

Exploding the asteroids!

By Colin Johnston, Science Communicator

NASA engineers have designed a nuclear-warhead-carrying spacecraft intended to ward off asteroids or comets that threaten to collide with Earth. Asteroids and comets whose orbits bring them close to Earth's orbit are termed Near Earth Objects (NEOs). We know that NEOs have collided with our planet throughout its history, with often cataclysmic results for Earth's inhabitants. If you want to know just how bad such a collision can be, ask a dinosaur about the impact 65 million years ago (There aren't any dinosaurs to ask? Rather answers the question, doesn't it?)

It is a good idea to plan ahead for such an unlikely eventuality. Apophis is a 46 million tonne asteroid discovered in 2004 which regularly passes by Earth. On Friday 13 April 2029 (Friday the 13th!), Apophis will whizz past the Earth closer than most communication satellites before returning for another close Earth approach in 2036. Just how close it will come on its later visits is worryingly uncertain (it is very unlikely to hit us, but it would be reassuring to say for certain that it will miss). According to Flight International magazine, a NASA study has posed the question of what could be done if we knew that Apophis was going to collide with Earth. The solution may require the strangely-named pilotless spacecraft, Cradle, and the deadliest cargo ever carried into space.

The Cradle spacecraft would be 8.9 m long and be launched on NASA's planned but unbuilt moon rocket, the Aries V. Powered by solar arrays, the spacecraft would use both a laser detection and ranging (lidar) instrument and cameras to navigate to the vicinity of the intruder. Cradle's payload would be six interceptor vehicles each of which is tipped with a 1.2 megatonne nuclear warhead. In this context 'megatonne' is the weight of conventional explosives the exploding device would be equivalent to. Each warhead's detonation would be comparable to 1.2 million tonnes of TNT which is almost a hun-

dred times as devastating as the atomic bombs dropped on Japanese cities in 1945.

Unlike the Hollywood version of Earth-protecting missions, the intention is not to blast apart the NEO (even these six large bombs would not be enough) but instead to deflect it. A modest push months ahead of the day of impact would cause the asteroid to miss Earth by thousands of kilometres. To facilitate this, the interceptors would be launched at hourly intervals when Cradle is still more than four days from its target. The warheads would explode above the NEO's surface and the radiation from each detonation would vaporize a layer of the surface. The force of this white-hot plasma surging outwards will hopefully deflect the NEO. It may seem unlikely but NASA once considered building a crew-carrying spacecraft utilizing this principle (see the December 2006 Astronotes).

Cradle would be preceded by a 1.5 tonne observer spacecraft (based on the 2005 Deep Impact comet probe) which would explore the NEO to determine its composition. This is important as there is evidence that the consistencies of NEOs varies from solid nickel-iron to piles of loosely bound dust as delicate as cigarette ash. If we know what to expect the nuclear option may not be required and a less drastic solution could be used. These alternative options to push away the NEO include ramming it with a fast-moving but non-explosive projectile or using a vast but light-weight solar mirror to focus sunlight and melt part of the surface. In both cases the thrust of vaporized surface material escaping would nudge the NEO from its collision course.

By the 2020s NASA hopes that spacecraft of the Cradle-type could deflect NEOs of 100-500m diameter as long as there was two years warning. Larger NEOs would need at least five years warning. This is one future space mission nobody wants to see launched!