# Tug of war around gravity

August 12 2019, by Martijn Van Calmthout

Spinoza Laureate Erik Verlinde. Credit: Willeke Duijvekam

In the summer of 2009, theoretical physicist Erik Verlinde had a brainwave that developed into a radical new idea about gravity and the universe as an ocean of information. Ten years later, the last word about this has not yet been said.

Spinoza Laureate Erik Verlinde says he can understand that a lot of people had difficulty with the radical idea he proposed ten years ago. Gravity is not the invisible pulling force of Newton or the curved space-time of Einstein. Gravity arises due to the reallocation of information in the universe. Verlinde still realises that it is a staggering idea that elicits an awful lot of questions.

## Currently rewriting

"However a lot has happened since then too," he says in his small office at the Science Park in Amsterdam. "Over the past ten years, we have gradually learned a lot more about how you should talk about space and time information. I am seriously considering rewriting my story from 2009, but now formulated much more precisely. I think that could remove some of the scepticism that still exists."

Ten years ago, however, the newspapers and media did not doubt it for a single moment: a brand new theory about gravity had been born. For the sake of convenience, Verlinde was called the new Einstein in news programmes and in the popular Dutch talk show De Wereld Draait Door. In retrospect, he finds that awkward. "That media hype sometimes gives rise to irritation among scientists," says theoretician Koenraad Schalm from Leiden University looking back. "The headlines were about a new

theory of gravity that had been discovered, whereas Verlinde had a hypothesis that still had to be elaborated and tested. The media simply do not understand that nuance, all they want is the next Einstein or Eddington on the front page."

## Hypothesis, not a theory

Just like researchers at many other universities, Schalm gave a colloquium in Leiden soon after the publication to subject Verlinde's paper to closer scientific scrutiny. A nice hypothesis, but still a long way off from a theory, was the down to earth assessment. Elaborate it and, in particular, come with observations and evidence. Justifiable scepticism, Schalm still thinks. "But don't misunderstand me, it is incredibly difficult to have a really good idea in this discipline. So I have a lot of respect for Verlinde, because he has definitely given the field a new direction."

In blogs and other public media there is sometimes harsh criticism of Verlinde's work. He is accused of just floating ideas for the sake of it, providing no testable predictions, publishing too little, only being taken seriously in the Netherlands, and scarcely publishing any subsequent articles. "In all honesty, I follow that as little as possible," confesses Verlinde. He prefers to focus on specialists.

"People who all too easily say that I do not have a theory, clearly do not understand how theoretical physics works. You need to elaborate and test a new idea step-by-step. We must find the correct formulations and techniques." He does, however, admit that he publishes relatively little. "I have a certain preference for papers that constitute a significant step forward."

## Not at all strange

"Contrary to the sceptics' opinions, Verlinde's work is definitely taken seriously," says Schalm in Leiden. "He has been cited more than 700 times. But it is very difficult material for which it is difficult to generate new results overnight." Verlinde feels that the idea that information is the deepest building block of the universe is gaining more ground.

"It is no longer as strange as it seemed ten years ago. Perhaps as a result of so much ICT we are getting more used to the idea of information. However, the problem remains that the ideas in that area have only been properly elaborated for a universe that does not expand and has an edge. For years now, I have been trying to persuade fellow theoreticians to take a better look at accelerating expanding universes without an edge, like ours. That has become a mission in itself." That would be a great idea, he thinks, even independent of his own gravitational theory.

## Calculate something for once

And who is actually right? Science philosopher Sebastian de Haro from Amsterdam University College performed studies into the basic ideas in Verlinde's work. As a philosopher, he looks at them from a distance, and he can see familiar patterns in the sometimes sharp responses. "Astronomers and cosmologists are definitely interested in ideas that they can test. They always want to do that. But some string theorists still find it too vague and suggestive. Calculate something for once, is the complaint." The lesson? De Haro calls for patience and modesty. "Science costs time. People like to use big words. That easily generates misunderstandings about how gradual the process in good research really is."

## Powerful information

In 2009, and to the surprise of many, string theoretician Erik Verlinde

derived Newton's law of gravity from the idea that the universe is an ocean full of information. The rules that apply in this are similar to the laws of thermodynamics for gases. In the gas world, it takes effort to blow up a balloon. In the same way, a weight opposes being lifted up because that requires the supply of extra information. That opposition was found to fully accord with Newton's formula in which two masses attract each other with a force that is inversely proportional to the square of the distance. But unlike Newton, Verlinde's theory also gives an idea as to where gravity comes from.

It is an emergent force which arises from an interaction between fundamental units of information. Later, Einstein's equations for gravity could also be derived in the same manner. In addition, Verlinde developed a version for an expanding universe in which a possible explanation also emerges for the extra gravitational force that keeps rotating galaxies together. Most physicists think that this arises due to dark matter, which is made up of as yet unknown particles.

Provided by Netherlands Organisation for Scientific Research (NWO)

Citation: Tug of war around gravity (2019, August 12) retrieved 23 April 2024 from https://phys.org/news/2019-08-war-gravity.html