations made in 2004 showed a 2.7% chance of it impacting with Earth in April 2029. The threat of a collision in 2029 was eliminated when more data were collected, though the possibility of an impact in 2036 was raised.

However, our understanding of the asteroid improved once again in January 2013. Don Yeomans, manager of NASA's Near-Earth Object Program at Caltech, announced that:

'We have effectively ruled out the possibility of an Earth impact by Apophis in 2036. The impact odds as they stand now are less than one in a million, which makes us comfortable saying we can effectively rule out an Earth impact in 2036. Our interest in asteroid Apophis will essentially be for its scientific interest for the foreseeable future.'

New infrared data

The most recent data were taken by the Herschel Space Observatory, an orbiting infrared telescope named after William Herschel (who discovered infrared radiation in 1800). Apophis was photographed as it approached Earth on 5–6 January 2013 in infrared wavelengths of 70, 100 and 160 micrometres (μm). This is because asteroids are very small and dark but any object with a temperature above absolute zero emits infrared radiation, allowing us to observe its properties more easily. Previous data suggested that Apophis' average diameter was 270 ± 60 m; the new Herschel observations show a more precise diameter of 325 ± 15 m.

According to Thomas Müller of the Max Planck Institute for Extraterrestrial Physics: 'The 20% increase in diameter, from 270 to 325 m, translates into a 75% increase in our estimates of the asteroid's volume or mass.' A better idea of the asteroid's mass and diameter means that its trajectory can now be modelled more accurately.

Albedo

The Herschel observations have also provided an insight into Apophis' **albedo**. This is a unitless measurement of how much light an object reflects. The average albedo of Earth is around 0.3 — this means that 30% of the sunlight that falls on our planet is re-emitted into space. By looking at the infrared radiation emitted by Apophis, we can say that its albedo is around 0.23, whereas the previous estimate was 0.33.

The albedo of an asteroid tells us about its orbit, which is subtly altered by the way the asteroid emits thermal radiation. Asteroids rotate as they travel through space. When sunlight heats them, the parts that are exposed to the sun for longer become warmer. The warmer parts radiate more heat back into space. Newton's third law of motion tells us that when a first body exerts a force on a second body, the second body exerts an equal and opposite force back on the first body, therefore a small push is

exerted on the asteroid. This is called the Yarkovsky effect, after it was discovered by Ivan Yarkovsky in 1900.

As Göran Pilbratt of the European Space Agency says:

'Our unique Herschel measurements play a key role for the physical characterisation of Apophis, and will improve the long-term prediction of its orbit.'

Further information

For more information on Apophis and possible ways of deflecting threatening asteroids, see Peter Main's article 'An asteroid called Apophis' in PHYSICS REVIEW Vol. 20, No. 4.