

SCIENCE

Will earth escape asteroid hit?

It looks like our planet will get away this time, says s ananthanarayanan

CALLED 2011 AG5, a 140-metre piece of rock in orbit around the sun is an asteroid that astronomers think could collide with earth in 2040. It is one of 8,744 (as of February 2012) solar system objects that come reasonably close to the sun, which is within 1.3 times the earth-sun distance, and present the possibility of a collision with earth. And the first estimates of the path of AG5 suggested that this one was headed dangerously earthwards. There has, hence, been great interest in working out its trajectory with certainty. But a team at Hawaii's Institute of Astronomy has just announced that AG5 will miss earth by a safe margin.

Near Earth Objects include asteroids, comet and meteoroids. Asteroids are rocky and irregular objects that do not have the spherical shape of a planet and are usually quite small. There are millions of these, mostly orbiting the sun in a belt, in the inner solar system, between the orbits of Mars and Jupiter. But occasional ones have been pulled out of this orbit and approach the sun in an elongated orbit.

Comets are similar rocky objects, but they are distinguished by ice in their composition. Their origin is in the outer solar system and they have periods of orbit that can range from a few years to thousands of years. And their characteristic is that when they are near the sun, the ice that they contain melts and forms a thin atmosphere, the coma, and the pressure of the light from the sun sometimes 'blows back' some of the coma which shows itself as a tail.

As for meteoroids, these are small pieces of rock that enter earth's atmosphere and usually burn out before they reach the ground.

As orbiting NEOs have different periods, the relative position of earth and the object changes at every visit and it is possible that over a large number of visits, there may be a collision. But given the very small size of the objects and earth, compared to the distances that they travel, or even earth's orbit, the likelihood of this happening is very small. But there is evidence that large objects have crashed into earth, obviously with cataclysmic results.

The earth is pockmarked with craters that have arisen from the impact of large asteroids and the extinction of the dinosaurs is believed to have been because of the long chill that followed one

such event, which raised a cloud that enveloped earth for millennia.

2011 AG5 2011 AG5 was discovered in January 2011 and the danger of a collision was described provisionally as '1' in the '1 to 10' Torino Impact Hazard Scale. This represents a very low level of Impact Hazard but is alarming, nevertheless, given the consequences. At the time of its discovery and even till the present, the position of the asteroid is in the direction of the sun and one can observe it, distant and tiny as it is, only during a few minutes of twilight. It is in 2013 that it will move sufficiently away from the sun, for a clear night-time view, when its coordinates could be fixed more exactly. The data available so far indicates that AG5 will pass 1.6 million km from earth in 2023 and 16.7 million km from earth in 2028. But during the pass in 2040, it was felt that there was a possibility of the paths intersecting, although the chance that this would happen is only 1 in 625.

In the USA, the National Aeronautics and Space Administration has the task of cataloguing and monitoring NEOs that present any significant danger, and the programme of observation, using both ground-based and space-based telescopes, is called *spaceguard*. While NASA has been waiting for better data to be sure about AG5, other scientists view the current data with great concern. Russian scientists, in fact, have called for an 'earth defence network' of space-capable nations to be set up immediately. Asteroid threat dominated the Vienna conference of the 49th session of the Scientific and Technical Subcommittee of the UN Committee on the Peaceful Uses of Outer Space, in June 2012. But NASA has just announced, based on data



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collected at the *Gemini North telescope* on Mauna Kea, Hawaii, that AG5 will not, in fact, actually cross earth's path and this conclusion is 60 times more reliable than previous estimates. The Impact Hazard has been brought down to '0' on the Torino scale, which represents 'no significant risk.' The observations used Gemini's Multi-Object Image Spectrograph and 'were

extremely difficult observations of a very faint object', said team member Richard Wainscoat. 'We were surprised by how easily the Gemini telescope was able to recover such a faint asteroid so low in the sky.'

