# Researchers will study ways to deflect asteroids

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An Asteroid Deflection Research Center (ADRC) has been established on the Iowa State campus to bring researchers from around the world to develop asteroid deflection technologies. The center was signed into effect in April by the Office of the Executive Vice President and Provost.

“In the early 1990s, scientists around the world initiated studies to assess and devise methods to prevent near-Earth objects from striking Earth,” said Bong Wie, the Vance D. Coffman Chair Professor in Aerospace Engineering and director of the center. “However, it is now 2008, and there is no consensus on how to reliably deflect them in a timely manner,” he noted.

Wie, whose research expertise includes space vehicle dynamics and control, modeling and control of large space structures, and solar sail flight control system development and mission design, joined the Iowa State faculty last August. “I am very happy that Professor Bong Wie has joined the faculty at ISU,” said Elizabeth Hoffman, executive vice president and provost. “His work on asteroid deflection is exciting and of great importance.”

The ADRC will host an International Symposium on Asteroid Deflection Technology in fall 2008. Scientists and engineers from NASA, the European Space Agency, academia, and the aerospace industry will be invited to the Iowa State campus to formulate a roadmap for developing asteroid deflection technologies.

Despite the lack of an immediate threat from an asteroid strike, scientific evidence suggests the importance of researching preventive measures. Sixty-five million years ago, a six-mile-wide asteroid struck near the Yucatan Peninsula in Mexico and created the 106-mile-diameter Chicxulub Crater. Most scientists now believe that a global climate change caused by this asteroid impact may have led to the dinosaur extinction. Seventy-four million years ago, a smaller one-mile-wide asteroid struck in central Iowa, creating the Manson Crater. Now covered with soil, it is the largest crater in North America at more than 23 miles across.

Just 100 years ago, June 30, 1908, an asteroid or comet estimated at 100–200 feet in diameter exploded in the skies above Tunguska, Siberia. Known as the Tunguska Event, the explosion flattened trees and killed other vegetation over a 500,000-acre area. But if the explosion had occurred four hours later, it would have destroyed St. Petersburg or Moscow with an equivalent energy level of about 500 Hiroshima nuclear bombs.

The potential for such devastation has astronomers scanning the skies to find and track asteroids that pose a danger, and it has Wie initiating this concerted research effort now before any asteroids are discovered heading toward Earth.

Last November, NASA reported 900 known potentially hazardous objects (PHOs), most of which are asteroids. PHOs are defined as objects larger than 492 feet in diameter whose trajectories bring them to within about 4.6 million miles of the Earth's orbit. NASA scientists estimate the total population of PHOs to be around 20,000. "However," Wie said, "the asteroid we have to worry about is the asteroid that we don't know."

"Developing technologies that can be used to prevent or mitigate threats

from asteroids while also advancing space exploration is a challenge we accept as we work to assure a high quality of life for future generations," said Mark J. Kushner, dean of Iowa State's College of Engineering. "This research center serves as an excellent opportunity to provide leadership on an issue that has worldwide implications."

According to Tom Shih, professor and chair of aerospace engineering, "the potential for a major catastrophe created by an asteroid impacting Earth is very real. It is a matter of when, and humankind must be prepared for it. Our aerospace engineering department strongly supports Professor Bong Wie's effort in establishing this center to address the engineering and science issues of asteroid deflection."

Both high-energy nuclear explosions and low-energy non-nuclear alternatives will be studied as deflection techniques. The nuclear approach, which is often assessed to be 10–100 times more effective than non-nuclear approaches as stated in NASA's 2007 report to Congress, will be researched to verify its effectiveness and determine its practical viability, according to Wie.

"A 20-meter (66 feet) standoff distance is often mentioned in the literature for a maximum velocity change of a 1-kilometer (0.6 mile) asteroid. However, we have to determine how close the nuclear explosion must be to effectively change the orbital trajectories of asteroids of different types, sizes, and shapes," Wie explained. "We will develop high-fidelity physical models to reliably predict the velocity change and fragmentation caused by a nuclear standoff explosion."

The non-nuclear alternatives include kinetic impactors and slow-pull gravity tractors. Wie, who has previously worked on solar sail technology as applied to asteroid deflection, will present his recent study, "Multiple gravity tractors in halo orbits for towing a target asteroid," at the American Institute of Aeronautics and Astronautics Astrodynamics

Specialists Conference in August. His paper has been accepted for publication in the AIAA Journal of Guidance, Control, and Dynamics.

The chances of having to use deflection technologies on an asteroid in the near future are admittedly remote. Scientists estimate the frequency of an extinction-class (6 miles in diameter or larger) object striking Earth as once every 50–100 million years, and for a 200-foot or larger object as once every 100–500 years.

The technologies that will be developed, including precision orbital guidance and navigation and control, however, have other applications as well. These may include future advanced space vehicles that will carry astronauts to an asteroid or Mars and homeland security applications.

Source: Iowa State University