Change for a Time?

Time for a change?

Does Time Change?

By Graham Bell

Does our concept of time need to change again?

Newton was very successful ignoring time for much of his analysis of space and gravity, bringing time into play only in his equations of motion. When describing motion, the position of a moving object changes with time. Time is a variable in equations of velocity and acceleration. These concepts were considered the law of the universe (as opposed to the law of the land) for a couple of innocent centuries. After all, his equations fully described the planetary motion of the solar system with full accuracy. Well, at least as accurately as contemporary measurement could verify.

Einstein messed that thinking up a little. He proposed a new role for time. His vision had time and space interwoven into a single entity, space-time. Space and time could not be separated. Some say his concepts overturned Newtonian physics. If you are a physicist, I suppose you could say that is true. If you are an engineer, you would probably say that Einstein only offered a small refinement to Newtonian physics, as all measurements in both Newton's world and Einstein's world gave the same results, except in extreme cases, or when looking for more precision than an engineer would normally notice.

Einstein's theories meld with quantum theories well enough that electromagnetic forces can be described by the motion of photons. The problem with a good marriage between relativity and quantum mechanics has been the role of the graviton. Calculations where one tries to work out the gravitational force between two objects in terms of a quantum graviton run into trouble, as the calculations keep producing untenable infinities.

Pert Ho_ava, a physicist at UC Berkeley proposes a solution. Separate time from space again. "I'm going back to Newton's idea that time and space are not equivalent," Ho_ava says. He says that at high energies, the space-time fabric has the time threads snipped away from the fabric, while at lower energies, the fabric re-stiches.

Ho_ava took an approach which was successful in describing phase transitions in some exotic substances. A phase transition in a substance can be as simple as when water changes from (or to) the liquid, solid (frozen) or gaseous state. Is some situations, the change in property can become exotic, requiring some sophisticated mathematics to describe what happens. For instance, the properties of liquid helium can change quite dramatically at low temperatures, resulting in a "superfluid" which overcomes friction.

Several researchers have verified that Ho_ava's theories accurately predict planetary motion, though some question how well it works when considering non-spherical planetary (and solar) bodies. Other theoreticians have proposed minor changes to Ho_ava's theory, which he welcomes. These changes seem to overcome the non-spherical body problem, as well as others. "When I proposed this, I didn't claim I had the final theory," he says when confronted with the proposed modifications. "I want others to examine it and improve it."

Some consequences of Ho_ava's theory are interesting. Robert Brandenberger of McGill University believes that the theory indicates that the universe didn't start with a big bang, but instead with a big bounce. It seems that in certain circumstances, Ho_ava's graviton interacts with normal matter, causing fluctuations which increase somewhat the gravity which would be expected with general relativity. This

could explain the "illusion of dark matter." Another consequence stems from the intrinsic energy of empty space which is present in Ho_ava's theory, but not in general relativity. This intrinsic energy would be the dark energy which is necessary for the accelerated expansion of the universe.

One remaining skeptic is Gia Dvali, a quantum gravity expert at CERN. He tried a similar theory, but gave up when his model consistently allowed information to be communicated faster than the speed of light.

"My intuition is that any such models will have unwanted side effects," Dvali thinks. "But if they find a version that doesn't, then that theory must be taken seriously."

For those of us who believe in evolution, it will be interesting to see how this theory evolves over the next few years.

References:

Primary Source, http://www.scientificamerican.com/article.cfm?id=splitting-time-from-space

Another paper, rather technical, http://arxiv.org/abs/0904.1595