The increased reliability of the results has come from the mass of data, based on increased sampling points, that has been possible thanks to the scheduling flexibility and facilities at the Gemini observatory. According to a press release issued by the Jet Propulsion Laboratory, Pasadena, the experience gained in the current study and the contingency deflection analysis conducted has demonstrated that astronomers, using NASA and NASA facilities, are well poised to detect and predict the trajectories of earth-threatening asteroids in the future.

Deflecting asteroids The course of action, if an asteroid is found to be heading for a collision, would be to send spacecraft out to approaching threat, months ahead of the expected collision, to place nuclear

Collision course

At an interview for the post of station master:
What would you do if two express trains were rushing at each other on the same track?
I would set the signals to danger.
And if the signals did not work?
I would switch off the overhead power.
And if the circuit breaker failed?
I would rush to the village and fetch my uncle, Shri Ramaswami, (faffbergarsed); And what would Shri Ramaswami do?
Nothing, sir, but he has never seen a train crash.

Asteroid hits are statistically expected about once in 10,000 years. The consequence of a strike could be extinction of life forms or at least of dominant species. A successful species should, hence, devise methods of surviving asteroid hits. The dinosaurs ranged the earth for 160 million years and could be considered to have been the most successful species so far. But they had no way of escaping the great asteroid or meteor event of 65 million years ago that wiped them out. In contrast, humans have been around for less than a million years, but we have developed strategies that could save us from a similar fate. This ability has developed, in fact, only in the last 50 years, and if we are already thinking of putting it to use, we are acting in time!

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Small targets are difficult to hit

THE great security of the vastness of space is that collisions are exceedingly rare and unlikely events. There is a story of how a marksman's coach converted a player's legendary inability to be on target in a circus act. The marksman was any sporting coach's despair. In football, his strike would be a goal-length off target. In basketball, he would miss the basket by half the court. In archery, it was anybody's guess where the arrow would fly. The target is the safest place to be, someone quipped.

It was this wisecrack that gave the coach the idea. He strapped a lady model to a rotating disk and put her on the stage. Our hero, the marksman, was given a sheaf of 100 sharp daggers and he was asked to bring them down at the rotating lady. True to form, every single one missed the young woman, carving out the outline of her figure on the board — to the gasping wonderment of spectators and the great relief of the model!



A big red planet and a tiny particle

steve connor does a recap of the year in passing

IT isn't often we witness the greatest discovery of our time. The announcement in July that scientists had found the elusive Higgs boson, a subatomic particle that could explain some of the deeper mysteries of the universe, could easily be a contender for the prize.

For more than half a century, scientists have postulated the existence of a subatomic particle that creates an invisible force field that permeates the entire cosmos, imparting mass to matter but having no effect on other kinds of massless particles, such as photons of light.

When Peter Higgs, now a retired professor at the University of Edinburgh who will celebrate his 80th birthday in 2013, first dreamt of such an idea in 1964, few would have expected it to take this long to prove him right — or wrong.

The Higgs boson, or "God particle" as some have called it, is central to the Standard Model of physics. This is the model on which physicists have based their understanding of most of the fundamental forces of nature, from the weak electrostatic interactions between charged particles to the ultra-strong nuclear forces at the heart of the atom.

From what they knew about the Standard Model, theoretical physicists postulated there must be a missing subatomic particle that creates a field that interferes with the movement of other particles. Some types of matter find it difficult to move through this field, which means they have a greater mass than other kinds of matter that moves through it more easily.

It is a deceptively simple concept but one that was devilishly difficult to prove. In the end it required the combined effort of thousands of the brightest minds in science, several decades of painstaking experiments and a \$2.6-billion machine in the form of the Large Hadron Collider at the European Organisation for Nuclear Research (Cern) in Geneva.

Early one July morning, the leaders of the two teams working on the key LHC experiments gave details of their findings to their counterparts. Despite the dizzying display of charts, it soon became clear from the reaction of the assembled cognoscenti that the LHC had done its job and found a particle



Nasa scientists were throwing high-fives after landing the Curiosity rover on Mars in an extremely difficult operation.

that fitted the description of the Higgs boson. 'As a layman, I would say that I think we have it. Do you agree?' Cern director general Rolf-Dieter Heuer asked the audience at the end of the two presentations. The applause said it all.

