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Detecting the space warp

A project set up by the California and Massachusetts Institutes of Technology is trying to measure a length-change of the order of the width of the atom, to test Einstein's theory of gravity, says S.Ananthanarayanan.

The setup is called LIGO, or Laser Interferometer Gravitational Wave Observatory and makes use of the wavelength of light, of the order of a millionth of metre, over a distance of 4 kms, to make the effect visible.

Gravity Waves

Einstein's General Theory of Relativity describes gravity as a curve in the fabric of space, a bend caused by the presence of a mass. The force of gravity between masses then reduces to a geometric property and even light follows a longer, curved path when it passes by a massive body. The effect is minute indeed, but the bending of the path of light has been observed by viewing the sky behind the sun during the solar eclipse.

A deeper consequence of the theory is that when masses spin and oscillate, they should propagate a buckle through space-time, which would distort distances between points. This effect is far more minute and is considered to be the final, *acid test* of the theory, but has not been directly observed so far.

L-Shaped detector

The way LIGO hopes to detect the effect is to use interference of beams of laser light that pass up and down the 4-kilometer long arms of vacuum tubes shaped like a giant L. So long as the lengths stay unchanged, two beams that started at the vertex and traversed the two arms would reunite with the waves of light still 'in step'. But if a 'gravity wave' were to pass the earth, then, for an instance one of the two arms would grow longer or shorter, and one of the two beams would get 'out of phase'.

The effect is so exceedingly minute and fleeting that the experiment is hardly expected to work in the face of seismic disturbances that occur all the time. These are things like 'mini-quakes' the earth experiences, variations in temperature, storms, even passing of trains. To take care of these effects, the LIGO experiment is done at two distant places, one at Louisiana and the other at Washington – 2000 kms apart.

An instance of the two beams being disturbed is counted only if it occurs over both the sets of equipment at the same time. As the places are far apart, it is unlikely that the effect of casual disturbances would be simultaneous.

Many hands make light work

The objective of the experiment is to locate a source somewhere in the cosmos, a spinning neutron star is a possibility, that sends out regular ripples of gravitation. But the great problem is that with the signal sought for being so feeble and the quantity of ‘noise’ in the data, the data mining involved is far greater than available computing facilities can handle. "It's a needle in a haystack problem," says Bruce Allen, a physicist at the University of Wisconsin at Milwaukee.

LIGO has now developed a computer program that enlists domestic PCs the world over to lend their mite to help deal with the tidal waves of data coming in. In something like the way that programs like Napster or Kazaa recruit PCs over the world to share MP3, data and video files, LIGO’s program would invite domestic PC users to allow idle time on their computers to be used by the LIGO servers in the data handling effort.