

## The apple that did not fall!

A breakthrough at CERN is set to revolutionise mankind’s relationship with gravity.

It was long theorised that the apple’s falling is caused by a massless particle called the Graviton, and finding which was considered to be the Holy Grail of Physics. Many scientists believed that Gravitons would be impossible to observe given their size relative to the Planck length ... impossible, that is, until now! A ground breaking experiment at CERN finally provided not only the concrete proof that Gravitons exist but also the means for manipulating them – just like, for instance, photons.

Gravity was first defined by Isaac Newton in the late 1600s as a field which pulls objects together. In 1915, Einstein’s Theory of General Relativity described gravity as a distortion in space-time caused by mass. Though the concept of Gravitons was developed as early as 1934 by Soviet physicists Dmitrii Blokhintsev and F.M. Galperin, it only gained widespread traction in 1959 when Paul Dirac used the term. Most simplistically Gravitons are the smallest, quantum level, building blocks of gravity and classified as a massless spin-2 Boson. The term spin, in this context, refers to the intrinsic angular momentum of the particle, and mass-less to indicate that Gravitons have no mass. Gravitons were known to produce gravity by interacting with the stress-energy tensor... with the latter describing the density and flux of energy and momentum in spacetime.

The road to discovering Gravitons has been fraught with many challenges. By far the greatest hurdle was the incredibly weak

nature of gravity itself. A simple magnet holding aloft a paperclip in defiance of earth’s gravity is perhaps an apt illustration of this challenge. Traditional method of detecting new particles – colliding atoms – proved useless as the required equipment would be so gigantic as to collapse into a black hole. Even if suitable instruments could be built time would be the limiting factor since Rothman Bough estimated that a suitable detection equipment would, orbiting a neutron star, only detect a single Graviton in ten years. But these challenges have only propelled the indomitable human spirit to ever higher levels of creativity and ingenuity. The Breakthrough Propulsion Physics Program at NASA and Greenglow at BAE Systems can rightly be credited as pathfinders for the ultimate CERN breakthrough. The first reliable detection by Laser Interferometer Gravitational-Wave Observatory (LIGO) of gravitational waves in 2015 really set the stage when it discovered ripples in space-time caused by the violent merger of black holes ... and a half century after physicists set out to look for them!

The breakthrough came through the use of the Casimir effect. When two metallic plates are positioned nanometres apart, according to Quantum Theory, there are less fluctuations between the plates than outside the plates. While the cause of the net attractive force between these plates was previously attributed to electromagnetic quanta, in principle the phenomenon could be extended to Gravitons as well. For superconducting materials, the gravitational

effect should be much stronger, and therefore much more noticeable. Using this approach on its work with trapped anti-hydrogen atoms ALPHA (Antihydrogen Laser Physics Apparatus), which is an international

collaboration based at CERN, finally discovered a repeatable process for detecting and manipulating Gravitons. By precise comparisons of hydrogen and anti-hydrogen, their experiment identified fundamental symmetries between matter and antimatter ... and which ultimately led to the detection and measurement of the gravitational acceleration of antimatter Gravitons.

As Einstein once exalted the virtues of imagination over knowledge ... the world waits with bated breath for the practical ramifications of this discovery. The implications of the construction of a gravitational conductor to shield from Earth's gravitational force on the aerospace and airline industries will be revolutionary – what with spacecraft avoiding a ride atop massive, barely controlled, explosions. All the energy human beings expend moving things around, from trains to planes to cars, could be reduced or eliminated. Equally momentous would be the effect of artificial gravity on mankind's space-faring future by allowing the successful development of life supporting eco-systems of otherwise earth-bound organisms. In a development that would have, until now, seemed the stuff of science fiction the European Space Agency announced a project to develop a gravitational capacitor for creating artificial gravity fields, or "warp drives" – a way of deforming spacetime which, in theory, can propel forward by centuries mankind's ambitions as a space-faring civilisation.

And it isn't just the scientific community that is impressed. Markets reacted ecstatically as stock markets rose to record levels in the wake of a broad sectoral rally across the transportation and energy sectors. Global oil prices reduced for the first time to pre-supply-crisis levels heralding, perhaps, the dawn of a new age for finally ridding humanity of its destructive addiction to fossil fuels. The Chair of the G20 – Swedish Prime Minister Greta Thunberg was joined by the Secretary of the Global Climate Change Alliance Plus – Prime Minister Malala Yousafzai of Pakistan – in congratulating the scientists at CERN for their work in curing mankind of its last disease from the previous industrial revolution. The NATO General Secretary and winner of China's just concluded national elections – Ms Agnes Chow – have also joined the global polity in these felicitations – while hinting at a multi-trillion dollar collaboration for building global-scale matter-anti-matter superconductor manufacturing facilities in the Republic of Hong Kong. This pushed up markets and investor sentiment in Pyongyang as the North Korean economy positions itself to supply the resources for effecting this collaboration.

In the humble opinion of this reporter, and to paraphrase the words of Jawaharlal Nehru – India's first Prime Minister – a moment comes but rarely in history when we step out from the old to new, when an age ends, and when the soul of humanity finds utterance. This is that time. This discovery fuels the ambitions of our generation to construct a more perfect union of mankind's tryst with its destiny. The time has come to redeem that pledge, not wholly or in full measure, but very substantially.