Other scientists throwing high-fives in 2012 were the team at the US National Aeronautics and Space Administration, who successfully landed a sophisticated roving robot on Mars using the unconventional technique of lowering it down to the Martian surface from a 'sky crane' about 25 feet overhead.

The successful landing on 6 August followed seven minutes of terror, the period which started when the rover and its mother ship crashed through the Martian atmosphere at 13,200 mph. It took seven minutes and the combined effort of a heat shield, S-shaped flight manoeuvres, parachutes and retro-rockets to slow it down enough to carry out the final,



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delicate delivery by sky crane. The *Curiosity* rover, a robot the size of a large car, is loaded with sophisticated instruments designed to analyse the make-up of the Red Planet. It could tell us whether the conditions were ever ripe on Mars for the origin and evolution of the primitive extra-terrestrial life forms. If life on Mars ever existed, it is likely to have long ago disappeared with the planet's rivers and oceans. An environmental disaster on Mars led many millions of years

ago to the loss of the vital ingredient of life — liquid water. The big question as 2012 ends is whether life on earth is heading for something similar. The planet is in little danger of losing its water, but there is every sign that its climate is destined for a major upheaval in the coming decades. In September, scientists reported the biggest loss of Arctic sea ice since satellite records began in 1978. Other scientists confirmed that melting ice sheets in Greenland and Antarctica were contributing to a marked rise in sea levels. The amount of carbon dioxide released into the atmosphere from the burning of fossil fuels continued unabated in 2012, despite the global economic crisis. A separate team of researchers found evidence that the rising acidification of the oceans around Antarctica was beginning to corrode the shells of the tiny marine creatures forming the base of the food chain. All the signs suggest it is business as usual in terms of climate change. If the Higgs boson was the greatest discovery of our time, then global warming threatens to be the greatest slow-motion disaster of our age.

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'Habitable'

Scientists find a planet that orbits a sun visible to the naked eye, writes john hall

SCIENTISTS have discovered a "habitable" planet that orbits a sun visible to the naked eye. The world is just 12 light years away, is between two and six times bigger than earth, and is thought to be circling Tau Ceti, a star almost identical to our sun. The planet is one of five orbiting Tau Ceti, and lies within the star's habitable zone. It is thought to have five times earth's mass. Also known as the "Goldilocks zone", the habitable zone is the orbital region that is neither too hot nor too cold to allow liquid surface water and, potentially, life. Details of the discovery are to appear in the journal *Astronomy & Astrophysics*.

Because of the difficulties involved in detecting extra-solar planets, most found so far have had high masses. The Tau Ceti planetary family is thought to be the lowest mass solar system yet detected. Scientists found the planets using a highly sensitive technique that combined data from more than 6,000 observations from three different telescopes. They used the radial velocity method that looks for "wobble" in a star's



An artist's impression of the Tau Ceti planetary system.

movement caused by the gravitational tug of planets. Dr James Jenkins, a member of the international team from the University of Hertfordshire, said, "Tau Ceti is one of our nearest cosmic neighbours and so bright that we may be able to study the atmospheres of these planets in the not-too-distant future. Planetary systems found around nearby stars close to our sun indicate that these systems are common in our Milky Way galaxy."

More than 800 planets have been discovered orbiting stars beyond the sun since the 1990s. Those found around the nearest sun-like stars are the most interesting to astronomers. Professor Steve Vogt, another team member from the University of California at Santa Cruz, said, "This discovery is in keeping with our emerging view that virtually every star has planets, and that the galaxy must have many such potentially habitable earth-sized planets. They are everywhere, even right next door."

Professor Chris Tinney, an Australian member from the University of New South Wales, said, "As we stare at the night sky, it is worth contemplating that there may well be more planets out there than there are stars, some fraction of which may well be habitable."

Dr Jenkins is a visiting fellow at the University of Hertfordshire who is based at the University of Chile.

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