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THE EARTH HAS A COMPANION: YORK UNIVERSITY ASTRONOMERS AND FINNISH COLLEAGUE ANNOUNCE MAJOR NEW DISCOVERY

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TORONTO, June 11, 1997 -- York University astronomers, working with a Finnish colleague, have discovered a mysterious "companion" to the earth, shedding more light on the origins of our solar system.

York University postdoctoral researcher **Dr. Paul Wiegert**, York University astronomy professor **Dr. Kim Innanen**, and **Dr. Seppo Mikkola** of Turku University in Finland, have discovered that an asteroid accompanying the earth in its orbit is the only natural companion to the earth other than the moon.

Details of their startling discovery will appear tomorrow on the pages of *Nature*, the British-based cutting-edge scientific journal.

Innanen said the team's discovery, which they will share with their international colleagues at the Canadian Astronomical Society/*Societe canadienne d'astronomie* (CASCA) general meeting, in Edmonton this weekend, will invariably entice other scientists to investigate the region and could result in a spacecraft being sent to the asteroid for further study.

Wiegert and Innanen conducted computer simulations over the past eight months to support their research. Their Finnish colleague independently verified their findings.

Although the asteroid itself, called Asteroid 3753 (1986TO), was discovered 11 years ago, no one had tracked its path thoroughly enough to detect its rare orbit. At first, Wiegert didn't believe what he had found, thinking his results might be caused by a computer error. He repeated the tests several times before becoming convinced of the reality of the discovery.

"It was such a thrilling surprise," said Wiegert. "Discovering this asteroid's rare orbit in our solar system was like finding a diamond in your own backyard. The proximity and characteristics of our new companion make it like the Mona Lisa of asteroids," he said, adding that our solar system is one of the most studied regions of space.

"We were astonished when we realized what we were seeing," said Innanen. "This asteroid's orbit is so unlikely and so spectacular it's like a beautiful piece of choreography. It has a very unusual relationship to our planet and to the sun, and we are baffled as to how it got into this orbit."

The asteroid, which measures between one and 10 kilometres in diameter, follows a sophisticated orbit unique to the solar system and never before observed. Its path is so unusual and complex that the astronomers had to coin a new word -- "companion" -- to describe the relationship of the asteroid to earth. Innanen said the asteroid can best be described as "fickle" because it is both attracted to and repelled by the earth. Asteroid 3753 continuously follows an orbit in which it moves closer to, then travels away from, the earth.

The asteroid's orbit has eluded astronomers up to now because it is much farther away than a conventional satellite and its unusual characteristics mask its orbit. At its closest approach, the asteroid is 15 million kilometres away (about 40 times greater than the distance between the earth and the moon). At its farthest distance from earth, the asteroid is 375 million kilometres away (1000 times the earth-moon distance.)

This asteroid is unlike a satellite in that its orbit is influenced not only by the earth, but also by the sun. Asteroid 3753 follows a horseshoe orbit and has characteristics never before seen or even anticipated, either in theory or in computer simulations. No other known near-earth asteroid follows a horseshoe orbit. (See backgrounder for details.)

The astronomers see many intriguing research questions flowing from their discovery.

"The laws of nature would make it very difficult for the asteroid to have entered into this orbit recently," said Wiegert. "The asteroid may be five billion years old -- as old as the solar system itself -- and it might have found its way into this orbit when the solar system was forming."

"This asteroid could be an incredible survivor from the earliest days of our solar system, or, if it joined us more recently, it raises questions about the circumstances needed to arrange this spectacular choreography," said Innanen. "The mechanics and physics that would have been needed to get this asteroid into this orbit in recent times are akin to threading a needle."

Asteroid 3753 does not behave like most other asteroids that approach the earth. Usually, a close encounter between the earth and an asteroid results in a large change in the asteroid's orbit, and, occasionally, a collision. Collisions do not occur in this case because the path of Asteroid 3753 is tilted, causing it to pass underneath the earth.

The York University segment of the research was funded by a three-year \$90,000 grant to Innanen from the Natural Sciences and Engineering Council of Canada (NSERC).

This is the second major astronomical discovery to be announced at York University recently. In March 1995, York University astronomer Marshall McCall and Ronald Buta of the University of Alabama at Tuscaloosa, announced the discovery of two new galaxies near to our own.

York University President Dr. Susan Mann praised Wiegert and Innanen, saying their research serves to place York among the top institutions in the world. "This is the second major astronomical discovery at York University in the last two years," said President Mann. "We are immensely proud of York's

scientific research, and here we have another startling discovery to catch the imagination of astronomers around the world. My congratulations to York colleagues Paul Wiegert and Kim Innanen."

The asteroid will be visible through telescopes from the southern hemisphere in autumn 1997, when it will be closest to the earth. To learn more about this discovery, point your web browser to:
<http://www.asteroid.yorku.ca/companion>.

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YU/058/97

BACKGROUND

● **An asteroid** is a rock-like object with an irregular shape. It floats in the solar system, and is small in relation to the planets, measuring anywhere from a few metres to several hundred kilometres across. Most asteroids are found in a region between Mars and Jupiter called the Asteroid Belt, but a small number are found in the inner solar system (near the Sun, Mercury, Venus, Earth, and Mars) and are called **planet-crossing asteroids** --(like Asteroid 3753). They travel from a place closer to the sun to a

place farther away from the sun, while bracketing the planet.

- **An orbit** is the path through space followed by one object as it moves around another. For instance, the moon has an almost circular orbit around the earth. Most asteroids travel in elliptical orbits.
 - **A satellite** is an object that moves in an orbit around a planet, with the planet being the satellite's primary gravitational influence. Satellites are often referred to as **moons**. The earth has only one natural satellite: the moon.
 - **A "companion"** is a term coined by Wiegert, Innanen, and Mikkola to describe Asteroid 3753's relationship to the earth. Unlike a satellite, which is primarily influenced by the gravity of a planet, Asteroid 3753 is also influenced by the gravity of the sun, and perhaps by some other planets in our solar system. Asteroid 3753 is the only known natural companion of earth (other than the moon). This asteroid can be described as a "fickle" companion of earth, for it is continuously following an orbit in which it moves closer to, then travels far away from, the earth. As it follows its path, Asteroid 3753 is both attracted to and repelled by the earth.
 - **A horseshoe orbit** is one in which the object moves along a path away from earth and eventually turns around and goes the other way, travelling the other direction so that it comes closer to earth. Asteroid 3753 is the only near-earth asteroid known to follow a horseshoe orbit. There is only one other known horseshoe orbit anywhere. Saturn's moon, Janus, is accompanied by a smaller moon called Epimetheus, which follows a horseshoe orbit. However, Epimetheus lacks the unusual and sophisticated pattern of Asteroid 3753.
 - **Asteroid 3753** is following the most complicated horseshoe orbit ever seen, and it is unique in our solar system. It has unique characteristics, including: a spiralling motion; a high inclination (meaning its path is tilted); and an overlap at the end of the horseshoe.
 - **Collisions** between asteroids and planets happen in a small minority of instances. Usually a close encounter between an asteroid and a planet causes a large change in the asteroid's orbit.
 - **Nature** magazine, a cutting-edge scientific journal, has a 90 per cent rejection rate for all research papers submitted. Articles that make it onto the pages of *Nature* undergo extreme scrutiny and face a gruelling peer review process. The article by Wiegert, Innanen, and Mikkola is titled "An Asteroidal Companion to the Earth," and appears in tomorrow's issue (June 12, 1997) of *Nature*.
 - **The research** for this study was done on the York University campus by Wiegert and Innanen, and at Turku University in Finland by Mikkola.
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