Deflecting asteroids could lead to more versatile spaceprobes

September 27 2005

The UK's first engineering feasibility study into missions for deflecting asteroids has begun.

The Engineering and Physical Sciences Research Council (EPSRC) is funding a new three-year study into interception and deflection strategies for asteroids found to be on a collision course with Earth. Although there have been similar studies in the past, Dr Gianmarco Radice, department of Aerospace Engineering, University of Glasgow, and Professor Colin McInnes, department of Mechanical Engineering, University of Strathclyde, are approaching the subject in a new way.

"We will be looking at this as engineers. So we want to investigate the practicality of different deflection strategies," says McInnes. In other words, it is no use having a brilliant deflection scheme if no one can build it with current technology.

Although Hollywood blockbusters have popularised the idea of using nuclear weapons to blow up asteroids, the study will investigate more realistic alternatives such as space mirrors. These would be angled to focus sunlight onto the incoming object. The intense heat would boil away a section of the asteroid, creating a natural rocket that pushes the asteroid in the opposite direction. The study will also look into high-speed collisions to literally knock an asteroid out of the way using no explosives, just a 'battering ram' spacecraft.

Asteroids have widely differing compositions, ranging from pure rock or

even metal to ice and snow. Knowing what an asteroid is made from, and therefore its likely strength, is the crucial first step in determining the best way to divert it without shattering it. “One of the main objectives of this study is to try to associate a particular deflection strategy with a particular type of asteroid that has to be deviated,” says Radice.

The internal arrangement of Near Earth Objects (NEOs) can critically affect the deviation strategy. Some asteroids, known as rubble piles, are not solid slabs of rock but loose assemblages. Slamming an object into a rubble pile would not be very effective in altering its course, because the rubble would absorb the energy of impact rather like a crumple zone on a car absorbs a crash. Instead, scenarios which melt part of the surface, such as space mirrors, producing jets of gas that gradually ease the object into a new orbit, are favoured.

Yet this is about more than just diverting asteroids, no matter how critical that need may one day become. The biggest part of the study concerns how to intercept such targets. In conventional space exploration, everything is precisely worked out beforehand and targets are chosen that have well-known orbits. That’s how NASA recently bulls-eyed comet Tempel 1 with its Deep Impact mission.

However, a dangerous object is likely to be newly discovered and that means its orbit will be poorly known. “We’d probably have to launch a deflection mission without a clear idea of where we’re aiming,” says McInnes. So, the study will seek to find the best strategies for launching space missions into approximate intercept orbits that can be adjusted later.

To do this, it will investigate the additional fuel that such a spacecraft would require. Because fuel is heavy, spacecraft are traditionally designed to carry little extra. That will have to change with this new approach to space exploration.

Such seat-of-the-pants flying could result in more versatile spacecraft across the board. These would be better able to respond to a variety of unexpected situations. As well as fuel considerations, the team will investigate ‘general purpose’ orbits and flexible navigation strategies that keep a spacecraft’s options open for longer, before committing it to a final destination.