appeared in 2003

Spinning earth warps space

Scientists are looking for a correction to Einstein's General Theory of Relativity, which may show a way out of an impasse in physics, says S.Ananthanaryanan.

Quantum Mechanics, the theory of very small dimensions, like those within atoms and nuclei, is found to work to hairbreadth accuracy. Einstein's theory, which makes a difference at the galactic scale, has also proved to work perfectly wherever it has been tested. Yet the two theories have no meeting ground and there is no one theory that explains both ends of the spectrum of phenomena.

The Theories of Relativity

The Special Theory of Relativity was a new way of looking at the world, which took care of an inconsistency that was noticed in the earlier theory, and the new theory predicted many unusual things when objects started moving at speeds near that of light. This way of looking at the world was a new kind of geometry for high speeds, which just reduced to everyday experience when the speeds were also 'pedestrian'. But the calculations for higher speeds have been verified to many places of decimals.

Einstein extended this new geometry idea to explain the nature of mass and gravity. He developed a way of considering the force of gravity to be a result of a curvature in space itself, a curvature that arises from the energy associated with a mass! The extent of curvature is exceedingly small and is only just noticeable as a curvature when the light from a distant star passes by a body as massive as the sun, for instance.

Gravity waves and vortices

Continuiing with this way of looking at the universe leads to concepts of moving undulations in the fabric of space when masses accelerate. This has a parallel in the radiation that emanates from oscillating electric charges. Events of colossal dimensions, like the collision of galaxies, should then cause ripples in space, or momentary changes in distance between things, that may be detectable even at distances as great as to the earth. Experiments using spacecraft and sensitive instruments are in progress to see if these waves do in fact exist.

Another consequence of the theory is that spinning masses should 'drag' along what amounts to the universe itself. We can imagine that the effect must be minute indeed. Yet this is just what the Gravity Probe experiment started in April this year is meant to try and measure.

Gravity Probe B, as the experiment is called, will measure the change in direction in the axes of spin in a set of 4 gyroscopes launched into a North-South orbit 650 km above the surface of the earth. The experiment, which depends on the axes of the gyroscopes being altered, in the course of going round the earth, because of the warping of space due to the mass of the earth, is looking for a shift of the order of milli-arc-seconds, or the thousandth parts of 1/3600 of a degree, in a year. Gravity Probe is pretty sensitive and is expected to yield an accurate result.

Even before Gravity Probe results are in, an experiment of tracking two NASA satellites, LAGEIS and LAGEOS2, has shown that the distance between the satellites has changed by 6 feet a year, due to the same effect. But the result is not considered conclusive, as there are other factors, like the unevenness of the earth, which could be responsible.

Small as the effect is in the case of the earth, this may be the way huge amounts of energy are generated in events in distant worlds where the masses are billions of times greater. Scientists say that this is the first time relativistic effects of rotations are being looked at. In case the experiment gives a result even a bit removed from theory, it may suggest a way to connect general relativity with phenomena at the atomic scale.