"Gravity Doesn't Exist" --Is this Fundamental Phenomenon of the Universe an Illusion?

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Could both gravity and the Big Bang be an illusion? In January 2010, Erik Verlinde, professor ofTheoretical Physics and world-renowned string theorist, caused a worldwide stir with the publication of *On the Origin of Gravity and the Laws of Newton*, in which he challenged commonly held perceptions on gravity, going so far as to state 'for me gravity doesn't exist'. If he is proved correct, the consequences for our understanding of the universe and its origins in a Big Bang will be far-reaching.

"Everyone who is working on theoretical physics is trying to improve on Einstein," says Robbert Dijkgraaf, UvA University Professor and current director of the Institute for Advanced Study in Princeton (where scientists

including Turing, Oppenheimer and Einstein have worked) In my opinion, Erik Verlinde has found an important key for the next step forward."
Verlinde, who received the Spinoza prize (the Dutch Nobel Prize) from the Netherlands Organisation for Science, is famous for developing this new theory, or idea, on gravity in which he says that gravity is an illusion. "Gravity is not an illusion in the sense that we know that things fall," says Verline." Most people, certainly in physics, think we can describe gravity perfectly adequately using Einstein's General Relativity. But it now seems that we can also start from a microscopic formulation where there is no gravity to begin with, but you can derive it. This is called 'emergence'."
"We have other phenomena in Physics like this," Verlinde continued. "Take a concept like 'temperature', for instance. We experience it every day. We can feel temperature. But, if you really think about the microscopic molecules, there's no notion of temperature there. It's something that has to do with the property of all molecules together; it's like the average energy per molecule."

To Verlinde, gravity is similar. It's something that only appears when you put many things together at a microscopic scale and then you suddenly see that certain equations arise. "As scientists," he observes, "we first want to understand nature and our universe. In doing so, we have observed things that are deeply puzzling, such as phenomena related to dark matter. We see things happening that we don't understand. There must be more matter out there that we don't see. There's also something called 'dark energy'. And then there's the whole puzzle of the beginning of the universe. We now have what is called the 'Big Bang' theory.

Verline belives his ideas will shed new light on the concept of 'dark matter' and 'dark energy' and why they're important in relation to gravity.

"We think we understand gravity in most situations," he says "but when we look at galaxies and, on much larger scales, at galaxy clusters, we see things happening that we don't understand using our familiar equations, like Newton's equation of gravity or even Einstein's gravity. So we have to assume

there's this mysterious form of matter, which we call dark matter, which we cannot see. Now dark energy is even weirder, in the sense that we don't even know what it consists of. It's something we can put in our equations to make things work, but there's really a big puzzle to be solved in terms of why it's there and what it's made of. At present, we have not really found the right equations to describe it. There's clearly progress to be made in terms of finding a better theory of gravity, and understanding what's happening in our universe."

For example, the Big Bang theory is the idea that at a particular moment things suddenly started exploding and growing, and that our universe got bigger, which Verlinde finds illogical to think it came from this one moment. "It's illogical to think there was nothing and then it exploded. We use concepts like time and space," he adds, "but we don't really understand what this means microscopically. That might change. The Big Bang has to do with our understanding of what time should be, and I think we will have a much better understanding of this in the future. I think we will figure out that what we thought was the Big Bang was actually a different kind of event. Or maybe that we should not think that the universe really began at a particular moment and that there's another way to describe that."

Verlinde believes that the information we have today and the equations we now use only describe a very small part of what is actually going on. "If you think that something grows, like our universe, than something else must become smaller," he observes."I think there's something we haven't found yet and this will help us discover the origins of our universe. In short, the universe originated from something, not from nothing. There was something there and we have to find the equations. It has something to do with dark energy and how that is related to dark matter. If we understand the equations for those components of our universe, I think we'll also have a better understanding of how the universe began. I think it's all about the interplay between these different forms of energy and matter.

The Big Bang theory works well in the sense that it gives us some understanding of how particular elements in our universe came about and there are other things that we can observe, like the radiation that came from the Big Bang. But the whole idea of an expanding universe that started with a big explosion will change. "You need to think about the equations in a bigger setting," Verlinde observes. "You need to describe more than just the matter particles. You need to know more about what space/time is. All these things have to come together in order to be able to explain the Big Bang."

Quantum mechanics took approximately 26 years to develop, Verlinde concludes. "We've had string theory for 40 years and nothing yet has come out of that which can be directly tested with observations or experiments. I think my idea has a greater chance of being tested with observations, which is an exciting thing. I think it will take no more than 10 or 15 years."

The end result be belives will lead to a paradigm shift in how people think that the universe was created.