

Who cares about the fourth dimension?

3 February 2009



Comic Gravitation (c) Florian Aigner

Austrian scientists are trying to understand the mysteries of the holographic principle: How many dimensions are there in our universe?

Some of the brightest minds of the world are doing research work in this sector - and still have not succeeded so far: Creating a unified theory of quantum gravitation is often considered to be the "Holy Grail" of modern science. Daniel Grumiller from the Institute of Theoretical Physics, Vienna University of Technology, Austria, can now at least unravel some of the mysteries of quantum gravitation. His results on black holes and gravitational waves are pretty mind-boggling - to say the least. Only recently he won the START prize and will use these funds to engage even more young physicians at the TU Vienna.

We perceive the space around us as three-dimensional. According to Einstein, time and space are inseparably linked. Adding the time axis to our three-dimensional space makes our space-time-continuum four-dimensional. For decades, scientists have been wondering about the existence of additional dimensions so far hidden to our senses. Grumiller and his colleagues are trying the opposite approach: Instead of postulating additional dimensions, they believe that our universe could in fact be described by less than four dimensions.

"A hologram, as you find it on bank notes or credit cards, appears to show a three-dimensional picture, even though in fact it is just two-dimensional", Grumiller explains. In such a case, reality has fewer dimensions than we would think it appears to have. This "holographic principle" plays an important role in the physics of space time. Instead of creating a theory of gravity in all the time and space dimensions, one can formulate a new quantum theory with one fewer spatial dimension. That way, a 3D theory of gravitation turns into a 2D quantum theory, in which gravity does not appear any more. Still, this quantum theory correctly predicts phenomena like black holes or gravitational waves.

"The question, how many dimensions our world really has, does probably not even have a proper answer probably cannot be answered explicitly", Grumiller thinks. "Depending on the particular question we are trying to answer, either one of the approaches may turn out to be more useful."

Grumiller is currently working on gravitational theories which include two spatial dimensions and one time dimension. They can be mapped onto a two-dimensional gravitationless quantum theory. Such theories can be used to describe rapidly rotating black holes or "cosmic strings" - spacetime defects, which probably appeared shortly after the Big Bang.

Together with colleagues from the University of Vienna, Grumiller is organizing an international workshop, which will take place from April 14 to 24, 2009. Renowned participants, like scientists from Harvard, Princeton, the MIT and many other universities, reveal that the Viennese gravitation physicians are held in high regard internationally.

Source: TU Vienna

APA citation: Who cares about the fourth dimension? (2009, February 3) retrieved 21 September 2021 from <https://phys.org/news/2009-02-fourth-dimension.html>

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